EUTRA/LTE/IoT
R&S®SMW-K55/-K69/-K84/-K85/-K112/-K113/-K115/-K119/-K143/-K146/-K175
User Manual

1175670302
Version 34

ROHDE&SCHWARZ
Make ideas real

This document describes the following software options:

- R&S®SMW-K55, LTE Rel. 8 (1413.4180.xx)
- R&S®SMW-K69, LTE closed-loop BS test (1413.4480.xx)
- R&S®SMW-K84, LTE Rel. 9 (1413.5435.xx)
- R&S®SMW-K85, LTE Rel. 10 (1413.5487.xx)
- R&S®SMW-K112, LTE Rel. 11 (1413.8505.xx)
- R&S®SMW-K113, LTE Rel. 12 (1414.1933.xx)
- R&S®SMW-K115, Cellular IoT eMTC and NB-IoT Rel. 13 (1414.2723.xx)
- R&S®SMW-K119, LTE Rel. 13/14/15 (1414.3542.xx)
- R&S®SMW-K143, Cellular IoT eMTC and NB-IoT Rel. 14 (1414.6064.xx)
- R&S®SMW-K146, Cellular IoT eMTC and NB-IoT Rel. 15/16/17 (1414.6564.xx)
- R&S®SMW-K175, U-plane data generation (1413.3261.xx)

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMW200A.

Muehldorfstr. 15, 81671 Muenchen, Germany
Phone: +49 89 41 29 - 0
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

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The following abbreviations are used throughout this manual: R&S®SMW200A is abbreviated as R&S SMW, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2

Contents

1 Welcome to the EUTRA/LTE/IoT options

The R&S SMW-K55/-K69/-K81/-K84/-K85/-K112/-K113/-K115/-K119/-K143/-K145/-K175 are firmware applications that add functionality to generate signals in accordance with the 3GPP standard EUTRA/LTE.

In the following, the terms LTE and EUTRA are used interchangeably.

1.1 Key features

Preamble

All supported **LTE** features are in line with 3GPP Release 14; the following official 3GPP specifications are implemented:

- 3GPP TS 36.211, version 15.6.0
- 3GPP TS 36.212, version 15.6.1
- 3GPP TS 36.213, version 15.6.0

The R&S SMW-K55/-K69/-K81/-K84/-K85/-K112/-K113/-K119 key features

The R&S SMW simulates EUTRA/LTE at the physical channel level. The following list gives an overview of the functions provided for generating an EUTRA/LTE signal:

- Supports FDD and TDD
- Intuitive user interface with graphical display of time plan
- Full support of P-SYNC, S-SYNC and DL reference signal derived from cell ID
- PBCH, PDSCH, (E)PDCCH, PCFICH, PHICH supported
- Downlink 256QAM for PDSCH and PMCH
- PDCCH with full DCI configuration (all DCI formats supported), incl. DCI format 1C for eIMTA-RNTI
- Channel coding and scrambling for PDSCH and PBCH (including MIB)
- Automatic PDSCH scheduling from DCI
- Automatic scheduling of downlink transmissions according to long HARQ patterns
- Full downlink MIMO and transmit diversity support
- Uplink MIMO support
- Supports PUSCH with channel coding and scrambling
- Configuration of all PRACH and PUCCH formats
- Fixed reference channels (FRC) in line with 3GPP TS 36.141
- Downlink test models (E-TMs) in line with 3GPP TS 36.141, incl. E-TMs for 256QAM
- Test case wizard
- Real-time processing of HARQ feedback commands and timing adjustment commands for closed-loop base station tests

- Simulation of single-layer, dual-layer and up to eight-layer beamforming scenarios (transmission modes 7, 8 and 9) on antenna ports 5 and 7 to 14
- Support of MBMS single frequency network (MBSFN) subframes on antenna port 4
- Generation of positioning reference signals (PRS) on antenna port 6
- Access to intermediate results of the FEC chain for design cross-verification
- Generation of LTE-Advanced downlink and uplink carrier aggregation scenarios (up to 5 carriers) with support for cross-carrier scheduling; incl. uplink carrier aggregation with mixed duplexing
- LTE-Advanced enhanced SC-FDMA with PUSCH/PUCCH synchronous transmission and clustered PUSCH
- Support of CSI reference signals
- Support of DL LAA bursts configuration
- Support of QAM256 in uplink

The R&S SMW-K115 key features

The R&S SMW simulates eMTC and NB-IoT at the physical channel level. The following is an overview of provided functions:

- Supports uplink eMTC and NB-IoT configuration, and downlink NB-IoT configuration for CAT-M1 and CAT-NB1 devices
- Supports IoT standalone configuration and mixed configuration with LTE
- Supports NB-IoT in-band and guard band operating modes
- Intuitive user interface with graphical display of time plan
- Support of coverage enhancement CE modes A and B and CE levels 0, 1 and 2
- Support of the new NB channels and synchronization signals (NPSS, NSSS and DL reference signal derived from NCell ID)
- MPBCH, PDSCH, PBCH supported
- DCI-based configuration of NPDCCH and NPDSCH
- Channel coding and scrambling for NPDCCH, NPDSCH and NPBCH (including SIB type 1)
- Supports NPUSCH with channel coding and scrambling
- NPRACH configuration
- Support of all specified modulation schemes

The R&S SMW-K143 key features

- 3GPP LTE Rel. 14 (eMTC and NB-IoT)
  Introduces eMTC widebands and new types CAT-M2 and CAT-NB2 devices.

The R&S SMW-K146 key features

- 3GPP LTE Rel. 15/16/17 (NB-IoT)
  Introduces NB-IoT TDD mode in UL, FDD NPRACH formats, early data transmission, NB-IoT wake up signal, scheduling request in uplink for NPUSCH F2, and NPUSCH modulation up to 16QAM.

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMW user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMW200A

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMW service manual.

1.2 Accessing the EUTRA/LTE dialog

To open the dialog with EUTRA/LTE settings

► In the block diagram of the R&S SMW, select "Baseband > EUTRA/LTE".

A dialog box opens that display the provided general settings.

The signal generation is not started immediately. To start signal generation with the default settings, select "State > On".

1.3 What's new

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMW200A.

Compared to the previous version 5.20.043, the EUTRA/LTE/IoT firmware application provides the following new features and changes:

- Support of 16QAM with NPUSCH for NB-IoT, see "Modulation" on page 450
- Time-based trigger added, see "Time Based Trigger" on page 671

1.4 Documentation overview

This section provides an overview of the R&S SMW user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/smw200a

1.4.1 Getting started manual

Introduces the R&S SMW and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.4.2 User manuals and help

Separate manuals for the base unit and the software options are provided for download:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S SMW is not included.

The contents of the user manuals are available as help in the R&S SMW. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

All user manuals are also available for download or for immediate display on the Internet.

1.4.3 Tutorials

The R&S SMW provides interactive examples and demonstrations on operating the instrument in form of tutorials. A set of tutorials is available directly on the instrument.

1.4.4 Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.4.5 Instrument security procedures

Deals with security issues when working with the R&S SMW in secure areas. It is available for download on the internet.

1.4.6 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.4.7 Data sheets and brochures

The data sheet contains the technical specifications of the R&S SMW. It also lists the options and their order numbers and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smw200a

1.4.8 Release notes and open source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smw200a

1.4.9 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/smw200a and www.rohde-schwarz.com/manual/smw200a

1.4.10 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

On the menu bar, search for your product to find related videos.

Figure 1-1: Product search on YouTube

1.5 Scope

Tasks (in manual or remote operation) that are also performed in the base unit in the same way are not described here.

In particular, it includes:

- Managing settings and data lists, like saving and loading settings, creating and accessing data lists, or accessing files in a particular directory.
- Information on regular trigger, marker and clock signals and filter settings, if appropriate.
- General instrument configuration, such as checking the system configuration, configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S SMW user manual.

1.6 Notes on screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 About the EUTRA/LTE options

For better understanding of the required configuration settings, this section lists:

- Some background information on basic terms and principles used in the EUTRA/LTE technology
- Information on functions specific to the instrument
- Detailed information on the implementation of the realtime feedback functionality for closed loop BS tests

2.1 Required options

The basic equipment layout for generating LTE signals includes the:

- Standard or wideband baseband generator (R&S SMW-B10/-B9)
- Baseband main module (R&S SMW-B13) or wideband baseband main module (R&S SMW-B13XT)
- Frequency option (e.g. R&S SMW-B1003)
- Digital standard EUTRA/LTE release 8 (R&S SMW-K55)

The following options are required to **support all LTE-related settings** described in this user manual:

- Standard or wideband baseband generator (R&S SMW-B10/-B9)
- Baseband main module, two I/Q paths (R&S SMW-B13T) or wideband baseband main module (R&S SMW-B13XT)
- Frequency option (e.g. R&S SMW-B1003)
- Frequency option (e.g. R&S SMW-B2003)
- Option LTE release 8 (R&S SMW-K55)
- Option LTE log file generation (R&S SMW-K81)
- Option LTE release 9 (R&S SMW-K84)
- Option LTE release 10 (R&S SMW-K85)
- Option LTE release 11 (R&S SMW-K112)
- Option LTE release 12 (R&S SMW-K113)
- Option LTE release 13/14/15 (R&S SMW-K119)
- O-RAN: U-plane generation (R&S SMW-K175)
- Option cellular IoT release 13 (R&S SMW-K115)
- Option cellular IoT release 14 (R&S SMW-K143)
- Option cellular IoT release 15/16/17 (R&S SMW-K146)
- Option LTE closed loop BS test (R&S SMW-K69)
  (supported by standard and wideband baseband generators (R&S SMW-B10/-B9))

Further options are required to perform all test cases implemented in the "Test Case Wizard", see Chapter 8.2, "Required options", on page 533.

You can generate signals via play-back of waveform files at the signal generator. To create the waveform file using R&S WinIQSIM2, you do not need a specific option.

To play back the waveform file at the signal generator, you have two options:

- Install the R&S WinIQSIM2 option of the digital standard, e.g. R&S SMW-K255 for playing LTE waveforms
- If supported, install the real-time option of the digital standard, e.g. R&S SMW-K55 for playing LTE waveforms

For more information, see data sheet.

2.2 Introduction to the EUTRA/LTE technology

This section provides an introduction to the EUTRA/LTE technology.

2.2.1 LTE downlink transmission scheme

The downlink transmission scheme for E-UTRA FDD and TDD modes is based on conventional OFDM. In an OFDM system, the available spectrum is divided into multiple subcarriers, which are orthogonal to each other. Each of the subcarriers is independently modulated by a low rate data stream.

The OFDM signal is generated using the inverse fast Fourier transform (IFFT) digital signal processing. The IFFT converts a number N of complex data symbols used as frequency domain bins into the time domain signal. Such an N-point IFFT is illustrated on Figure 2-1.

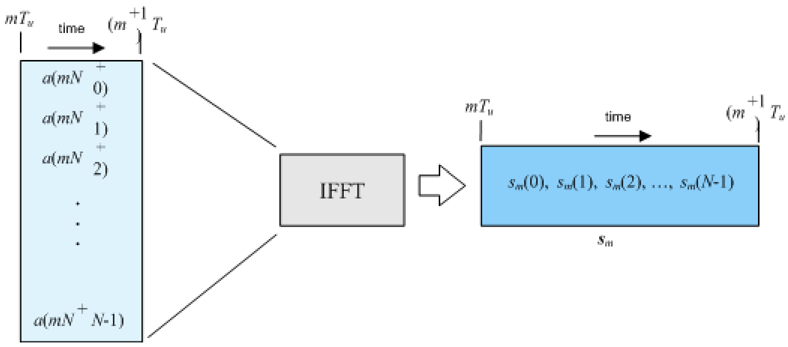


Figure 2-1: OFDM useful symbol generation using an IFFT (3GPP TR 25.892)

a(mN+n) = n^{th} subchannel modulated data symbol
$mT_u < t \leq (m+1)T_u$ = time period

The vector s_m is defined as the useful OFDM symbol. It is the time superposition of the N narrowband modulated subcarriers. Therefore, from a parallel stream of N sources of data, each one independently modulated, a waveform composed of N orthogonal subcarriers is obtained. Each of the subcarriers is a frequency sinc function.

The Figure 2-2 illustrates the mapping from a serial stream of QAM symbols to N parallel streams, used as frequency domain bins for the IFFT. The N-point time domain blocks obtained from the IFFT are then serialized to create a time domain signal. Not shown in the figure is the process of cyclic prefix insertion.

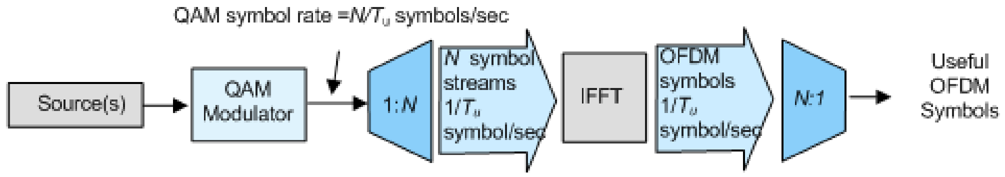


Figure 2-2: OFDM signal generation chain (3GPP TR 25.892)

In contrast to an OFDM transmission scheme, OFDMA allows the access of multiple users on the available bandwidth. Each user is assigned a specific time-frequency resource. As a fundamental principle of E-UTRA, the data channels are shared channels. For each transmission time interval of 1 ms, a new scheduling decision is taken regarding which users are assigned to which time/frequency resources during this transmission time interval.

2.2.1.1 OFDMA parameterization

Two radio frame structures, one for FDD (frame structure type 1) and one for TDD (frame structure type 2) mode are defined. These EUTRA frame structures are described in TS 36.211.

Channel bandwidth

OFDMA physical layer parameterization is based on a bandwidth agnostic layer 1. However, current 3GPP specifications focus on the channel bandwidth listed in Table 2-1.

The bandwidth is expressed as number of resource blocks in the range from 6 to 110 resource blocks (RB), which results in bandwidths from 1.08 MHz to 19.8 MHz.

Table 2-1: Channel bandwidth according to 3GPP TS 36.804

Channel bandwidth	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Number of RBs	6	12	25	50	75	100
Number of occupied subcarriers	73	181	301	601	901	1201
FFT size	**128**, 256, 512, 1024, 2048	**256**, 512, 1024, 2048	**512**, 1024, 2048	**1024**, 2048	1536, **2048**	**2048**

Frame structure type 1 (FDD)

The FDD frame structures type 1 is based on a 10 ms radio frame that is divided into 20 equally sized slots of 0.5 ms. A subframe consists of two consecutive slots, so one radio frame contains 10 subframes.

Frame format 1 (FDD mode) illustrates frame structure type 1 (T_s is expressing the basic time unit corresponding to 30.72 MHz). Frame format 1 is applicable to both full and half duplex FDD.

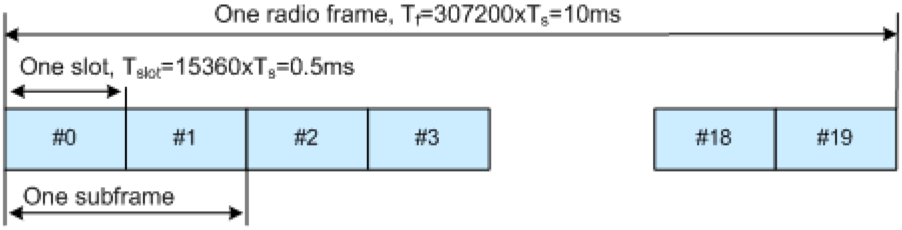


Figure 2-3: Frame format 1 (FDD mode)

Related settings

See:

- "Duplexing" on page 66
- Chapter 4.3, "DL frame configuration settings", on page 136
- Chapter 7.1, "OFDMA time plan", on page 518.

Frame structure type 2 (TDD)

The TDD frame format 2 is based on a 10 ms radio frame, but the frame is divided into two half-frames, 5 ms each. Each half-frame consists of five 1 ms long subframes, which are reserved either for downlink or uplink transmission or are caring special information (see Figure 2-4).

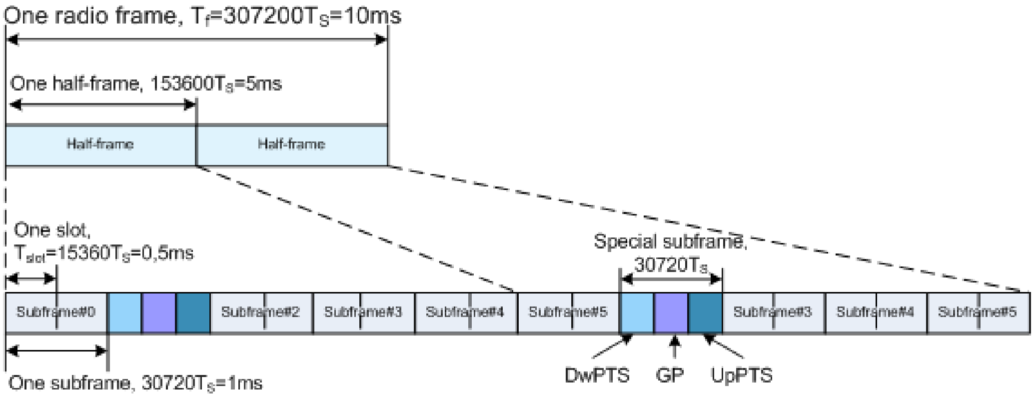


Figure 2-4: Frame format 2 (TDD mode), 5 ms switching periodicity

All non-special subframes are divided into two 0.5 ms long slots. The special subframes consist of three fields DwPTS (downlink pilot timeslot), GP (guard period), and UpPTS (uplink pilot timeslot). The length of these fields can vary in specified limits so that the total special subframe's length is maintained constant (1 ms). The 3GPP specification defines 10 special subframe configurations for normal cyclic prefix type and eight for extended cyclic prefix type. These subframe configurations specify the allowed DwPTS/GP/UpPTS lengths' combinations.

The 3GPP specification defines seven different uplink-downlink configurations, i.e. defines the downlink-to-uplink switch-point periodicity (5 ms or 10 ms) and the allowed combination of downlink, uplink, and special slots. In all the uplink-downlink configurations and for any downlink-to-uplink switch-point periodicity, subframe 0, subframe 5, and DwPTS are always reserved for downlink transmission. UpPTS and the subframe following the special subframe are always reserved for uplink transmission.

Figure 2-5 shows the supported uplink-downlink configurations according to TS 36.211.

UL/DL Configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Figure 2-5: Uplink-downlink configurations

D = Denotes a subframe reserved for downlink transmission
U = Denotes a subframe reserved for uplink transmission
S = Denotes the special subframe

Related settings

See:

- "Duplexing" on page 66
- Chapter 4.2.6, "TDD frame structure settings", on page 108
- Chapter 7.3, "TDD time plan", on page 522.

2.2.1.2 Downlink resource grid

The Figure 2-6 shows the structure of the downlink resource grid for one downlink slot. The available downlink bandwidth consists of N^{DL}_{BW} subcarriers with a spacing of Δf = 15 kHz. In the case of multi-cell MBMS transmission, a subcarrier spacing of Δf = 7.5 kHz is also possible. N^{DL}_{BW} can vary to allow for bandwidth operation up to 20 MHz.

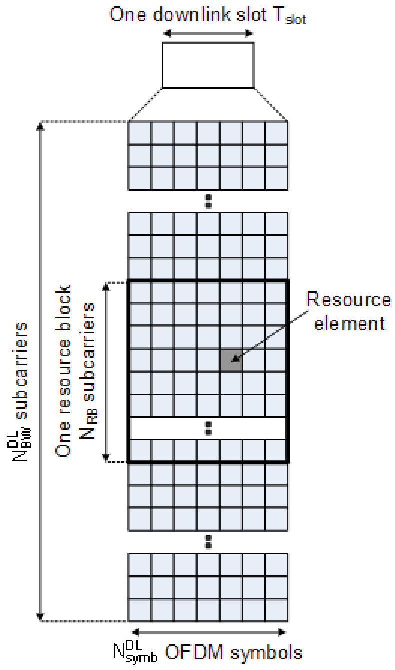


Figure 2-6: Downlink resource grid (3GPP TS 36.211)

One downlink slot consists of N^{DL}_{Symb} OFDM symbols. To each symbol, a cyclic prefix (CP) is appended as guard time. N^{DL}_{Symb} depends on the cyclic prefix length. The generic frame structure with normal cyclic prefix length contains N^{DL}_{Symb} = 7 symbols. This translates into a cyclic prefix length of T_{CP}≈5.2μs for the first symbol and T_{CP}≈4.7μs for the remaining six symbols. Additionally, an extended cyclic prefix is defined to cover large cell scenarios with higher delay spread and MBMS transmission. The generic frame structure with extended cyclic prefix of T_{CP-E}≈16.7μs contains N^{DL}_{Symb} = 6 OFDM symbols (subcarrier spacing 15 kHz). The generic frame structure with extended cyclic prefix of T_{CP-E}≈33.3μs contains N^{DL}_{Symb} = 3 symbols (subcarrier spacing 7.5 kHz). The Table 2-2 gives an overview of the different parameters for the generic frame structure.

Table 2-2: Parameters for downlink generic frame structure

Configuration	Number of symbols N^{UL}_{symb}	Cyclic prefix length, samples	Cyclic prefix length, us
Normal cyclic prefix Δf=15 kHz	7	160 for first symbol 144 for other symbols	5.2 us for first symbol 4.7 us for other symbols
Extended cyclic prefix Δf=15 kHz	6	512	16.7 us
Extended cyclic prefix Δf=7.5 kHz	3	1024	33.3 us

Related settings

See:

- Chapter 7.1, "OFDMA time plan", on page 518
- Chapter 7.3, "TDD time plan", on page 522

2.2.1.3 Downlink data transmission

Data is allocated to the UEs in terms of resource blocks. A physical resource block consists of 12 (24) consecutive subcarriers in the frequency domain for the Δf = 15 kHz (Δf = 7.5 kHz) case. In the time domain, a physical resource block consists of DL N_{symb} consecutive OFDM symbols, see Figure 2-6. N^{DL}_{symb} is equal to the number of OFDM symbols in a slot. The resource block size is the same for all bandwidths, therefore the number of available physical resource blocks depends on the bandwidth. Depending on the required data rate, each UE can be assigned one or more resource blocks in each transmission time interval of 1 ms. The scheduling decision is done in the base station (eNodeB). The user data is carried on the physical downlink shared channel (PDSCH).

Related settings

See Chapter 4.4, "Enhanced PBCH, PDSCH and PMCH settings", on page 211.

2.2.1.4 Downlink control information transmission

Control information is mapped to the resource elements in terms of resource elements groups (REG). A REG consists of four consequent resource elements within one resource block which are not used for cell-specific reference signals. Thus, there are two types of resource blocks, resource blocks containing three REGs and resource blocks containing only two REGs.

Two REGs are available within the OFDM symbols with allocated reference signals. These are the OFDM symbol 0 in the first slot in a subframe and in the OFDM symbol 1 in the four-antenna system case. 3 REGs are then available in the OFDM symbols 2 and in the OFDM symbol 1 if one- or two-antenna system are used (see Figure 2-7 and Figure 2-9).

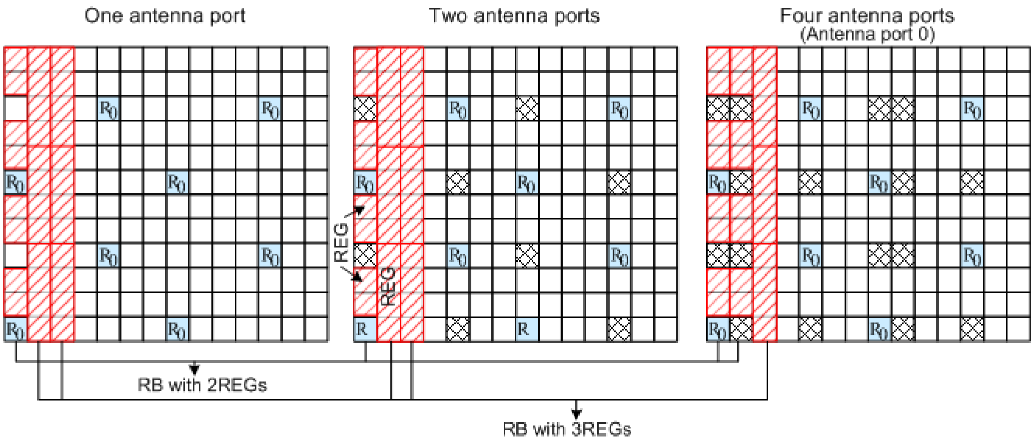


Figure 2-7: Resource elements groups (REG)

Three physical DL channels are carrying the control information: the Physical Control Format Indicator Channel (PCFICH), the Physical Hybrid ARQ Indicator Channel (PHICH) and the Physical Downlink Control Channel (PDCCH).

- The **PCFICH** carries the information about the number of OFDM symbols used for transmission of PDCCH in a subframe and is mapped to four REGs within the first OFDM symbol.
- The **PHICH** carries the HARQ ACK/NACK messages and is transmitted in terms of PHICH groups. A PHICH group uses three REGs. For normal CP, a PHICH group consists of up to eight ACK/NACK messages. Four ACK/NACK messages are carried by one PHICH group if an extended CP is used.

  For frame format 1 and non-MBSFN transmission, the PHICH can be transmitted:
  - Over only the first OFDM symbol (or the so called normal PHICH duration).
  - In case of extended PHICH duration, over the first three OFDM symbols.
- Downlink control signaling on the Physical Downlink Control Channel (**PDCCH**) is used to convey the scheduling decisions to individual UEs. The PDCCH is located in the first OFDM symbols of a slot.

  The maximum number of OFDM symbols used for the transmission of a PDCCH is determined by the number of RB used:
  - For channel bandwidth with ≤ 10 RBs, four OFDM symbols are necessary (OFDM symbol 0 to 3)
  - For channel bandwidths with ≥ 10 RBs, three OFDM symbols are sufficient (OFDM symbol 0 to 2).

  The minimum number of OFDM symbols used for the transmission of a PDCCH is determined by the PHICH duration and the channel bandwidth.
  The PDCCH is mapped to the REGs not used for PHICH and PCFICH and transmitted on one or several control channel elements (CCEs), where a CCE corresponds to 9 REGs.

Related settings

See:

- "PHICH Duration" on page 85

- Chapter 4.3.1, "General frame configuration settings", on page 136.

2.2.1.5 Downlink reference signal structure and cell search

The downlink reference signal structure is important for cell search, channel estimation, and neighbor cell monitoring.

For the LTE downlink, five types of reference signals are defined:

- Cell-specific downlink reference signals
  The cell-specific reference signals are common signals in a cell, that are intended for all UE within this cell.
- MBSFN reference signals
  These reference signals are used for channel estimation and demodulation of signals transmitted by MBSFN.
- UE-specific reference signal (DMRS)
  These reference signals are intended for a specific user.
- Positioning reference signals
- CSI reference signals
  These reference signals are intended channel quality measurements and frequency-dependent scheduling.

Related settings

See:

- "Downlink Reference Signal Structure" on page 110
- Chapter 4.2.7.3, "Positioning reference signal (PRS) settings", on page 112
- Chapter 4.2.7.4, "CSI-RS settings", on page 116.

Mapping of reference signals to antenna ports

The LTE standard specifies so-called antenna ports (AP). Antenna ports are logical elements, used to describe identical propagation conditions. The mapping of these antenna ports to the physical antennas is not specified by 3GPP.

LTE specifies AP 0 to AP 5 and defines one reference signal per downlink antenna port (see Table 2-3). LTE-Advanced introduces new reference signals, new control channels and defines additional antenna ports, AP 6 to AP 22 and AP 107 to AP 110.

From LTE Rel. 14 on, also the AP 23 to AP 46 are supported and the multiple CSI-RS configuration mapped on them. See also Chapter 2.2.8, "LTE Release 13/14 introduction", on page 55.

Table 2-3: Mapping of reference signals to antenna ports

Antenna port (AP)	Reference signal
AP 0 to AP 3	Cell-specific reference signals (CS-RS)
AP 4	MBSFN-RS
AP 5	UE-specific reference signals (DMRS) for single-layer transmission (TM7)

Antenna port (AP)	Reference signal
AP 6	Positioning reference signals (PRS)
AP 7 to AP 8	UE-specific reference signals (DMRS) for up to 2 layers beamforming (TM8/TM9/TM10)
AP 9 to AP 14	UE-specific reference signals (DMRS) for multi-layer beamforming (TM9/TM10)
AP 15 to AP 22 AP 23 to AP 46	Channel state information reference signals (CSI-RS)
AP 107 to AP 110	Demodulation reference signal associated with EPDCCH

The Figure 2-8 [1MA169] illustrates the mapping of the logical antenna ports to physical transmit antennas.

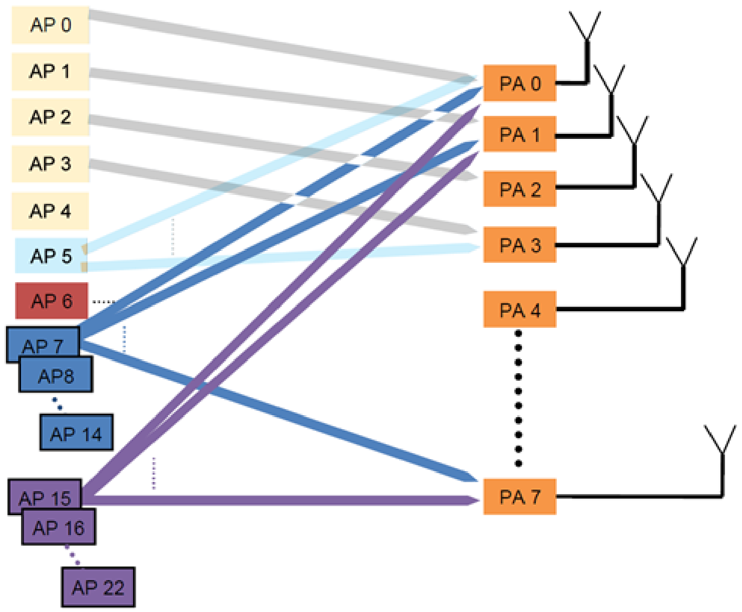


Figure 2-8: Mapping of logical antenna ports to physical transmit antennas (3GPP Rel. 10)

AP = Antenna port
PA = Physical antenna

See also:

- Table 2-6
- Chapter 2.2.5, "LTE Release 10 (LTE-Advanced) introduction", on page 46

Related settings

See Chapter 4.5, "DL antenna port mapping settings", on page 222.

Cell-specific downlink reference signals

The Figure 2-9 shows the principle of the downlink reference signal structure for one-antenna, two-antenna, and four-antenna transmission (antenna ports 0 to 3, AP 0 to

AP 3). Specific predefined resource elements in the time-frequency domain carry the reference signal sequence. Besides first reference symbols, there can be a need for second reference symbols. The different colors in the figure represent the sequences transmitted from up to four transmit antennas.

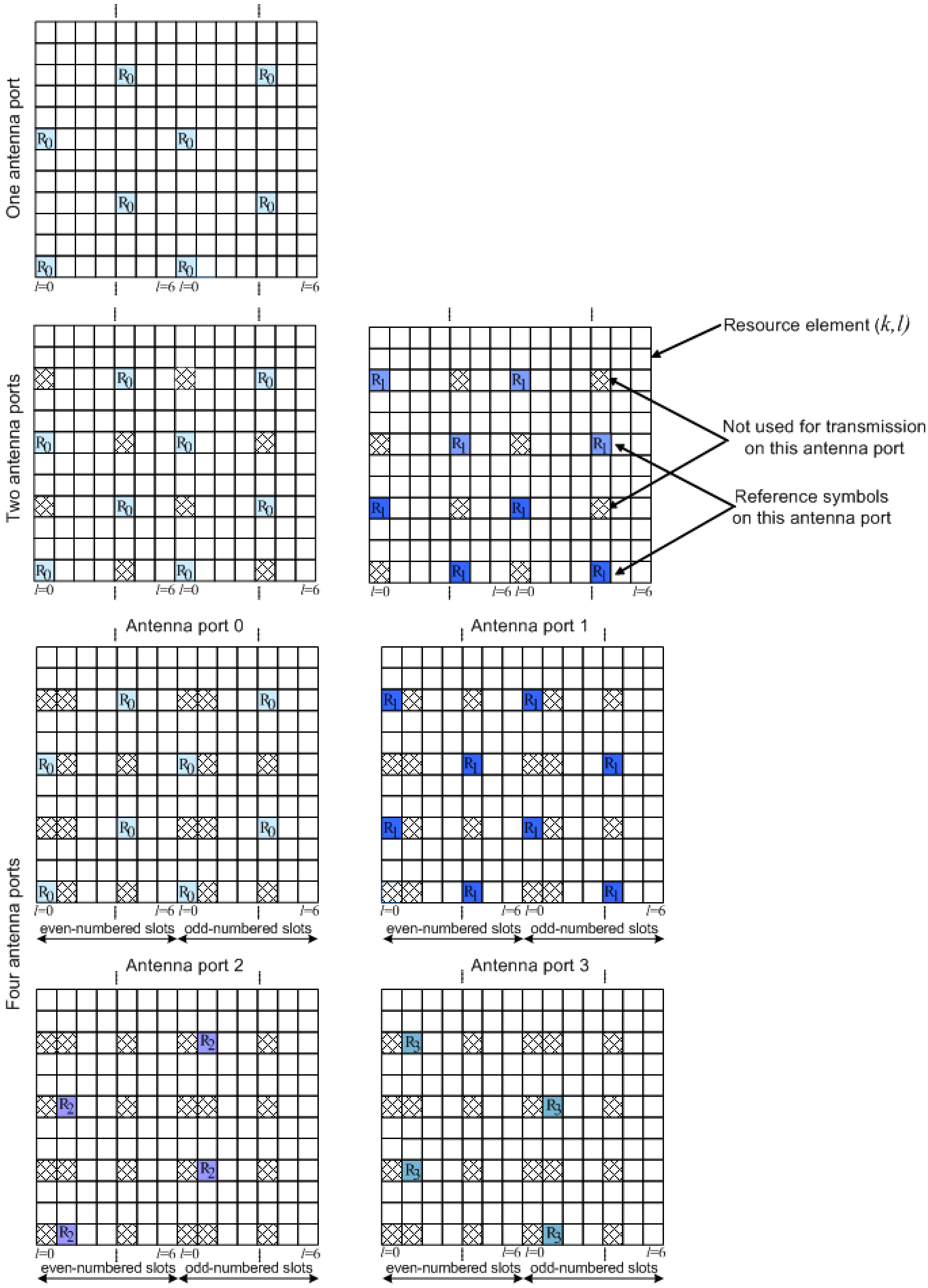


Figure 2-9: Downlink reference signal structure (normal cyclic prefix)

The reference signal sequence carries the cell identity. There are 504 unique physical layer cell identities, grouped into 168 unique physical cell identity groups that contain three unique identities each. Each reference signal is generated as a pseudo-random sequence that depends on the physical layer cell identity.

Frequency hopping can be applied to the downlink reference signals. The frequency hopping pattern has a period of one frame (10 ms).

During cell search, the handset identifies different types of information: symbol and radio frame timing, frequency, cell identification, overall transmission bandwidth, antenna configuration, and cyclic prefix length.

Besides the reference signals, synchronization signals are therefore needed during cell search. EUTRA uses a hierarchical cell search scheme similar to WCDMA. This means that the synchronization acquisition and the cell group identifier are obtained from different SYNC signals. Thus, a primary synchronization signal (**P-SYNC** or **PSS**) and a secondary synchronization signal (**S-SYNC** or **SSS**) are defined with a pre-defined structure. They are transmitted on the 72 center subcarriers (around DC sub-carrier) within the same predefined slots (twice per 10 ms) on different resource elements, see Figure 2-10. This figure is taken from TS 36.211.

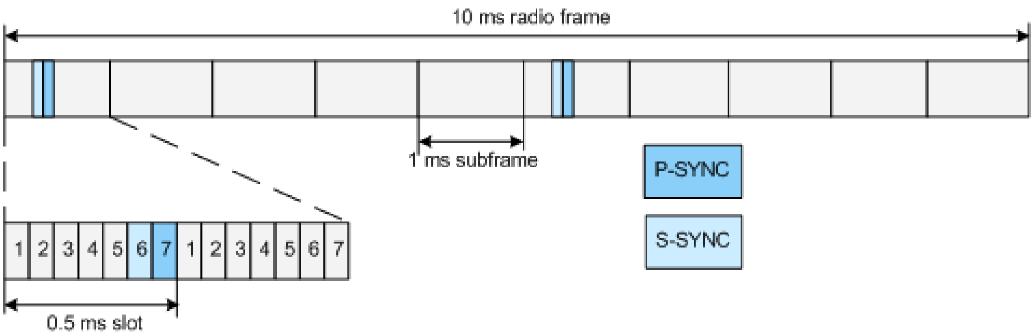


Figure 2-10: P-SYNC and S-SYNC structure (normal CP; 1.25 MHz bandwidth)

As additional help during cell search, a common control physical channel (CCPCH) is available which carries BCH type of information, e.g. system bandwidth. It is transmitted at predefined time instants on the 72 subcarriers centered on the DC subcarrier.

To enable the UE to support this cell search concept, it was agreed to have a minimum UE bandwidth reception capability of 20 MHz.

Related settings

See "Synchronization Signal Settings" on page 110.

MBSFN reference signals

MBSFN reference signals are defined fro extended cyclic prefix only. The MBSFN reference signals are transmitted on antenna port 4 (AP 4) and only when the PMCH is transmitted.

The Figure 2-11 shows the resource elements used by the MBSFN reference signal if Δf=15 kHz .

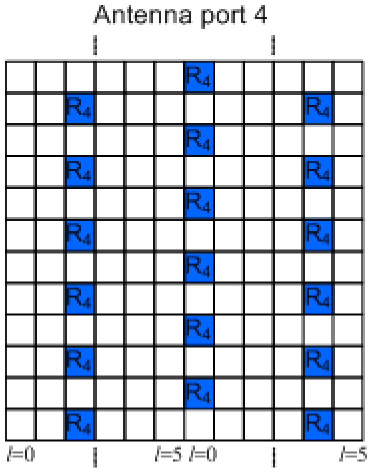


Figure 2-11: MBSFN reference signal structure (extended cyclic prefix, carrier spacing 15 KHz)

Related settings

See Chapter 4.2.3, "MBSFN settings", on page 86.

UE-specific reference signal (DMRS)

These reference signals are intended for a specific user and mapped to predefined PDSCH RBs of this particular user. The resource elements predefined for the UE-specific RS do not overlap with the resource elements reserved for the cell-specific reference signals.

For single-antenna transmission, the UE-specific reference signals are transmitted on antenna port 5, 7 or 8 (AP 5, AP 7, and AP 8). If a spatial multiplexing is applied, the UE-specific reference signals are transmitted on antenna ports 7 to 10 (AP 7 to AP 10).

The UE-specific RS are also called demodulation reference signals (DMRS) and are intended for channel estimation and demodulation instead of the common reference signals. One typical example of the application of UE-specific RS is the channel estimation and demodulation, if beamforming transmission is used. This is also called transmission using antenna port 5 (AP 5).

In contrary to the common reference signals that are not precoded, the UE-specific RS are precoded in the same way as the PDSCH they are mapped to.

See Figure 2-12 and Figure 2-13 for illustration of the mapping of the UE-specific reference signals to the resource elements.

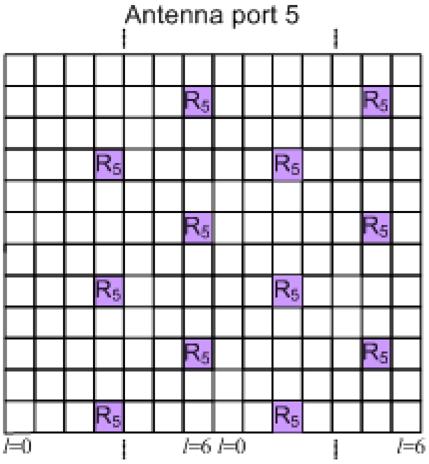


Figure 2-12: UE-specific reference signals, antenna port 5 (normal cyclic prefix)

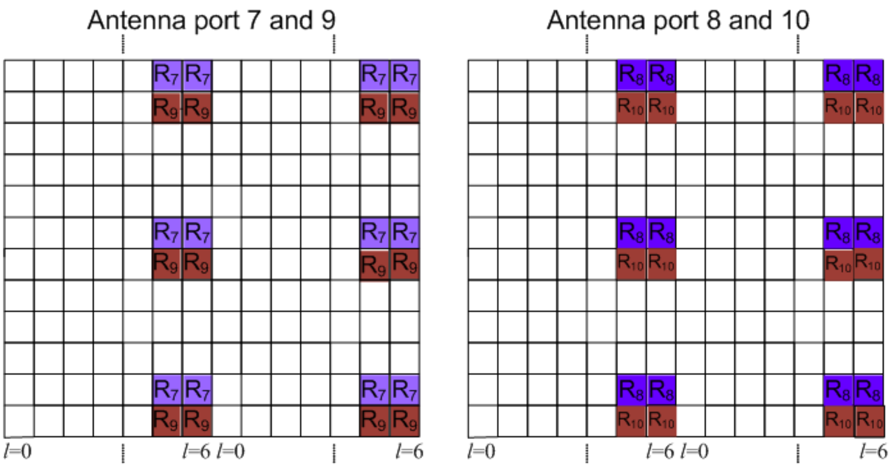


Figure 2-13: UE-specific reference signals, antenna ports 7 to 10 (normal cyclic prefix, downlink subframe)

See also "Transmission mode TM10 and DCI format 2D" on page 53.

Positioning reference signals

The positioning reference signals are transmitted only in downlink subframes configured for positioning reference signals transmission. Positioning reference signals are transmitted on antenna port 6 (AP 6).

The Figure 2-14 shows the mapping of the positioning reference signals for the one and two PBCH antenna ports case (normal cyclic prefix). Refer to the specification for information about the mapping in all other cases.

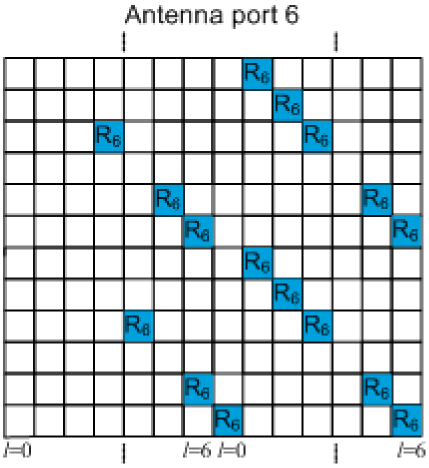


Figure 2-14: Mapping of PRS (normal cyclic prefix), one and two PBCH antenna ports.

Related settings

See Chapter 4.2.7.3, "Positioning reference signal (PRS) settings", on page 112 .

CSI reference signals

The CSI reference signals (CSI-RS) are intended for the acquisition of channel-state information (CSI) for UE working in transmission mode 9 or 10 (TM9 or TM10). This is because in TM9, the DMRS are used for channel estimation.

The CSI-RS structure depends on the number of CSI-RS (1, 2, 4 or 8) configured in a cell and can differ between the cells. This is illustrated on Figure 2-15 [TS 36.211].

Up to LTE Rel. 13, the CSI-RS are transmitted on antenna ports 15 to 22 (AP 15 to AP 22).

From LTE Rel. 14 on, also the AP 23 to AP 46 are supported and the multiple CSI-RS configuration mapped on them. See also Chapter 2.2.8, "LTE Release 13/14 introduction", on page 55.

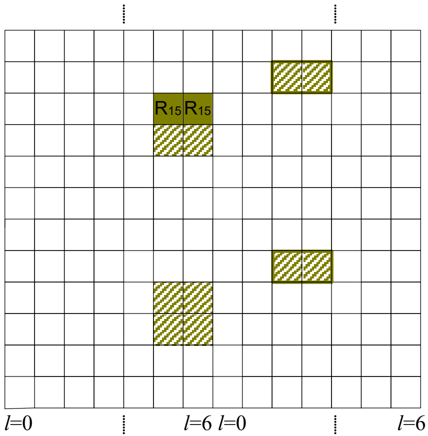


Figure 2-15: Mapping of a CSI-RS on antenna port 15 (CSI configuration 0, normal cyclic prefix)

Pattern = Example of possible position of the CSI-RSs
Dark green = Example of allocated CSI-RS signals in a cell
Border = Example of muted (ZeroTxPower) CSI-RSs

The CSI-RS can be configured with different transmission periods (5 ms to 80 ms) and per subframe (see Table 4-3).

In normal operation, the CSI-RS is transmitted on the allocated resource elements (dark green color on Figure 2-15). The remaining possible but not allocated resource elements (the pattern elements on the same figure) are used for PDSCH transmission. The 3GPP specification allows the configuration of an extra subset of resource elements. These resource elements are reserved for CSI-RS transmission and have the same structure as the CSI-RS but use a zero transmission power (ZeroTxPower). Nothing is transmitted during these resource elements.

Related settings

See:

- Chapter 4.2.7.4, "CSI-RS settings", on page 116
- Chapter 4.4.2, "CSI-RS settings", on page 217
- "CSI Awareness State" on page 145

2.2.1.6 Downlink physical layer procedures

For E-UTRA, the following downlink physical layer procedures are especially important:

- **Cell search and synchronization**
  See "Cell-specific downlink reference signals" on page 28.
- **Scheduling**
  Scheduling is done in the base station (eNodeB). The downlink control channel PDCCH informs users about their allocated time/frequency resources and the transmission formats to use. The scheduler evaluates different types of information, e.g. quality-of-service parameters, measurements from the UE, UE capabilities, and buffer status.
- **Link adaptation**
  Link adaptation is already known from HSDPA as adaptive modulation and coding. Also in E-UTRA, modulation and coding for the shared data channel is not fixed, but rather is adapted according to radio link quality. For this purpose, the UE regularly reports channel quality indications (CQI) to the eNodeB.
- **Hybrid automatic repeat request (ARQ)**
  Downlink hybrid ARQ is also known from HSDPA. It is a retransmission protocol. The UE can request retransmissions of incorrectly received data packets.

2.2.2 LTE uplink transmission scheme

During the study item phase of LTE, alternatives for the optimum uplink transmission scheme were investigated. While OFDMA is seen optimum to fulfill the LTE requirements in downlink, OFDMA properties are less favorable for the uplink. This is due to weaker peak-to-average power ratio (PAPR) properties of an OFDMA signal, resulting in worse uplink coverage.

Thus, the LTE uplink transmission scheme for FDD and TDD mode is based on SC-FDMA (single carrier frequency division multiple access) with cyclic prefix. SC-FDMA signals have better PAPR properties compared to an OFDMA signal. This was one of the main reasons for selecting SC-FDMA as LTE uplink access scheme. The PAPR characteristics are important for cost-effective design of UE power amplifiers. Still, SC-FDMA signal processing has some similarities with OFDMA signal processing, so parameterization of downlink and uplink can be harmonized.

There are different possibilities how to generate an SC-FDMA signal. DFT-spread-OFDM (DFT-s-OFDM) has been selected for EUTRA. The principle is illustrated on Figure 2-16. This figure is taken from 3GPP R1-050584, "EUTRA Uplink Numerology and Design".

For DFT-s-OFDM, a size-M DFT is first applied to a block of M modulation symbols. QPSK, 16QAM and 64 QAM are used as uplink EUTRA modulation schemes, the latter being optional for the UE. The DFT transforms the modulation symbols into the frequency domain. The result is mapped onto the available subcarriers. In EUTRA uplink, only localized transmission on consecutive subcarriers is allowed. An N point IFFT where N>M is then performed as in OFDM, followed by addition of the cyclic prefix and parallel to serial conversion.

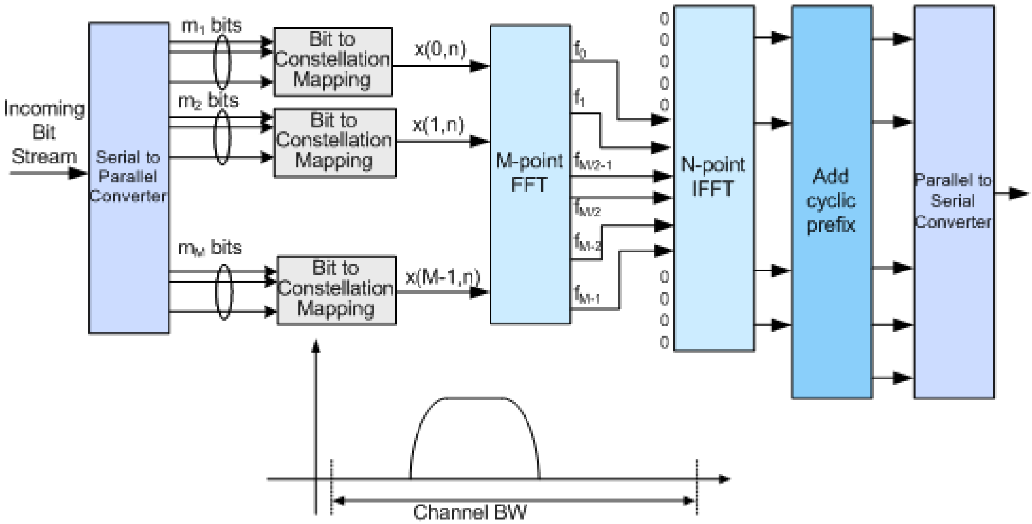


Figure 2-16: Block diagram of DFT-s-OFDM (localized transmission)

The DFT processing is therefore the fundamental difference between SC-FDMA and OFDMA signal generation. This is indicated by the term DFT-spread-OFDM. In an SCFDMA signal, each subcarrier used for transmission contains information of all transmitted modulation symbols. This due to fact that the input data stream has been spread by the DFT transform over the available subcarriers. In contrast, each subcarrier of an OFDMA signal only carries information related to specific modulation symbols.

2.2.2.1 SC-FDMA parameterization

The EUTRA uplink structure is similar to the downlink. An uplink radio frame consists of 20 slots of 0.5 ms each, and 1 subframe consists of 2 slots. The slot structure is shown on Figure 2-17 (taken from TS 36.211).

Each slot carries N_{symb}^{UL} SC-FDMA symbols, where N_{symb}^{UL} = 7 for the normal cyclic prefix and N_{symb}^{UL} = 6 for the extended cyclic prefix. SC-FDMA symbol number 3 (i.e. the 4th symbol in a slot) carries the reference signal for channel demodulation.

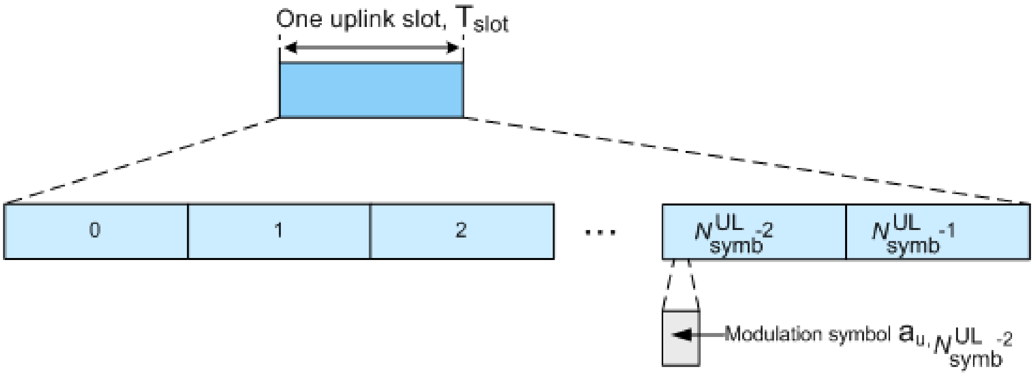


Figure 2-17: Uplink slot structure

Also for the uplink, a bandwidth agnostic layer 1 specification has been selected. The table below shows the configuration parameters in an overview table.

Configuration	Number of symbols N_{symb}^{UL}	Cyclic prefix length in samples	Cyclic prefix length in µs
Normal cyclic prefix Δf=15 kHz	7	160 for first symbol 144 for other symbols	5.2 us for first symbol 4.7 us for other symbols
Extended cyclic prefix Δf=15 kHz	6	512	16.7 us

Related settings

See:
- Chapter 4.1, "General settings", on page 63
- Chapter 4.2.6, "TDD frame structure settings", on page 108
- Chapter 7.2, "SC-FDMA time plan", on page 520
- Chapter 7.3, "TDD time plan", on page 522.

2.2.2.2 Uplink data transmission

In uplink, data is allocated in multiples of one resource block. Uplink resource block size in the frequency domain is 12 subcarriers, i.e. the same as in downlink. To simplify the DFT design in uplink signal processing only factors 2, 3, and 5 are allowed.

The uplink transmission time interval (TTI) is 1 ms (same as downlink).

User data is carried on the physical uplink shared channel (**PUSCH**).

Related settings

See:
- Chapter 4.6.7, "PUSCH structure", on page 251
- Chapter 4.8.4, "Physical uplink shared channel (PUSCH)", on page 273
- Chapter 4.9, "Enhanced PUSCH settings", on page 323

2.2.2.3 Uplink control information transmission

According to the LTE specifications, one of the following channels carries the uplink control information depending on whether an uplink resource has been assigned to the UE or not:
- Physical Uplink Shared Channel (PUSCH)
- Physical Uplink Control Channel (PUCCH)

Control information (CQI reports and ACK/NACK information related to data packets received in the downlink) is multiplexed with the PUSCH, if the UE has been granted with UL-SCH transmission.

The PUCCH carries uplink control information, e.g. CQI reports, HARQ ACK/NACK information, or scheduling requests (SR), in case the UE has not been assigned an UL-SCH transmission. The PUCCH is transmitted on a reserved frequency region at the edges of the total available UL bandwidth. One PUCCH resource comprises a pair of resource blocks within slot 0 and 1 that are located in the upper and the lower part of the spectrum. PUCCH is allocated as shown on the Figure 2-18 [TS 36.211].

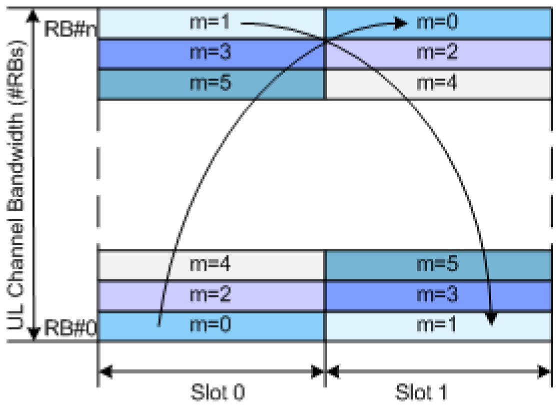


Figure 2-18: PUCCH mapping

TS 36.211 specifies seven PUCCH formats, see Table 2-4.

Table 2-4: PUCCH formats

PUCCH format	Description	Physical bits	Modulation scheme	ODFM symbols used for DMRS (normal CP)	ODFM symbols used for DMRS (extended CP)
1	Scheduling request (SR)	0	-	2, 3, 4	2, 3
1a	ACK/NACK ACK/NACK + SR	1	BPSK	2, 3, 4	2, 3
1b	ACK/NACK for MIMO ACK/NACK + SR	2 4	QPSK	2, 3, 4	2, 3
2	CQI CSI + ACK/NACK	20	QPSK	1, 5	3
2a	CSI + ACK/NACK	21	QPSK+BPSK	1, 5	-
2b	CSI + ACK/NACK for MIMO	22	QPSK+QPSK	1, 5	-
3*)	ACK/NACK (if DL carrier aggregation with more than 2 cells) ACK/NACK + SR	48	QPSK	1, 5	3
4 and 5	ACK/NACK (if DL carrier aggregation with more than 5 cell)	Depends on RB size (number of used subcarriers and for F4 also number of RBs), CP and PUCCH format	QPSK	3	2

*) eMTC does not support PUCCH formats 3, 4 and 5

The different PUCCH formats are mapped to the reserved PUCCH region. The mapping is performed so that there can be only one resource block per slot that supports a combination of PUCCH formats 1/1a/1b and 2/2a/2b.

For simultaneous transmission of multiple users on the PUCCH, different PUCCH resource indices are used. Multiple UEs are distinguished within one resource block by using different cyclic shifts (CS) of the CAZAC (constant amplitude zero auto-correlation) sequence. For PUCCH formats 1/1a/1b, three different orthogonal cover sequences (OC) can also be used. For the different PUCCH formats, different number of PUCCH resource indices are available within a resource block (see Table 2-5). The actual number of the used orthogonal sequences is also determinated by the parameter delta_shift, used to support working in different channel conditions.

Table 2-5: PUCCH resource indices per PUCCH format

PUCCH format	PUCCH resource indices	Number available within a resource block
1/1a/1b	N(1)_PUCCH	36 for normal CP 24 for extended CP
2/2a/2b	N(2)_PUCCH	12
3*)	N(3)_PUCCH	5
4*)	N(4)_PUCCH	1
5*)	N(5)_PUCCH	3

*) eMTC does not support PUCCH formats 3, 4 and 5

Related settings

See:
- Chapter 4.6.8, "PUCCH structure", on page 252
- Chapter 4.10, "Enhanced PUCCH settings", on page 333

2.2.2.4 Uplink reference signal structure

Uplink reference signals are used for two different purposes:
- For channel estimation in the eNodeB receiver to demodulate control and data channels
- To provide channel quality information as a basis for scheduling decisions in the base station.
  This purpose is also called channel sounding.

The uplink reference signals are based on CAZAC (constant amplitude zero auto-correlation) sequences.

Sounding reference signals (SRS)

The specification defines two types of sounding reference signals (SRS), periodic SRS and aperiodic SRS. A user equipment (UE) can be configured with both SRS trigger types.

- Periodic SRS occurs at regular time intervals.
  It is referred as "trigger type 0" SRS and is known form LTE Rel. 8
- The aperiodic SRS transmission is a single (one-shot) transmission
  It is referred as "trigger type 1" SRS and is introduced by LTE Rel. 10.
  Aperiodic SRS is triggered by the "SRS Request" flag in one of the DCI formats 0/1A/4/2B/2C/2D.
  Triggering aperiodic SRS by using DCI format 0 requires one dedicated SRS set of parameters whereas the triggering by using DCI formats 1A/2A/2B/2C uses a common SRS set. For the triggering by DCI format 4, the specification defines three SRS sets.

Related settings

See:
- Chapter 4.6.5.1, "UL reference signals", on page 246
- Chapter 4.6.5.2, "Cell-specific SRS settings", on page 247
- Chapter 4.8.6, "Sounding reference signal (SRS)", on page 280
- "Aperiodic SRS State" on page 145
- "DCI Format 1A" on page 201

2.2.2.5 Uplink physical layer procedures

For EUTRA, the following uplink physical layer procedures are especially important:

Non-synchronized random access

The random access is used to request initial access, as part of handover, when transiting from idle to connected, or to re-establish uplink synchronization. The structure is shown on Figure 2-19 (taken from TS 36.211).

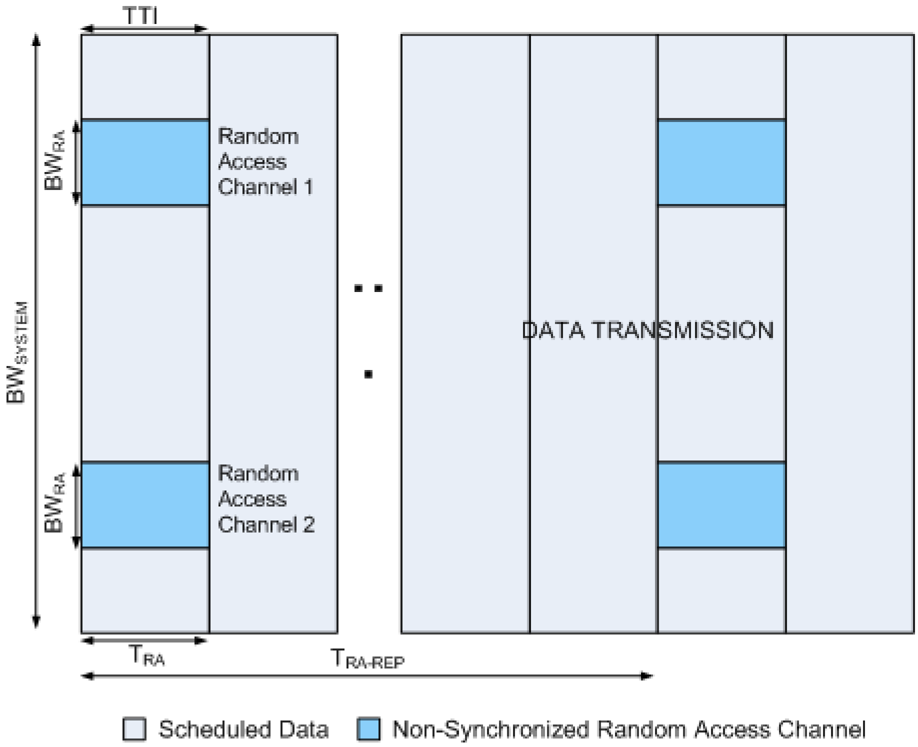


Figure 2-19: Random access structure, principle

Multiple random access channels can be defined in the frequency domain within one access period TRA to provide enough random access opportunities.

For the random access, a preamble is defined as shown on Figure 2-20 (taken from TS 36.211). The preamble length depends on the preamble format. The preamble bandwidth is 1.08 MHz (72 subcarriers). Higher layer signaling controls in which subframes the preamble transmission is allowed, and the location in the frequency domain. Per cell, there are 64 random access preambles. They are generated from Zadoff-Chu sequences.

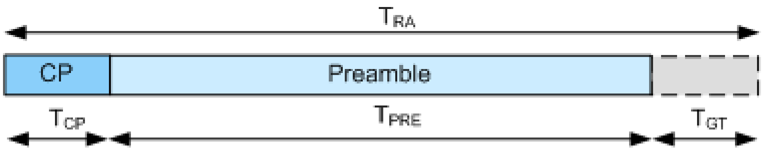


Figure 2-20: Random access preamble

The random access procedure uses open loop power control with power ramping similar to WCDMA. After sending the preamble on a selected random access channel, the UE waits for the random access response message. If no response is detected, then another random access channel is selected and a preamble is sent again.

Related settings

See:

- Chapter 4.6.6, "PRACH settings", on page 249
- Chapter 4.8.9, "PRACH power ramping", on page 319
- Chapter 4.8.10, "PRACH configuration", on page 320

Uplink scheduling

As in the downlink direction, the uplink scheduling is *dynamical scheduling* of uplink resources performed by eNodeB on a subframe basis. The eNodeB assigns certain time/frequency resources to the UEs and informs UEs about transmission formats to use. Scheduling decisions affecting the uplink are communicated to the UEs via the physical downlink control channel (PDCCH) in the downlink. The scheduling decisions can be based on QoS parameters, UE buffer status, uplink channel quality measurements, UE capabilities, UE measurement gaps, etc.

The LTE specification defines a second uplink scheduling method, the *semi-persistent scheduling (SPS)*. The semi-persistent scheduling is used to reduce the control signaling overhead for regularly occurring services and transmissions of relative small payloads. With SPS, the scheduling decisions are not transmitted every subframe but once. Via the PDCCH, the UEs first receive information on the SPS periodicity, that is information about the SPS pattern or the subframes on which scheduling decisions can be transmitted. Semi-persistent scheduling is then activated and deactivated by an explicit trigger, the SPS C-RNTI. The dynamic scheduling commands have higher priority than the SPS.

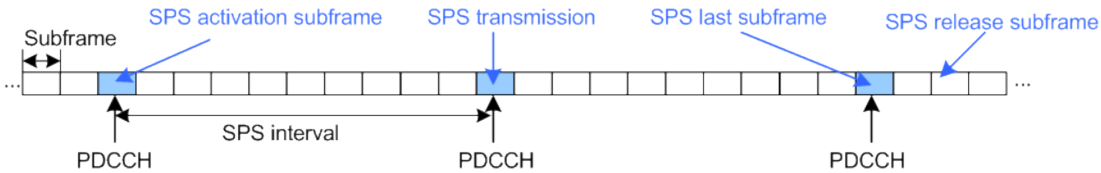


Figure 2-21: Semi-persistent scheduling (SPS)

In carrier aggregation transmission, SPS is allowed only on the primary component carrier.

Related settings

See Chapter 4.3.7, "SPS configuration settings", on page 162.

Uplink link adaptation

As uplink link adaptation methods, transmission power control, adaptive modulation and channel coding rate, and adaptive transmission bandwidth can be used.

Uplink timing control

Uplink timing control is required to time align the transmissions from different UEs with the receiver window of the eNodeB. The eNodeB sends the appropriate timing-control commands to the UEs in the downlink, commanding them to adapt their respective transmit timing.

Hybrid automatic repeat request (ARQ)

The eNodeB uses the uplink hybrid ARQ protocol to request retransmissions of incorrectly received data packets.

2.2.3 LTE MIMO concepts

Multiple Input Multiple Output (MIMO) systems form an essential part of LTE to achieve the ambitious requirements for throughput and spectral efficiency. MIMO refers to the use of multiple antennas at the transmitter and at the receiver.

2.2.3.1 Downlink MIMO

For the LTE downlink, a 2x2 configuration for MIMO is assumed as baseline configuration, i.e. two transmit antennas at the base station and two receive antennas at the terminal. Configurations with four or more antennas are also being considered.

Different MIMO modes are envisaged. It has to be differentiated between spatial multiplexing and transmit diversity, and it depends on the channel condition which scheme to select.

Related settings

See:

- Chapter 4.2.8, "Antenna ports settings", on page 133
- Chapter 4.4.1, "Precoding settings", on page 212
- Chapter 4.5, "DL antenna port mapping settings", on page 222.

Spatial multiplexing

Spatial multiplexing allows transmitting different streams of data simultaneously on the same downlink resource blocks (see Figure 2-22 for illustration of the principle). These data streams can belong to one single user (single user MIMO / SU-MIMO) or to different users (multi-user MIMO / MU-MIMO). While SU-MIMO increases the data rate of one user, MU-MIMO allows increasing the overall capacity.

Spatial multiplexing is only possible if the mobile radio channel allows it.

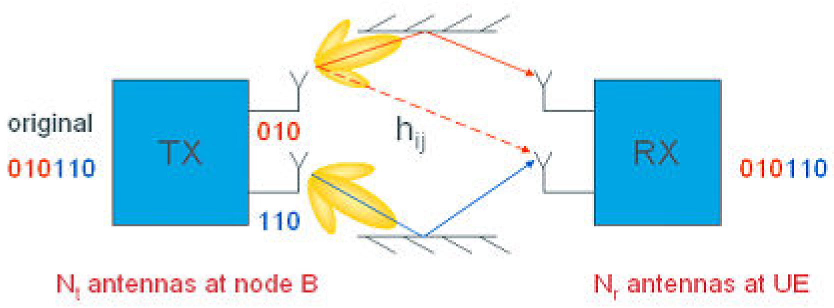


Figure 2-22: Spatial multiplexing

In the Figure 2-22, each transmit antenna transmits a different data stream. Each Rx antenna receives the data streams from all transmit antennas. The channel (for a specific delay) can thus be described by the following channel matrix H:

$$\mathbf{H} = \overbrace{\begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1M} \\ h_{21} & h_{22} & & h_{2M} \\ \vdots & & \ddots & \vdots \\ h_{N1} & h_{N2} & \cdots & h_{NM} \end{bmatrix}}^{\mathbf{N_t}} \mathbf{N_r}$$

In this general description, N_t is the number of transmit antennas, N_r is the number of receive antennas, resulting in a 2x2 matrix for the baseline LTE scenario. The coefficients h_{ij} of this matrix are called channel coefficients from transmit antenna *j* to receive antenna *i*, thus describing all possible paths between the transmitter and the receiver.

The number of data streams that can be transmitted in parallel over the MIMO channel is given by min $\{N_t, N_r\}$. It is limited by the rank of the matrix H. The transmission quality degrades significantly in case the singular values of matrix H are not sufficiently strong. This can happen in case the two antennas are not sufficiently de-correlated, for example in an environment with little scattering or when antennas are too closely spaced.

Codewords and spatial layers

A block of information bits that can be separately processed before it is transmitted in a subframe, is called codeword [17].

A spatial layer indicates the number of spatial streams that can be simultaneously transmitted [17]. The number of layers for transmission is less than or equal to the number of transmit antenna ports and depends on the rank of the matrix H.

In LTE Rel. 8/9, up to two codewords can be transmitted simultaneously and mapped onto up to four layers. There is a fixed mapping between codewords to layers, see Figure 2-23.

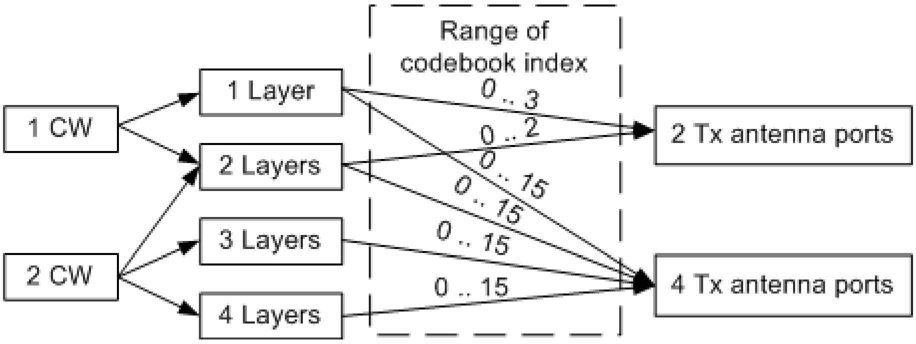


Figure 2-23: Codeword to layer mapping for downlink spatial multiplexing (LTE Rel. 8/9)

Precoding

Precoding on transmitter side is used to support spatial multiplexing, see Figure 2-24 (from TS 36.211). This is achieved by applying a precoding matrix W to the signal before transmission.

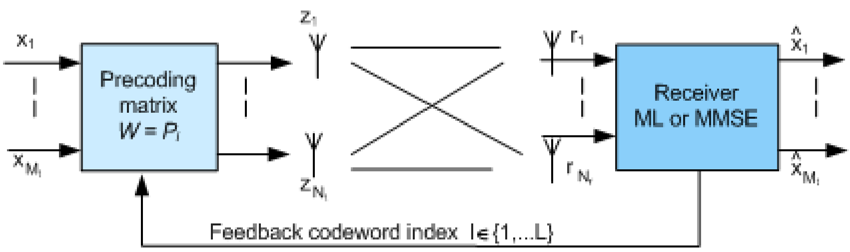


Figure 2-24: Precoding principle

The optimum precoding matrix W is selected from a predefined "codebook" which is known at the eNodeB and at the UE. Unitary precoding is used, i.e. the precoding matrices are unitary: $W^H W = I$. The UE estimates the radio channel and selects the optimum precoding matrix. The optimum precoding matrix is the one which offers maximum capacity. The UE provides feedback on the uplink control channel regarding the preferred precoding matrix (precoding vector as a special case). Ideally, this information is made available per resource block or at least group of resource blocks, since the optimum precoding matrix varies between resource blocks. The Figure 2-25 (from TS 36.211) gives an overview of EUTRA downlink baseband signal generation including the steps relevant for MIMO transmission.

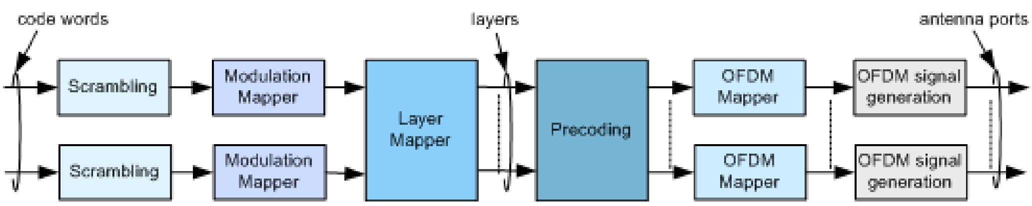


Figure 2-25: Overview of downlink baseband signal generation

Transmission modes

LTE defines the following transmission modes for the PDSCH (TS 36.213).

Table 2-6: Downlink transmission modes overview

Transmission mode	Transmission scheme
Tx Mode 1	Single-antenna transmission (AP 0); SISO/SIMO but no MIMO
Tx Mode 2	Transmit diversity
Tx Mode 3	• Transmit diversity • Open-loop spatial multiplexing with large delay CDD; SU-MIMO (single user MIMO)
Tx Mode 4	• Transmit diversity • Closed-loop spatial multiplexing; SU-MIMO
Tx Mode 5	• Transmit diversity • MU-MIMO (multi-user MIMO)
Tx Mode 6	• Transmit diversity • Closed-loop spatial multiplexing using a single transmission layer
Tx Mode 7	Single-antenna port transmission (AP 5); single layer beamforming
Tx Mode 8	• Dual layer transmission (AP 7 and AP 8); dual layer beamforming • Single-antenna port (AP 7 or AP 8)
Tx Mode 9	Multi-layer transmission (AP 9 to AP 14); MU-MIMO, SU-MIMO, 8 layer beamforming
Tx Mode 10	Multi-layer transmission (AP 9 to AP 14), CoMP (coordinated multi-point operation)

See also "Mapping of reference signals to antenna ports" on page 27.

Transmit diversity

Instead of increasing data rate or capacity, MIMO can be used to exploit diversity. If the channel conditions do not allow spatial multiplexing, a transmit diversity scheme is used instead, so switching between these two MIMO modes is possible depending on channel conditions. Transmit diversity is used when the selected number of streams (rank) is one.

Beamforming

The beamforming is a method to shape the transmitted signal in the receiver's direction. In LTE, the beamforming is defined as transmission mode 7, 8 and 9 (Tx Mode 7/8/9). Beamforming uses the special antenna ports 5 and 7 to 14, see Table 2-6.

The channel estimation in a beamforming scenario is based on the UE-specific reference signal (DMRS).

2.2.3.2 Uplink MIMO

Uplink MIMO schemes for LTE differ from downlink MIMO schemes. Up to LTE Rel. 9, only uplink MU-MIMO is specified. Multiple user terminals can transmit simultaneously on the same resource block. This is also referred to as spatial domain multiple access

(SDMA). The scheme requires only one transmit antenna at the UE. The UEs sharing resource blocks have to apply mutually orthogonal pilot patterns.

For information on the SU-MIMO and the LTE-Advanced MIMO concept, see Chapter 2.2.5.3, "Enhanced MIMO schemes", on page 49.

2.2.4 LTE MBMS concepts

In LTE, MBMS transmission is performed as single-cell transmission or as multi-cell transmission. In multi-cell transmission, the cells and content are synchronized to enable for the terminal to soft-combine the energy from multiple transmissions. The superimposed signal looks like multipath to the terminal. This concept is also known as single frequency network (SFN). The EUTRAN can configure which cells are part of an SFN for transmission of an MBMS service. The MBMS traffic can share carrier with the unicast traffic or be sent on a separate carrier. For MBMS traffic, an extended cyclic prefix is provided. Specific reference signals are used in the subframes that carry MBMS SFN data (see "MBSFN reference signals" on page 30).

MBMS data is carried on the MBMS traffic channel (MTCH) as logical channel. The MBMS control channel MCCH carries the MBMS control information. Both logical channels, the MTCH and the MCCH, are mapped onto the physical multicast channel PMCH in the multi-cell transmission case. If a single-cell transmission is used, they are mapped on the PDSCH.

Related settings

See Chapter 4.2.3, "MBSFN settings", on page 86.

2.2.5 LTE Release 10 (LTE-Advanced) introduction

This description gives a brief description only of the LTE-A features currently covered by the software option R&S SMW-K85. The full set of LTE-Advanced features is described in 1MA232.

For a complete LTE-Advanced technology introduction and an insight description of the LTE-A features, refer to:

- White Paper 1MA169 "LTE-Advanced Technology Introduction"
- Application Note 1MA166 "LTE-Advanced Signals Generation and –Analysis"

2.2.5.1 Carrier aggregation

The LTE-A Rel. 10 specification uses the aggregation of multiple LTE carriers. Two or more component carriers (CC) are grouped to support wider transmission bandwidths of up to 100 MHz. To an LTE Rel. 8 terminal, each component carrier appears as an LTE carrier. An LTE Rel. 10 terminal can exploit the total aggregated bandwidth. As backward compatibility is fulfilled, a LTE-Advanced cell can serve both LTE Rel. 8 and LTE Rel. 10 terminals simultaneously.

Spectrum deployment can be either contiguous with adjacent component carriers, or non-contiguous with non-adjacent component carriers (see Figure 2-26, 1MA169). The individual component carriers can belong to the same frequency band (intra-band) or to different frequency bands (inter-band). Component carriers transmitted by the same eNodeB provide the same cell coverage.

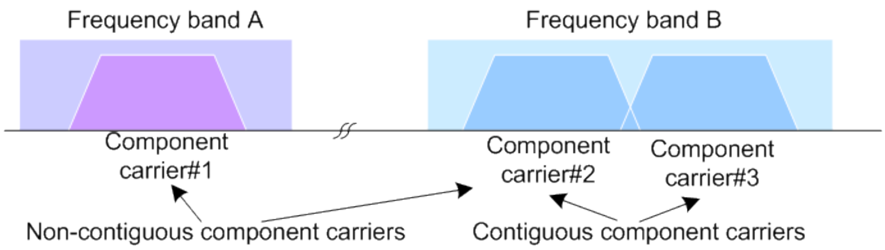


Figure 2-26: Carrier aggregation

The LTE-A specification defines two different approaches about informing the UE about the scheduling for each band: a separate PDCCH for each carrier or a common PDCCH for multiple carriers (cross-carrier scheduling).

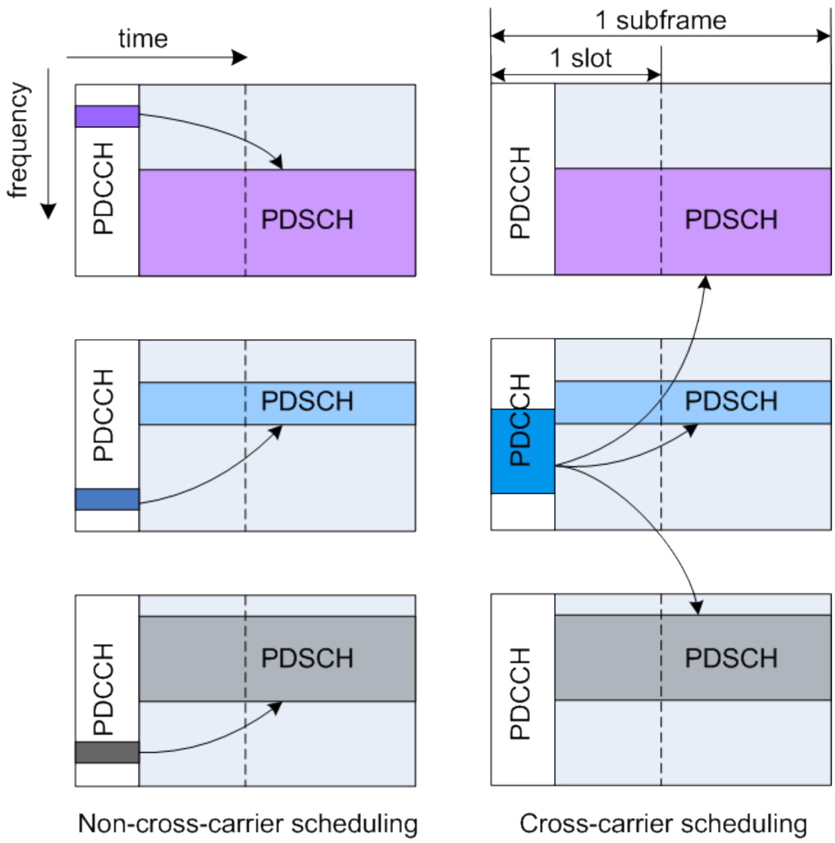


Figure 2-27: LTE-A scheduling approaches

In the dedicated/non-cross-carrier approach, the PDCCH on a component carrier assigns PDSCH resources on the same component carrier. The used PDCCH structure is identical to the LTE Rel. 8/9 PDCCH structure.

In the cross-carrier approach, the PDCCH on a component carrier assigns resources on one of multiple component carriers. The component carriers are identified by the new introduced DCI field, the CIF (carrier indicator field).

Related settings

See:

- Chapter 4.2.2, "DL carrier aggregation configuration", on page 73.
- Chapter 4.3, "DL frame configuration settings", on page 136.
- Chapter 4.3.3, "User configuration settings", on page 139.

2.2.5.2 Enhanced uplink SC-FDMA

The LTE-A Rel. 10 enhances the uplink transmission scheme compared to the LTE Rel. 8 uplink with the following:

- Control-data decoupling
  In LTE Rel. 8/9, a UE only uses physical uplink control channel (PUCCH) when it does not have any data to transmit on PUSCH. If a UE has data to transmit on PUSCH, it would multiplex the control information with data on PUSCH. This behavior is not valid in LTE-Advanced, which means that simultaneous PUCCH and PUSCH transmission is possible in uplink direction.
- Non-contiguous data transmission
  LTE-Advanced extends the uplink transmission scheme by allowing clustered PUSCH. The uplink transmission is not restricted to the use of consecutive subcarriers. Clusters of resource blocks can be allocated (two "sets" of consecutive PUSCH resource block groups according to resource allocation type 1 as defined in TS 36.213).

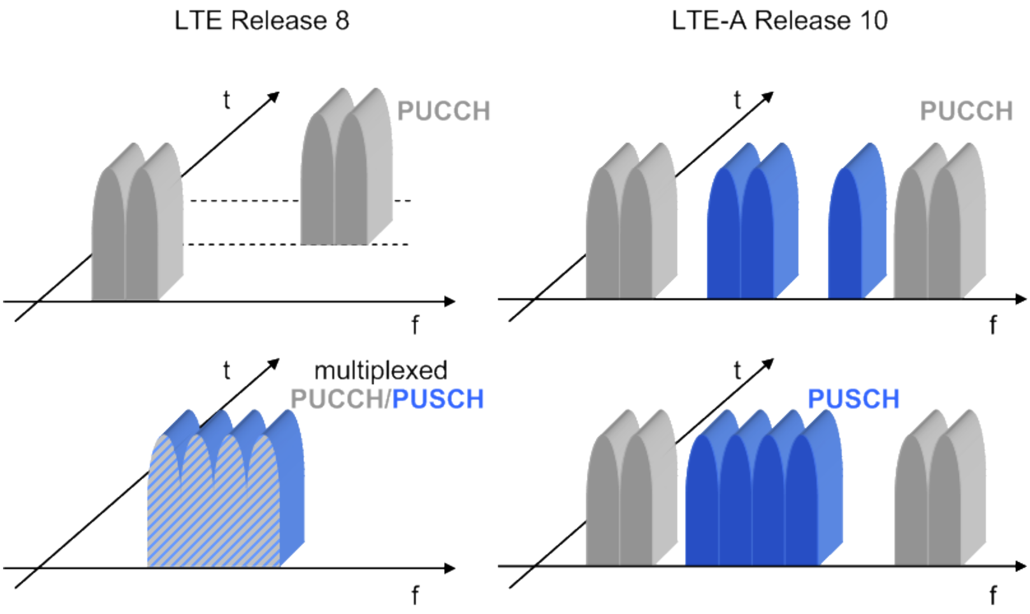


Figure 2-28: LTE Release 8 and LTE-A Release 10 UL transmission schemes

Related settings

See:
- Chapter 4.7, "UL frame configuration settings", on page 255
- Chapter 4.8, "User equipment configuration", on page 265.

2.2.5.3 Enhanced MIMO schemes

LTE Rel. 8 supports MIMO schemes in downlink direction. In downlink direction, up to four transmit antennas can be used whereas the maximum number of codewords is two irrespective of the number of antenna ports. LTE-Advanced extends the MIMO capabilities of LTE Rel. 8/9 to now supporting eight downlink antennas (8x8 antenna configuration) and four uplink antennas (4x4 antenna configuration), see Figure 2-29, and Figure 2-30, 1MA169.

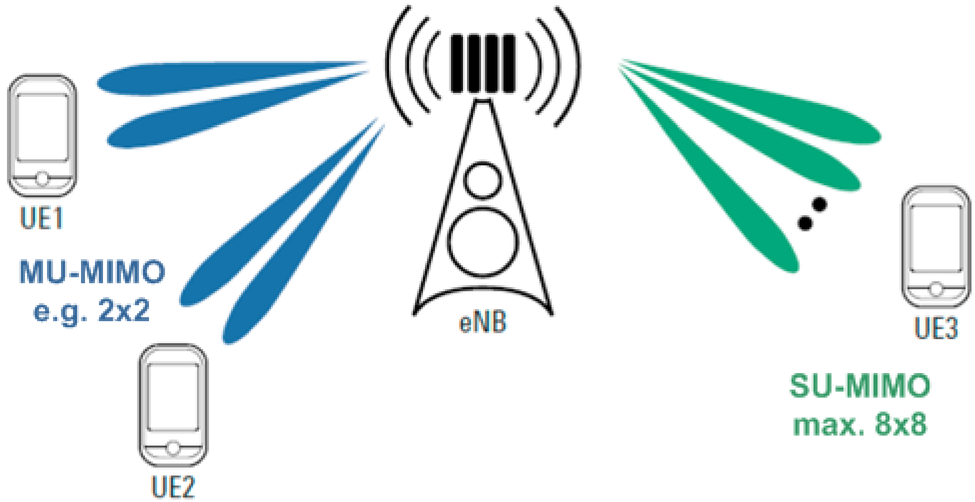


Figure 2-29: Supported transmit layers in LTE-Advanced (downlink)

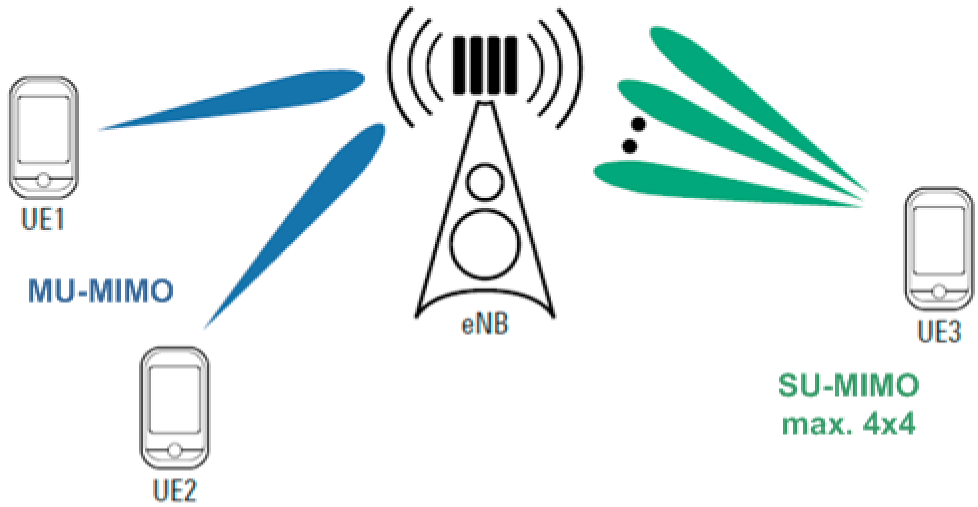


Figure 2-30: Supported transmit layers in LTE-Advanced (uplink)

In addition to the spatial multiplexing schemes, transmit diversity is possible in both downlink and uplink direction.

Downlink MIMO

The following is a list of the main differences compared to LTE Rel. 8/9:

- Layer mapping for downlink spatial multiplexing that uses the AP 7 to AP 14 for up to 8 layer PDSCH
  See "Mapping of reference signals to antenna ports" on page 27 and Figure 2-23
- Scheduling of downlink resources uses the DCI format 2C and transmission mode 9 (TM9)
  See "Transmission modes" on page 45
- Introduced are the PDSCH demodulation reference signals DMRS
  See "UE-specific reference signal (DMRS)" on page 31
- Channel state estimation reference signals (CSI-RS)
  See "CSI reference signals" on page 33

Uplink MIMO

The following is a list of the main difference compared to LTE Rel. 8/9:

- PUSCH transmission uses up to two codewords, up to four layers and up to four antenna ports to support SU-MIMO
- If two PUSCH codewords are used, these codewords can use different modulation schemes
- Defined are different codebooks depending on the used number of antenna ports and layers

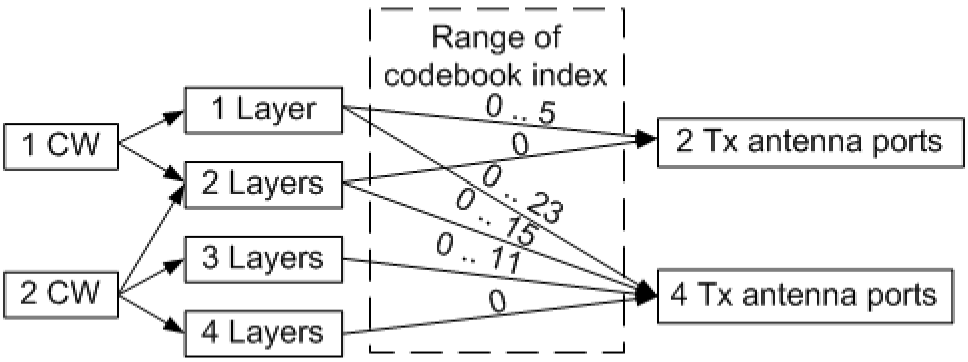


Figure 2-31: Codeword to layer mapping for uplink spatial multiplexing (LTE Rel. 10)

- PUCCH can be transmitted on up to two antenna ports
- SRS can be transmitted on up to four antenna ports

See Table 2-7

Table 2-7: Uplink transmission modes overview

Transmission mode	Transmission scheme
Tx Mode 1	No spatial multiplexing; transmission on a single antenna port
Tx Mode 2	Spatial multiplexing

Related settings

See:

- Chapter 4.7.3, "UL allocation table", on page 260
- Chapter 4.8.2, "Physical uplink control channel (PUCCH)", on page 268,
Chapter 4.8.4, "Physical uplink shared channel (PUSCH)", on page 273,
Chapter 4.8.5, "Demodulation reference signal (DMRS)", on page 279,
Chapter 4.8.6, "Sounding reference signal (SRS)", on page 280 and
Chapter 4.8.8, "Antenna port mapping", on page 316
- Chapter 4.9, "Enhanced PUSCH settings", on page 323
- Chapter 4.10, "Enhanced PUCCH settings", on page 333

2.2.6 LTE Release 11 introduction

This section gives a brief description only of the LTE-A Rel. 11 features currently covered by the software option R&S SMW-K112.

For a complete LTE-Advanced (3GPP Rel. 11) technology introduction and an insight description of the LTE-A features, refer to:

- White Paper 1MA232 "LTE-Advanced (3GPP Rel. 11) Technology Introduction"

LTE carrier aggregation enhancements

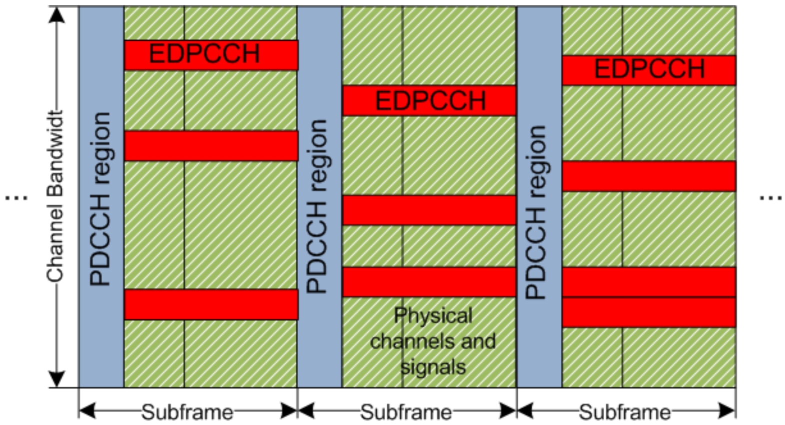
LTE-Advanced 3GPP Rel. 11 introduces the following new features:

- Multiple timing advances (TA) for uplink carrier aggregation
- Non-contiguous intra-band carrier aggregation
- Two special subframe configurations for LTE TDD
  - Special subframe configuration 9 with normal cyclic prefix in downlink
  - Special subframe configuration 7 with extended cyclic prefix in downlink
- Support of different UL/DL configurations on different bands
If TDD carrier aggregation is used, the individual carriers can use different UL/DL configurations
- Enhanced TxD schemes for PUCCH format 1b with channel selection

New control channel: enhanced PDCCH (EPDCCH)

LTE-Advanced 3GPP Rel. 11 introduces the new downlink control channel to support new features and to increase the control channel capacity.

The enhanced physical downlink control channel (EPDCCH) carries the downlink control information. Compared to the PDCCH, the EPDCCH is not allocated on the first symbols of a subframe as it is with PDCCH but uses resource blocks normally reserved for the PDSCH.



EPDCCH is a user-specific control channel. It is always transmitted in an EPDCCH set. For each component carrier and user, you can define one or two EPDCCH sets. Each EPDCCH set consists of 2, 4 or 8 physical resource block (PRB) pairs that do not have to be contiguous in frequency.

Each PRB pair consists of a number of enhanced control channel elements (ECCE). Each ECCE consists of 4 or 8 enhanced resource element groups (EREG), where there are 16 EREG per PRB pair. If the subsequent EREGs are allocated within a single PRB pair, the EPDCCH transmission is referred as localized. Opposite, if the EREGs are distributed over several PRB pairs, the transmission is referred as distributed. The two different transmission schemes can be used depending on the availability of reliable channel feedback and knowledge about the channel state conditions. Distributed transmission for instance can be used to exploit frequency diversity.

DMRSs associated with EPDCCH are transmitted on antenna ports AP 107 to AP 110. In the resource blocks mapping grid, these APs replace the AP 7 to AP 10 used for DMRS. See also Figure 2-13.

DMRSs for EPDCCH are scrambled with higher layer user-specific identifier $n^{EPDCCH}_{ID,m}$, where m = 0 or 1 and indicates the EPDCCH set.

Related settings

See:

- Chapter 4.3.5, "EPDCCH configuration settings", on page 156
- "(E)PDCCH" on page 195
- DCI Format 2/2A/2B/2C/2D > "HARQ-ACK Resource Offset"

Coordinated multi-point operation for LTE (CoMP)

CoMP is a new interference mitigation technique that aims to improve coverage of high data rates and increase cell-edge throughput. CoMP also aims to optimize the transmission and reception from multiple transmission points (TP). A TP is a term that describes the location, where the transmission physical occurs. TPs can be the sectors on the same site, different remote radio heads (RRH), or different cells for example.

In CoMP scenarios, a UE can receive signals from up to 3 transmission points (TP). During reception, the UE is unaware which of the TP is transmitting. All TPs transmitting to a particular UE can use the same scrambling sequence for generation of the user-specific reference signals (DMRS). The same applies for the cell-specific reference signals (CSI-RS).

According to TS 36.211, the CSI-RS sequence is generated as a function of the variable N_{ID}^{CSI}, where $N_{ID}^{CSI} = N_{ID}^{cell}$ unless configured by higher layers. The CSI-RS sequence can be initialized with the cell identity as it is in the legacy systems and if CoMP is used, it can be initialized with "virtual cell ID". The latter is introduced to support measurements from different TPs.

According to TS 36.211, the demodulation reference signals (DMRS) for PDSCH are generated as a function of the variable n_{ID} and n_{SCID}.

- Up to LTE Rel. 11, the $n_{ID} = N_{ID}^{cell}$.
  The DMRS sequence is initialized with the physical cell identity (PCI) N_{ID}^{cell}.
- In LTE Rel. 11, the following applies:
  – $n_{ID} = N_{ID}^{cell}$ or
  – If signaled by the DCI or higher-level, $n_{ID} = n_{ID}^{DMRS,i}$
    Where i = 0, 1 and $n_{ID}^{DMRS,i}$ are two DMRS scrambling identity.
- The n_{SCID} is the scrambling identity and it is n_{SCID} = 0 or given by the corresponding field of DCI format 2B, 2C or 2D.

Related settings

See:

- Chapter 4.3.6, "Scrambling configuration settings", on page 161
- "DCI Format 2/2A/2B/2C/2D" on page 208
  – DCI format 2C and 2D: "Ant. Port(s), Layers, SCID"
  – DCI format 2B: "Scrambling Identity"
- "Scrambling Identity n_SCID" on page 215

Transmission mode TM10 and DCI format 2D

The TM10 is intended for multi-layer PDSCH transmission with up to eight layers and in case of coordinated multi-point operation (CoMP).

The transmission mode TM10 is similar to the transmission mode TM9. It uses DCI format 2D that serves the same purpose as the DCI format 2C does for the TM9. Both formats carry the same information fields but the DCI format 2D comprises four additional bits. The first two indicate one of four pre-configured sets of parameters and are related to the rate matching information and the QCL (quasi-co-located) indicator.

Related settings

See:

- "Tx Modes" on page 142
- "Transmission Scheme" on page 213
- "DCI Format" on page 195
- "DCI Format 2/2A/2B/2C/2D" on page 208

2.2.7 LTE Release 12 introduction

This section gives a brief description only of the LTE-A Rel. 12 features that are covered by the software option R&S SMW-K113.

For a complete LTE-Advanced (3GPP Rel. 12) technology introduction and an insight description of the LTE-A features, refer to:

- White Paper 1MA252 "LTE-Advanced (3GPP Rel. 12) Technology Introduction"

Higher-order modulation (256QAM)

TS 36.213 adds a modulation and coding scheme index table to allow signaling of the 256QAM modulation. The new modulation and coding scheme index table is referred as MSC table 2.

Related settings

See:

- "DL Frame Configuration" > "User Configuration" > MSC Table
- "MBFSN" > Use Table 2 and Modulation
- "DL Frame Configuration" > "Subframe" > Modulation
- "DL Frame Configuration" > "Dummy Data Configuration" > Modulation

LTE TDD-FDD joint operation including carrier aggregation

Combination of component carriers with TDD and FDD duplexing in both the downlink and in the uplink, including independent UL/DL configuration per component carrier.

See:

- "General UL Settings" > "CA" > Duplexing
- "General DL Settings" > "CA" > Duplexing

Enhanced interference mitigation & traffic adaption (eIMTA)

eIMTA (enhanced interference mitigation & traffic adaptation) is an enhancement to LTE TDD for UL-DL interference and load management. This feature is also known as dynamic or flexible TDD.

If eIMTA is used, an eNodeB can change the TDD pattern (TDD UL/DL Configuration) on a frame basis and adapt the frame structure to the traffic. That is, an eNodeB can decide to reconfigure a subset of the UL and special subframes to DL subframes. LTE-Advanced UEs that support eIMTA can receive DL transmissions in these subframes. An eNodeB does not send an UL DCI to legacy UEs for these subframes, so that legacy UEs cannot schedule UL transmissions in these subframes.

The following layer 1 parameters are supported:

- Dedicated eIMTA-RNTI used for CRC scrambling of the PDCCH
  See "DL Frame Configuration" > "User Configuration" > eIMTA-RNTI
- Modified DCI format 1C that indicates the UL/DL configuration numbers (1, 2, ...I).

Each UL/DL configuration number consist of 3 bits and corresponds to one of the UL/DL configurations (see Figure 2-5). Each UL/DL configuration is applied for a specific number of frames, where the number of frames is signaled by higher levels.
See "DL Frame Configuration" > "PDCCH" > "DCI Table" > DCI Format 1C for eIMTA.

According to TS 36.212, further parameters are set by higher-level signaling.

Further DL MIMO enhancements (enhanced 4Tx codebook)

To achieve better system throughput, Rel. 12 introduces a new enhanced 4Tx codebook as one of the DL MIMO enhancements.

The enhanced 4Tx codebook is specified in TS 36.213.

Figure 2-32 shows an example of the single-layer case. For reference information on all codebooks, see TS 36.213.

i_1	i_2							
	0	1	2	3	4	5	6	7
0 – 15	$W^{(1)}_{i_1,0}$	$W^{(1)}_{i_1,8}$	$W^{(1)}_{i_1,16}$	$W^{(1)}_{i_1,24}$	$W^{(1)}_{i_1+8,2}$	$W^{(1)}_{i_1+8,10}$	$W^{(1)}_{i_1+8,18}$	$W^{(1)}_{i_1+8,26}$
i_1	i_2							
	8	9	10	11	12	13	14	15
0 - 15	$W^{(1)}_{i_1+16,4}$	$W^{(1)}_{i_1+16,12}$	$W^{(1)}_{i_1+16,20}$	$W^{(1)}_{i_1+16,28}$	$W^{(1)}_{i_1+24,6}$	$W^{(1)}_{i_1+24,14}$	$W^{(1)}_{i_1+24,22}$	$W^{(1)}_{i_1+24,30}$

where $W^{(1)}_{m,n} = \frac{1}{2}\begin{bmatrix} v'_m \\ \varphi'_n v'_m \end{bmatrix}$

Figure 2-32: Codebook for 1-leyer CSI reporting [1MA252, TS 36.213]

See:
- "Use Alternative Codebooks" on page 227
- "Use Alternative Codebooks" on page 215

2.2.8 LTE Release 13/14 introduction

This section gives a brief introduction only of the LTE-A Rel. 13 features that are covered by the software option R&S SMW-K119.

For technical details, refer to the 3GPP Rel. 13 specifications TS 36.211, TS 36.212 and TS 36.213.

Up to LTE Rel. 12, all LTE networks use licensed spectrum bands. LTE Rel. 13 adds among others the downlink LAA (license assisted access) functionality. It enhances the carrier aggregation concept to use the unlicensed 5 GHz spectrum of the ISM (industrial, scientific and medical) band.

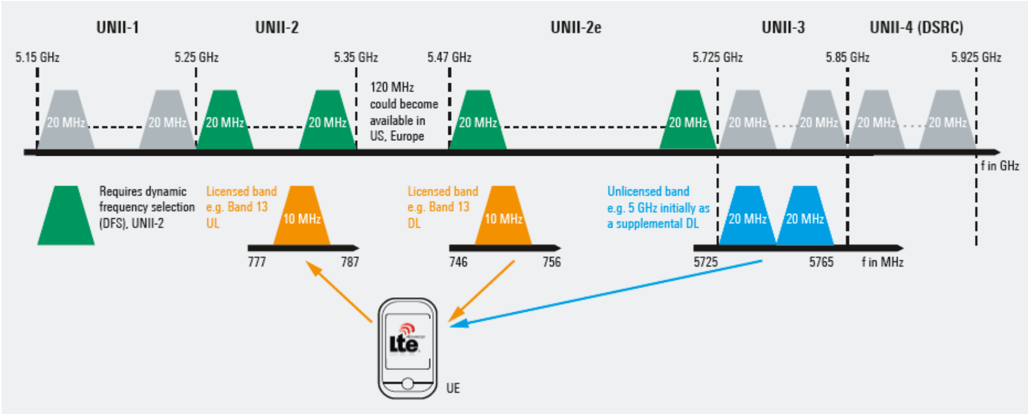


Figure 2-33: Carrier aggregation of licensed and unlicensed spectra [Rohde & Schwarz poster "Evolution of Carrier Aggregation (3GPP Releases 10 to 13)"

Mechanisms for spectrum sharing

Since the unlicensed spectrum has to be shared fairly, LTE is extended to include the following mechanisms:

- Clear channel assessment (CAA) based on listen-before-talk (LTB) functionality
- Discontinuous transmission (DTX) on a carrier with maximum channel occupancy time (MCOT)
- Dynamic frequency selection (DFS) for radar avoidance in certain bands

LAA SCells

Foreseen is a carrier aggregation of up to five component carriers, where the PCell must be within the licensed spectrum. Up to four component carriers (SCells) can use unlicensed frequency bands and span a 20 MHz channel bandwidth. Each component carrier can use a 2x2 MIMO operation. LAA SCells support only downlink operation by using frame structure type 3 with normal cyclic prefix (CP). LAA SCells do not support transmission modes 5, 6 and 7 for PDSCH.

Related settings

See:

- "General DL Settings > Carrier Aggregation" > Duplexing

2.2.8.1 Frame structure type 3 (LAA) and partial subframes

The frame structure type 3 is applicable for LAA SCells. It allows DL transmission in bursts with burst duration of up to 10 ms, where the 10 ms correspond to the allowed MCOT. Except from the discovery reference signal (DRS), channels cannot be sent outside the bursts.

LAA SCell using frame structure type 3 is always regarded as FDD component carriers. Hence, depending on the duplexing mode the PCell uses, the resulting configuration is FDD only or carrier aggregation with mixed TDD-FDD component carriers.

Radio frames with frame structure type 3 are 10 ms, composed of 20 slots with length of 0.5 ms each. Two consecutive slots build a subframe. Downlink transmission uses one or more consecutive subframes, starting **at the first or seventh symbol** within a subframe and ending with the last subframe. The last subframe can be either fully occupied or following one of the DwPTS durations, specified for frame structure type 2 (see "Frame structure type 2 (TDD)" on page 22).

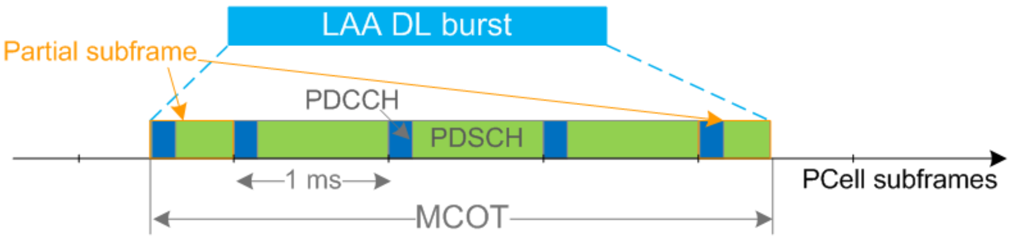


Figure 2-34: DL LAA burst transmission

LAA DL burst = Example of burst consisting of 3 consecutive and 2 partial subframes
PCell = LTE primary cell
MCOT = Maximum channel occupancy time ≤ 10 ms
1 ms = LTE PCell and LAA SCell slot duration
PDCCH, PDSCH = Channels are always sent within the bursts
Partial subframe = Starting at second slot boundary and ending as a DwPTS subframe

Partial subframes

LTE Rel. 13 introduces the concept of partial subframes, where the following applies:

- Starting subframe
  LAA DL burst can start at the LTE subframe boundary (`subframeStartPositon`) or at the boundary of the second slot of a subframe (`secondSlotStartingPositon`).
  A partial starting subframe is followed by a subframe with all symbols used.
- Ending subframe `n`
  The last subframe of a LAA DL burst can end on the LTE subframe boundary or on a symbol boundary as in DwPTS (`endingDwPTS`)
  Thus, the duration of the last subframe of a DL LAA burst can consist of 14 OFDM symbols or of 3, 6, 9, 10, 11 or 12 OFDM symbols. Where the lalter corresponds to the Downlink Pilot Time Slot (DwPTS) structure of the TDD frame.
  Ending subframe is configured by the dedicated DCI format 1C, see Chapter 2.2.8.2, "DCI format 1C", on page 57.

Related settings

See:

- "DL Frame Configuration" > LAA

2.2.8.2 DCI format 1C

DCI format 1C carries the field "Subframe Configuration for LAA" which specifies the number of symbols to be used for transmission.

Assuming `n` is the last subframe, DCI format 1C can be sent in the following ways:

- **`n` or `n-1`**:
  In the next-to-last subframe (`n-1`) or in the last subframe `n`.
- **`n` and `n-1`**:
  If present in both, then both subframes have to use identical subframe configuration.
- **`n`**:
  If "Subframe Configuration for LAA < 14", no other physical channels are sent in subframe `n`

Related settings

See:

- "DL Frame Configuration > (E)PDCCH > DCI Table" > User
- "DL Frame Configuration > (E)PDCCH > DCI Table > DCI Format = 1C" > DCI Format 1C for LAA

2.2.8.3 Physical channels and signals in an LAA SCell

LAA SCell supports:

- PDSCH, (E)PDCCH, CRS, CSI-RS and DRS

LAA SCell does not support:

- PHICH, PBCH and PMCH

Discovery reference signal (DRS)

DRS is 1ms (or 12 OFDM symbols) long and is transmitted at most once in any subframe during periodical occasions refereed as DRS measurement timing configuration (DMTC). The DMTC occasions have duration of 6 ms and a configurable period of 40 ms, 80 ms or 160 ms.

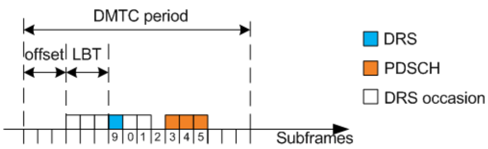


Figure 2-35: DRS allocation

DRS	= Discovery reference signal
LBT	= Listen-before-talk
DMTC	= DRS measurement timing configuration
DRS occasion	= Subframes during the DMTC period where DRS can occur
PDSCH	= Physical DL shared channel

If part of DRS, PSS and SSS are always transmitted, regardless of the subframe where the DRS occasion appears. Simultaneous transmission of DRS and PDSCH/(E)PDCCH is allowed in subframe#0 and subframe#5.

Related settings

See:

- "General DL Settings > Signals" > "DRS"
- "General DL Settings > Signals > DRS" > CSI-RS > "Config"

2.2.8.4 Full dimension MIMO (FD-MIMO)

Full Dimension MIMO is a MIMO method that employs antennas capable of beam steering in the 3D space. This 3D steering is realized by an antenna system that can form horizontal and vertical beams.

A vertical beam steering allows for focusing on different floor of a multi-story building, whereas horizontal beams facilities MU-MIMO transmission, as described in Chapter 2.2.5.3, "Enhanced MIMO schemes", on page 49. Antenna focusing in the vertical axis is also known as elevation beam steering; similarly, the horizontal one is referred to as azimuth beam steering.

Precise 3D beam steering requires measuring and reporting channel state information for each beam separately. The CSI-RS structure specified in the LTE standards up to LTE Rel. 12 is sufficient for the MU-MIMO case but not for the requirements of the 3D MIMO scenarios.

Thus, LTE Rel. 13 extends the specification to include multiple CSI-RS configurations per cell. It also extends the range of supported antenna ports by allowing transmission on AP 23 to AP 46. Moreover, it introduces a CDM scheme to support the mapping to the physical resources.

According to TS 36.211, CSI reference signals are transmitted on 1, 2, 4, 8, 12, 16, 20, 24, 28, or 32 antenna ports. Since there are a total number of 32 antennas and eight different CSI configurations, the specification limits the amount of possible combination by applying an aggregation rule. Table 2-8 lists the possible combinations.

Table 2-8: Aggregation of CSI-RS configurations [TS 36.211]

Total number of antenna ports $N_{res}^{CSI}*N_{ports}^{CSI}$	Number of antenna ports per CSI-RS configuration N_{ports}^{CSI}	Number of CSI-RS configurations N_{res}^{CSI}
12	4	3
16	8	2
20	4	5
24	8	3
28	4	7
32	8	4

Related settings

See:

- Chapter 4.2.7.4, "CSI-RS settings", on page 116

- Chapter 4.5, "DL antenna port mapping settings", on page 222

2.2.8.5 PUCCH formats 4 and 5

From LTE Rel. 14 on, the specification is extended with carrier aggregation of up to 32 carriers, both in the downlink and in the uplink direction. For the carrier aggregation in uplink, two new PUCCH formats are defined, PUCCH format 4 and PUCCH format 5.

Carrier aggregation with more than 5 carriers is not supported by the current firmware version, but you can configure the PUCCH formats. Other than in all other PUCCH formats, PUCCH format 4 spans more than one contiguous resource blocks and thus uses larger resource block in the time domain.

For overview information on the PUCCH formats, see Chapter 2.2.2.3, "Uplink control information transmission", on page 37.

Related settings

See:

- "Range n(4)_PUCCH/Range n(5)_PUCCH" on page 255
- "Number of Antenna Ports for PUCCH per PUCCH Format" on page 269
- Chapter 4.10, "Enhanced PUCCH settings", on page 333

2.2.8.6 TDD special subframe configuration 10

From LTE Rel. 13 on, the specification is extended to support special subframe configuration 10, both in the downlink and in the uplink direction. The PUSCH in UpPTS follows a cell-specific configuration and can be configured independently for each user.

For overview information on the TDD frame structure, see "Frame structure type 2 (TDD)" on page 22.

Related settings

See:

- Chapter 4.2.6, "TDD frame structure settings", on page 108
- "TDD Special Subframe Config" on page 83
- "TDD Special Subframe Config" on page 237
- "PUSCH in UpPTS" on page 278

2.2.8.7 DMRS enhancements and DCI format 2C/2D

Starting from LTE Rel. 13, the transmission modes TM9 and TM10 can utilize new antenna ports, the AP11 and AP13, for one or two-layer transmissions and for transmit diversity.

DCI format 2C/2D carry the field "Ant. Port(s), Layers, SCID" which specifies the combination of used antenna ports, scrambling identity and number of layers (TS 36.212).

The value range of this field depends on the higher-layer parameters semiOpenLoop and dmrs-tableAlt.

Related settings

See:

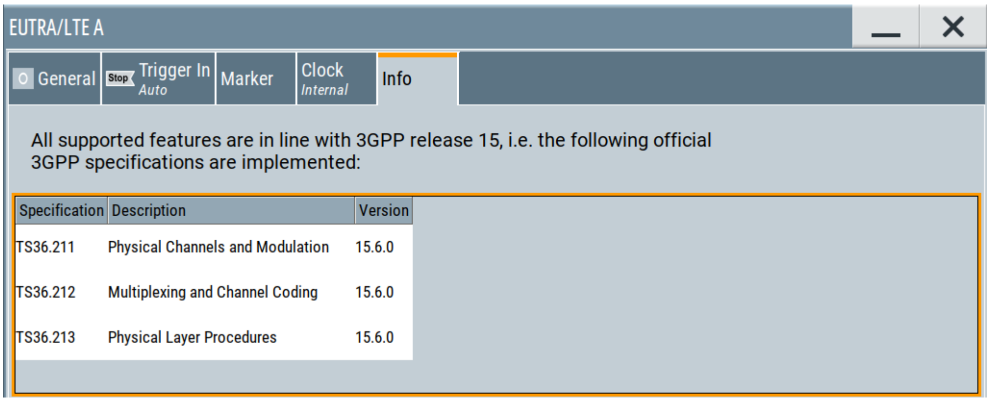
- "DL Frame Configuration > General > Configure User > Tx Mode = TM9|TM10" > DMRS Alt Table and Semi Open Loop
- "DL Frame Configuration > (E)PDCCH > DCI Table > DCI Format = 2C/2D" > DCI Format 2/2A/2B/2C/2D
- "DL Frame Configuration > General > Configure User > Tx Mode = TM9|TM10 > Antenna Mapping > Config" > User-Specific Antenna Port Mapping
- "DL Frame Configuration > Subrame > PDSCH > Enchanced Settings > Config" > Number of Layers, Antenna Ports and Mapping Table

3 Find out the implemented 3GPP specification

The Info dialog displays the currently supported version of the 3GPP standard.

Access:

► Select "EUTRA/LTE > Info".



The default settings and parameters provided are oriented towards the specifications of the version displayed.

Remote command:

`[:SOURce]:BB:EUTRa:VERSion?` on page 687

4 EUTRA/LTE configuration and settings

Access:

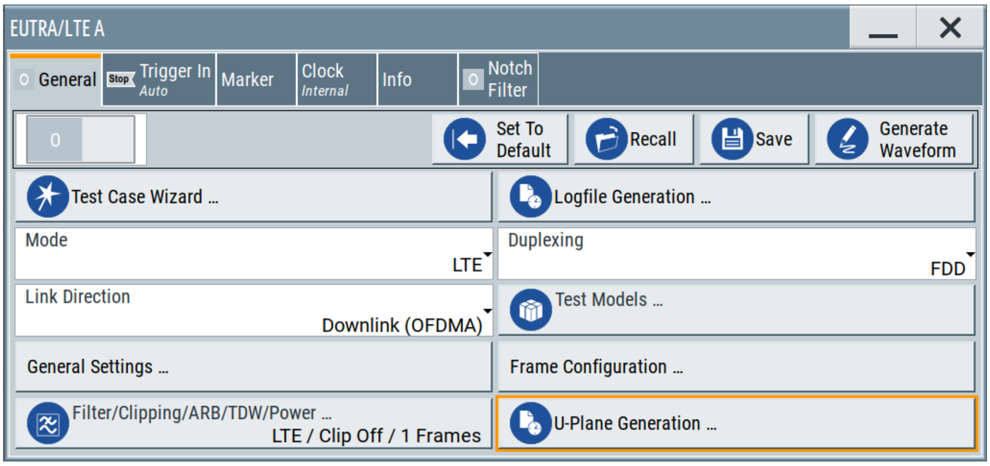
► Select "Baseband > EUTRA/LTE".

The remote commands required to define these settings are described in Chapter 11, "Remote-control commands", on page 681.

4.1 General settings

Access:

► Select "Baseband > EUTRA/LTE > General".



This dialog comprises the standard general settings, to the default and the "Save/Recall" settings, as well as setting for defining the link direction or the used duplexing mode and access to dialogs with further settings. The choice of link direction determines which parameters are available.

Provided are the following settings:

State

Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Remote command:
[:SOURce<hw>]:BB:EUTRa:STATe on page 683

Set to Default

Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Values
State	Not affected by "Set to Default"
Duplexing	FDD
Link Direction	Downlink (OFDMA)
Sequence Length	1 Frame
DL Channel Bandwidth	10 MHz
Physical Resource Block Bandwidth	12 * 15 kHz
Number Of Resource Blocks per Slot	50
Occupied Bandwidth /MHz	9.015
Sampling Rate /MHz	15.360
FFT Size	1024
Cell ID	0
Cyclic Prefix	Normal
PHICH Duration	Normal
Global MIMO Configuration	1 TxAntenna
Simulated Antenna	Antenna 1

Remote command:
[:SOURce<hw>]:BB:EUTRa:PRESet on page 685

Save/Recall
Accesses the "Save/Recall" dialog, i.e. the standard instrument function for storing and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The file name and the directory it is stored in are user-definable; the file extension is however predefined.

See also, chapter "File and Data Management" in the R&S SMW user manual.

Remote command:
[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog on page 685
[:SOURce<hw>]:BB:EUTRa:SETTing:LOAD on page 685
[:SOURce<hw>]:BB:EUTRa:SETTing:STORe on page 686
[:SOURce<hw>]:BB:EUTRa:SETTing:DEL on page 685

Generate Waveform
With enabled signal generation, triggers the instrument to save the current settings of an arbitrary waveform signal in a waveform file with predefined extension `*.wv`. You can define the filename and the directory, in that you want to save the file.

Using the ARB modulation source, you can play back waveform files and/or process the file to generate multi-carrier or multi-segment signals.

If the current configuration uses coupled baseband sources with more than one Tx antenna (for example "System Config > Baseband (Tx Antennas) = 2"), with this function you trigger the software to generate the signals of all antennas. Created is a subset of waveform files, where the number of files corresponds to the number the currently simulated antennas and the file names have the following structure:
`<user-defined file name><antenna#-1>.wv`.

Example:

Select "System Config > Fading/Baseband Config > Mode > Advanced"

Select "System Config > Fading/Baseband Config > Baseband (Tx Antennas) = 4"

Select "System Config > Fading/Baseband Config > BB Source Config > Coupled"

Select "Baseband > EUTRA/LTE > General > State > On"

Select "EUTRA/LTE > General > Generate Waveform > On"

In the "Generate Waveform" dialog, use the default directory and enter "File Name = lte".

Select [SAVE/RCL], select "File/Recall > File Manager" and in the directory tree open the default directory.

Displayed are four files, `lte.wv`, `lte1.wv`, `lte2.wv` and `lte3.wv`.

Note: If realtime feedback is used, the waveform file is generated as if realtime feedback is not used, see Chapter 5.6, "Real-time feedback configuration settings", on page 356

Remote command:
[:SOURce<hw>]:BB:EUTRa:WAVeform:CREate on page 687

Test Case Wizard
Accesses the "Test Case Wizard" dialog, see Chapter 8, "Performing BS tests according to TS 36.141", on page 531.

Logfile Generation
Option: R&S SMW-K81

Accesses the dialog for configuring the settings for generation of logfiles.

For description, see R&S SMW LTE/5G Logfile Generation user manual.

Mode
In instruments equipped with options R&S SMW-K55 and R&S SMW-K115, selects the standard to that the displayed settings belong.

If the instrument is equipped with one of these two options, the corresponding mode is selected automatically but the parameter "Mode" is not displayed.

"Mode"	Description	Required options
"LTE"	Standalone LTE IoT related settings and parameters are hidden.	R&S SMW-K55 (optionally also R&S SMW-K85)
"eMTC/NB-IoT"	Standalone IoT Configuration of parameters specified only for LTE is not possible.	R&S SMW-K115
"LTE/eMTC/NB-IoT"	Mixed LTE and IoT Allows mixed LTE and IoT configurations, for example for interoperability tests.	R&S SMW-K55 and R&S SMW-K115

Remote command:
[:SOURce<hw>]:BB:EUTRa:STDMode on page 684

Duplexing
Selects the duplexing mode. The duplexing mode determines how the uplink and downlink signals are separated.

"TDD" In TDD mode, the same frequency is used for both directions of transmission (uplink and downlink). With one baseband, either only downlink or only uplink can be generated.

"FDD" In FDD mode, different frequencies are used for downlink and uplink directions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DUPLexing on page 684

Link Direction
Selects the transmission direction.

"Downlink (OFDMA)"
The transmission direction selected is base station to user equipment. The signal corresponds to that of a base station. For the downlink, the physical layer mode is always set to OFDMA.

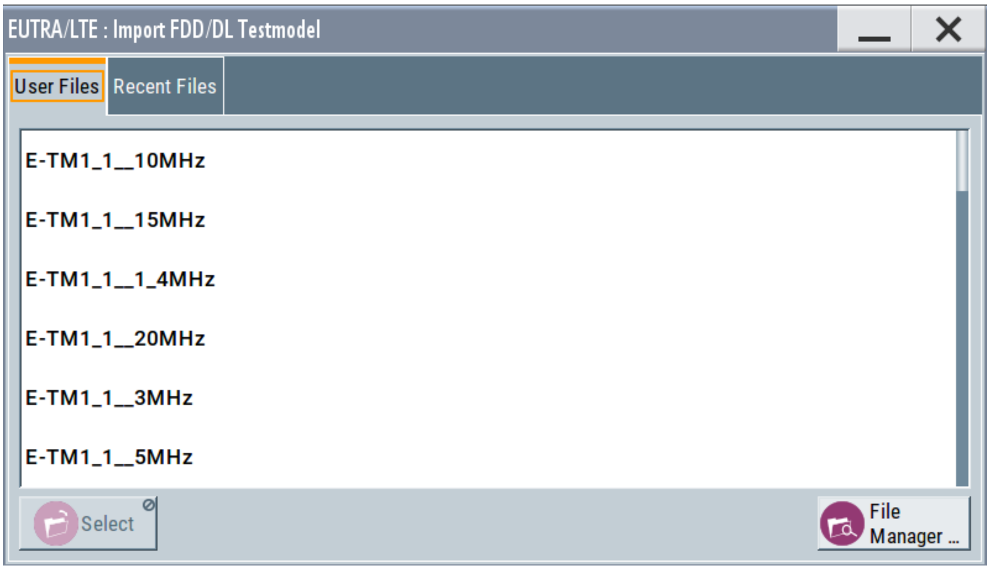
"Uplink (SC-FDMA)"
The transmission direction selected is user equipment to base station. The signal corresponds to that of a user equipment. For the uplink, the physical layer mode is always set to SC-FDMA.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:LINK` on page 684

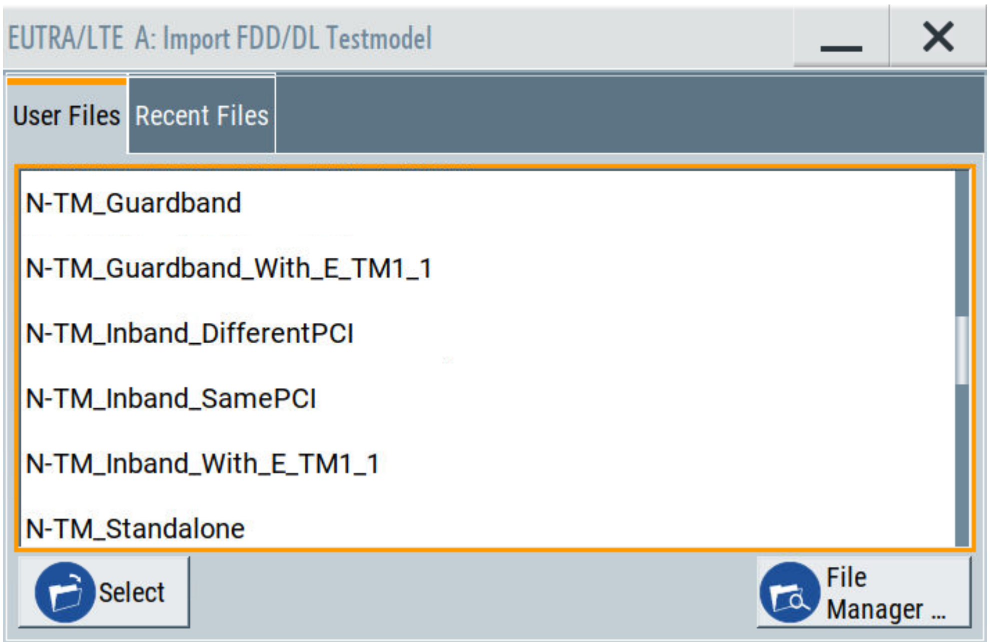
Test Models

Accesses a dialog for selecting of:

- One of the EUTRA Test Models (E-TM) defined in TS 36.141



- One of the NB-IoT Test Models (N-TM) defined in TS 36.141.



- Self-defined test setups
  Use "Recent Files" button to display the files last used.
  "File Manager" button opens the dialog to load or save configuration files. See also the section File and Data Management in the R&S SMW user manual.

The DL test models are predefined configurations of LTE settings. Three main groups of test models are defined, the E-TM1, E-TM2 and E-TM3. All test models use the following parameters:

- Single antenna port, single codeword, single layer and no precoding
- Duration of one frame
- Normal cyclic prefix
- Localized virtual resource blocks, no intra-subframe hopping for PDSCH
- UE-specific reference signals are not used

The data content of the physical channels and signals is defined in the 3GPP specification. Each test model is defined for six different channel bandwidths: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz. The test models are defined for specific test purpose.

EUTRA test model	Defined for tests on
E-TM1.1	• BS output power • Unwanted emissions • Transmitter intermodulation • RS absolute accuracy
E-TM1.2	• ACLR • Operating band unwanted emissions
E-TM2	• Total power dynamic range (lower OFDM symbol power limit at min power) • EVM of single 64QAM PRB allocation (at min power) • Frequency error (at min power)
E-TM2a	• Total power dynamic range (lower OFDM symbol power limit at min power for 256QAM) • EVM of single 256QAM PRB allocation (at min power) • Frequency error (at min power)

EUTRA test model	Defined for tests on
E-TM2b	• Total power dynamic range (lower OFDM symbol power limit at min power for 1024QAM) • EVM of single 1024QAM PRB allocation (at min power) • Frequency error (at min power)
E-TM3.1	• Output power dynamics • Transmitted signal quality (Frequency error and EVM for 64QAM modulation, at max power)
E-TM3.1a	• Output power dynamics for 256QAM • Transmitted signal quality (Frequency error and EVM for 256QAM modulation, at max power)
E-TM3.1b	• Output power dynamics for 1024QAM • Transmitted signal quality (Frequency error and EVM for 1024QAM modulation, at max power)
E-TM3.2	Transmitted signal quality: • Frequency error • EVM for 16QAM modulation
E-TM3.3	Transmitted signal quality: • Frequency error • EVM for QPSK modulation
E-TM3.2	Transmitted signal quality: • Frequency error • EVM for 16QAM modulation
E-TM3.3	Transmitted signal quality: • Frequency error • EVM for QPSK modulation

The NB-IoT DL test models (N-TM) are predefined configurations of settings for NB-IoT tests. Supported are the following N-TMs:
- NB-IoT guard band operation
- NB-IoT guard band operation in combination with LTE E-TM1.1 carriers
- NB-IoT in-band operation, where NB-IoT and LTE use different PCIs
- NB-IoT in-band operation, where NB-IoT and LTE share the same PCI
- NB-IoT in-band operation in combination with LTE E-TM1.1 carriers
- NB-IoT standalone operation

According to TS 36.141, all test models use the following parameters:
- Single antenna port
- Duration of 10 subframes or 10 ms
- Normal cyclic prefix
- The ration of synchronization signal EPRE and NRS EPRE is 0 dB
- NPDCCH format 1

With the option R&S SMW-K175 for O-RAN, the following test models in line with 3GPP TC 32.37x specifications are supported:
- ORAN-TC32371__x_yMHz
- ORAN-TC32372__x_yMHz
- ORAN-TC32373__x_yMHz
- ORAN-TC32374__x_yMHz
- ORAN-TC32375__x_yMHz
- ORAN-TC32376__x_yMHz
- ORAN-TC32376_TM3__x_yMHz

- ORAN-TC32376_TM4__x_yMHz

Where x ∈ {FDD, TDD}

Where y ∈ {1_4, 3, 5, 10, 15, 20}

Example: ORAN-TC32371__FDD_1_4MHz, ORAN-TC32376_TM3__TDD_5MHz

Remote command:
`[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:DL` on page 686
`[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:TDD` on page 686

General DL Settings/General UL Settings
Accesses the "General DL Settings / General UL Settings" dialog for configuring the EUTRA/LTE system.

For description of the available settings, refer to Chapter 4.2, "General DL settings / general TDD DL settings", on page 71 and Chapter 4.6, "General UL settings", on page 229 respectively.

Remote command:
n.a.

Frame Configuration
Accesses the "Frame Configuration" dialog for configuring the allocation of the resource blocks to the different users, as well as the configuration of the users.

The available settings depend on the selected link direction. For description, refer to Chapter 4.3, "DL frame configuration settings", on page 136 and Chapter 4.7, "UL frame configuration settings", on page 255 respectively.

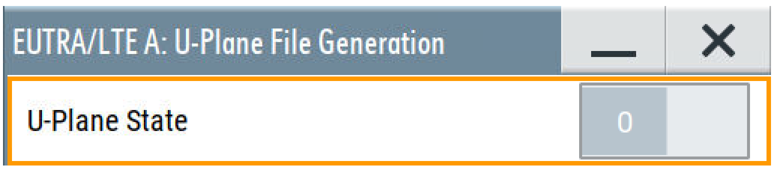
Remote command:
n.a.

Filter/Clipping/ARB/TDW/Power Settings
Accesses the dialog for setting baseband filtering, clipping, and the sequence length of the arbitrary waveform component, see Chapter 10.2, "Filter/clipping/ARB settings", on page 655.

U-Plane Generation
Option: R&S SMW-K175

Opens a dialog to turn user plane data generation according to the O-RAN standard on and off.

The selected mode (Baseband > EUTRA/LTE > General > Mode) specifies the type of data to be generated: LTE, NB-IoT, or both.



For the supported O-RAN test models, see "Test Models" on page 67

For more information, see Chapter 9, "Generating user plane data", on page 652.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UPLane:STATe` on page 688

4.2 General DL settings / general TDD DL settings

The "General DL Settings" dialog allows you to configure the EUTRA/LTE system for transmission direction downlink, i.e. the signal of one BS or one cell.

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings".

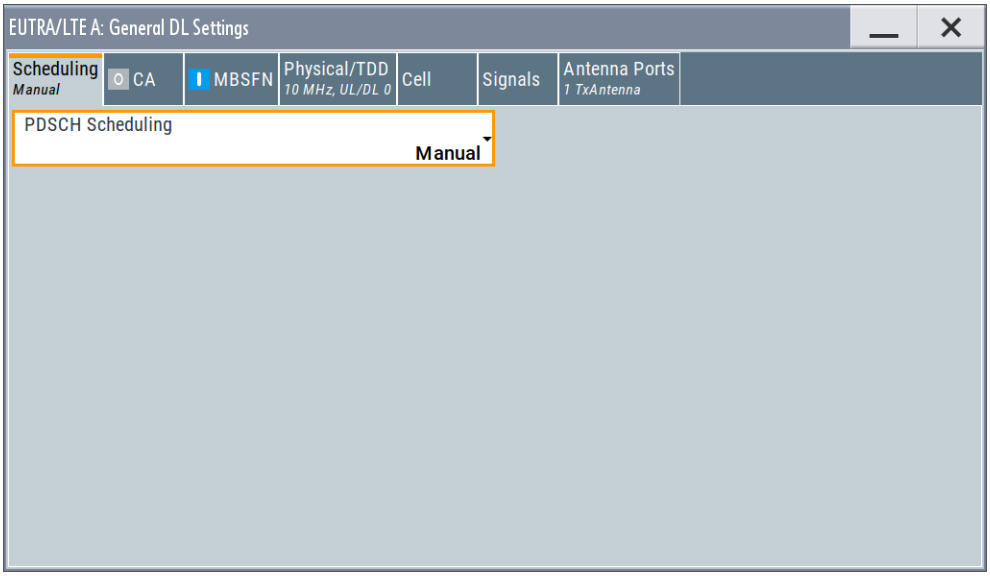
   The EUTRA/LTE standard defines no differences between TDD and FDD signals on the physical layer if only one link direction is considered at once. Therefore, the "General TDD DL Settings" dialog comprises the same parameters as the "General DL Settings" dialog but is extended with the TDD frame structure settings tab.
   The "General DL Settings" dialog consists of several sections:

4.2.1 PDSCH scheduling settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".

2. Select "General Settings > Scheduling".



In the "Scheduling" section, you define whether the PDSCH Scheduling is performed manually, according to the configuration made for the DCIs or according to the required HARQ processes and redundancy versions.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CONF:MODE` on page 711

Overview of the scheduling methods

In the R&S SMW, there are different approaches to configure and schedule the different PDSCH allocations:

- Manually and with full flexibility ("Manual")
  This is the default scheduling mode and the mode with full flexibility; you can configure any of the available settings.
  There is no cross-reference between the settings made for the PDCCH DCIs and the PDSCHs settings. The configuration is performed on a subframe basis and you are responsible for the content of the PDSCH allocations.
- According to the configuration made for the DCIs ("Auto/DCI")
  This is the mode supporting you to configure the precoding settings for spatial multiplexing according to TS 36.211.
  This mode assures a 3GPP compliant EUTRA/LTE signal and the PDSCH allocations are configured automatically according to the configuration of the PDCCH DCIs.
  There are however limitations in the configuration flexibility, especially regarding the power setting, see "Limitations and interdependencies in the Auto/DCI and Auto Sequence modes" on page 73.
  See also "Switching between "Auto/DCI" and "Manual" modes" on page 73.

Limitations and interdependencies in the Auto/DCI and Auto Sequence modes

The generation of a compliant signal requires some limitations in the configuration flexibility, especially regarding the power setting:

- The value of the parameter Reference Signal Power is fixed to 0dB.
- The PDSCH Rho A of each allocation belonging to a user is set as configured with the parameter P_A for the corresponding user in the "Configure User" dialog.
- All four users are activated with enabled Scrambling and Channel Coding.
- Not all combinations of DCI Table, Users and UE_ID/n_RNTI are allowed, see Table 4-1.

Table 4-1: DCI Formats dependencies

User	UE ID/n_RNTI	DCI Format
User x	As defined for the corresponding user	0,1,1a,1b,1d,2,2a,2c,3,3a
P-RNTI	65534	1a,1c
SI-RNTI	65535	
RA-RNTI	As defined with the parameter "General DL Setting" > RA_RNTI	

Switching between "Auto/DCI" and "Manual" modes

- Switching from "Auto/DCI" mode to "Manual"
  Enables all parameters in the DL allocation table for configuration without to change their values.
- Switching from "Manual" to "Auto/DCI" mode
  Triggers a reset of the subframe configuration prior to reconfiguration of the PDSCH allocations according to the settings made for the PDCCH DCIs, that is the settings made in the DL allocation table are lost.

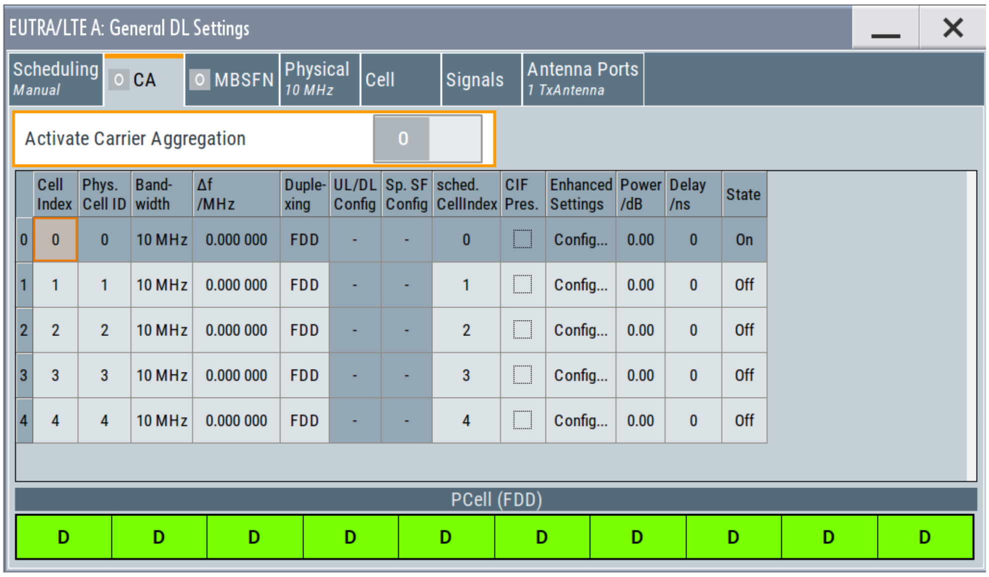
4.2.2 DL carrier aggregation configuration

Option: R&S SMW-K55 and R&S SMW-K85.

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".

2. Select "General DL Settings > CA".



The "General DL Settings > CA" dialog provides the settings for the configuration of one primary cell (PCell) and up to four secondary cells (SCell). In real system, the RRC messages signal all the relevant system information for a certain SCell. In this implementation, all relevant and configurable SCell settings are grouped in the "Carrier Aggregation" dialog. The remaining cell-specific settings are identical for all component carriers.

The available settings depend on the current "System Configuration" settings, in particular on the selected "BB Source Config".

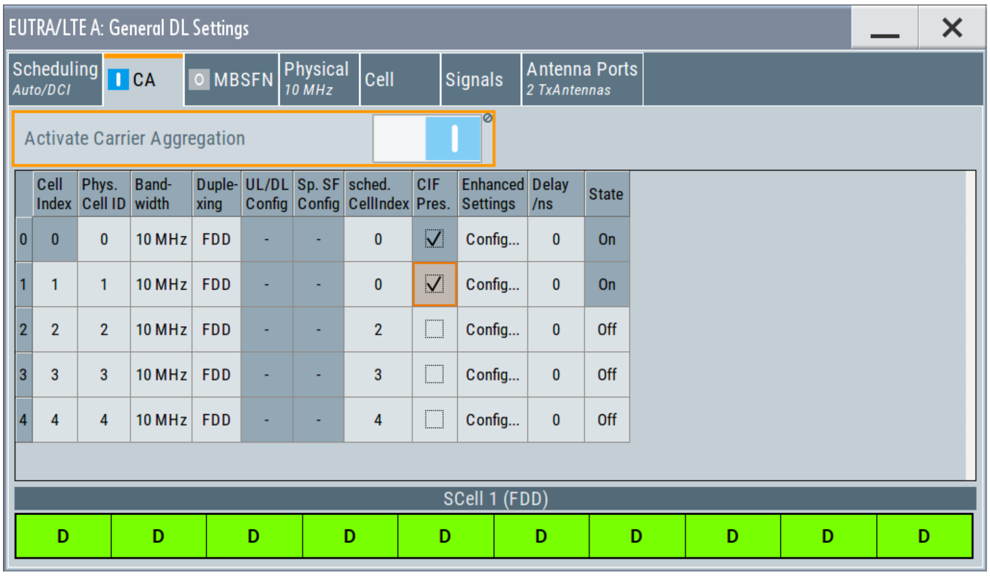


Figure 4-1: General DL Settings > Carrier Aggregation dialog in System Config > Fading and Baseband Configuration > BB Source Config > Coupled Sources

4.2.2.1 About DL carrier aggregation

This section lists implementation-related information. For background information on this topic, refer to Chapter 2.2.5, "LTE Release 10 (LTE-Advanced) introduction", on page 46.

In this description, the terms cell and component carrier (CC) are used interchangeably.

SCell settings derivation

The settings of each component carrier are calculated automatically form the configured PCell settings. They depend on the parameters in the "DL Carrier Aggregation Configuration" dialog. The following list provides an overview of the restrictions and interdependencies between related parameters if DL carrier aggregation is enabled:

- Combination of FDD and TDD is supported in "PDSCH Scheduling > Auto/DCI and Auto Sequence" modes
- Combination of TDD carriers with different UL/DL configuration or special subframe configuration is supported in "PDSCH Scheduling > Auto/DCI and Auto Sequence" modes
- Simultaneous support of LTE and LTE-A users is provided
  (See User configuration settings > Activate CA).
- To enable cross-carrier scheduling, the DCI formats are extended to support the CIF field.
  The DCIs have to be configured individually per component carrier.
- The "Control Region for PDCCH" and the PHICH parameters "PHICH Duration" and "PHICH N_g" can have different values in the component carrier. The component carriers use different Number of PHICH Groups, because the number of PHICH groups is calculated based on the parameter "N_g".
  The cell-specific settings in the "Cell" tab correspond to the configuration of the PCell.
- If a SCell spans channel bandwidth with fewer RBs than the PCell, the instrument ignores the allocations or part of the them that is outside of the SCell channel bandwidth.

Supported LTE-A bandwidth

The LTE specification defines a maximum Channel Bandwidth of 20 MHz and aggregation of up to 5 component carriers. This achieves a 100 MHz bandwidth.

The maximum bandwidth of the generated LTE-A signal depends on the installed options. Using the maximum sampling rate, the R&S SMW equipped with the options R&S SMW-B10/K522 can internally generate signals with up to 160 MHz RF bandwidth. With the options R&S SMW-B9/K527, the maximum bandwidth is up to 2 GHz.

For more information, see data sheet.

4.2.2.2 How to enable carrier aggregation and cross-carrier scheduling

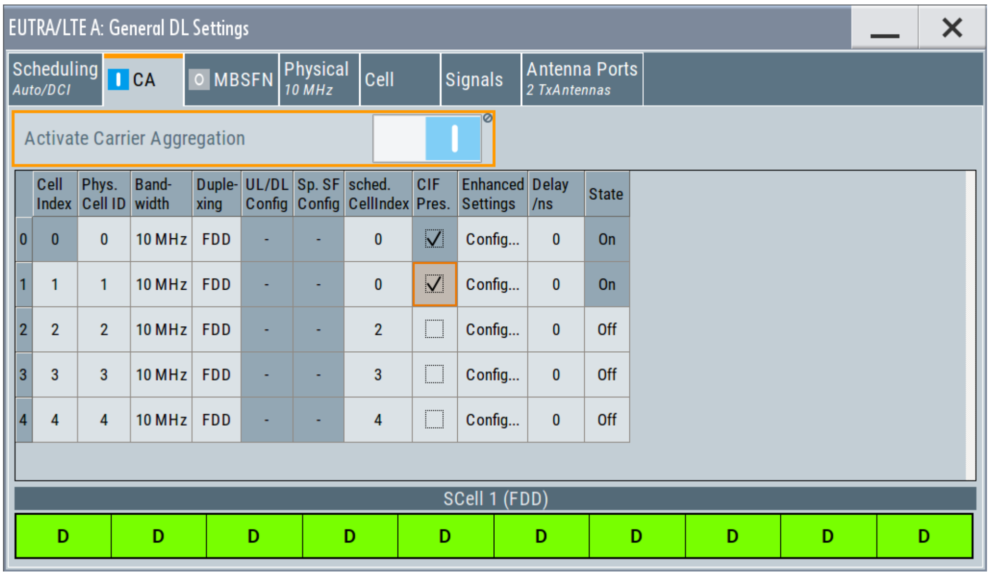
This section provides step-by-step instructions on how to use the settings to generate an LTE-A signal.

To enable carrier aggregation and cross-carrier scheduling in coupled mode

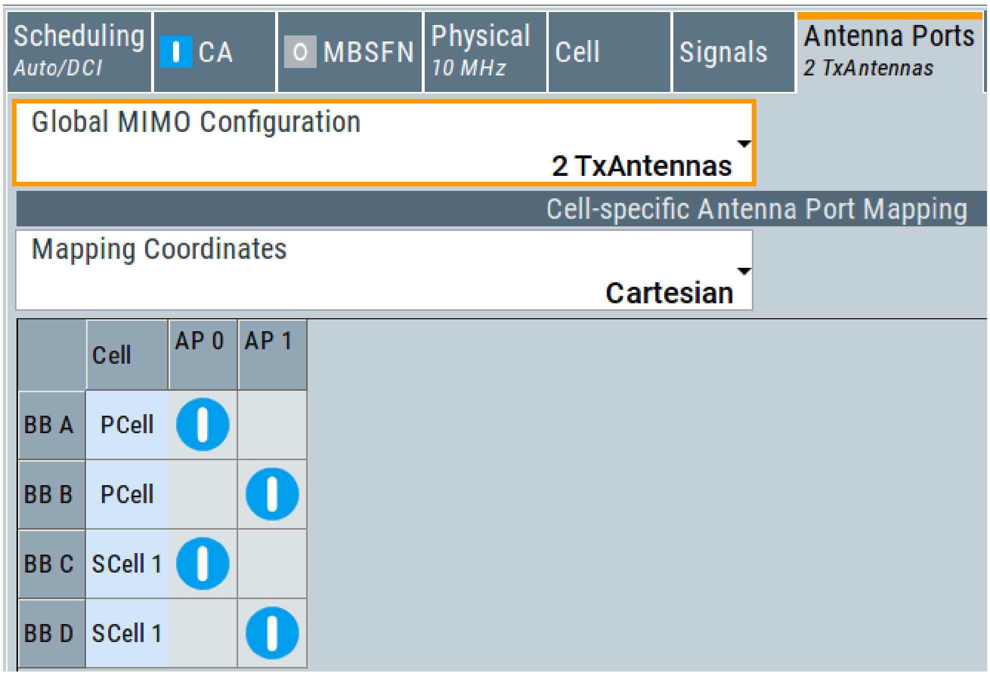
The R&S SMW generates the required signal in system configuration with *coupled* baseband sources.

1. Select "System Config > Fading and Baseband Configuration > Mode > Advanced"
2. Enable a suitable LxMxN configuration, for example:
   a) For an LTE-A carrier aggregation scenario without MIMO, enable a 2x1x1 configuration, that is "Entities = 2", "Basebands = 1", "Streams = 1"
   b) For an LTE-A carrier aggregation scenario with 2x2 MIMO each component carrier, enable a 2x2x2 configuration, that is "Entities = 2", "Basebands = 2", "Streams = 2"
3. Select "BB Source Config > Coupled Sources".
   Select "Apply".
4. For intra-band 2x2x2 scenario:
   a) Select "System Config > I/Q Stream Mapping".
      Enable "Combination > Add".
      Route the streams A and C to RF A and streams B and D to RF B.
      For more information, see the R&S SMW user manual.
   b) Apply an identical frequency offset for streams C and D, e.g. 20 MHz.
      This frequency offset determines the spacing of the two component carriers.
      For larger component carrier spacing, apply also a negative frequency offset for streams A and B.
5. Select "Baseband > EUTRA/LTE".
6. Select "General DL Settings > Scheduling > PDSCH Scheduling > Auto/DCI".
7. Select "General DL Settings > CA".

   The "Activate Carrier Aggregation > On" parameter confirms that carrier aggregation is enabled automatically. Activated are two component carrier with 10 MHz bandwidth each.
   The number of active component carriers depends on the selected "System Configuration".



8. To enable cross-carrier scheduling for the second component carrier:
   a) Set the "schedCell Index = 0".
      The component carrier SCell#1 can be cross-scheduled over the PCell.
   b) Enable the "CIF Present" parameter.
      The component carrier SCell#1 is cross-scheduled over the PCell.
9. Select "General DL Settings > Antenna Ports" to verify the configured "Cell" per Baseband (BB) configuration.



10. Select "EUTRA/LTE > DL Frame Configuration".
    Configure the settings, for example:

a) Select "User > User x > Tx Modes = 9/9".
b) Select "(E)PDCCH > Subframe#0".
   Select "Append" to add a second row in the DCI table.
c) Set the same "Cell Index = 0" to enable cross-carrier scheduling.
d) Set the "DCI Format". For example, select "DCI Format = 2C" for the 2x2x2 configuration.

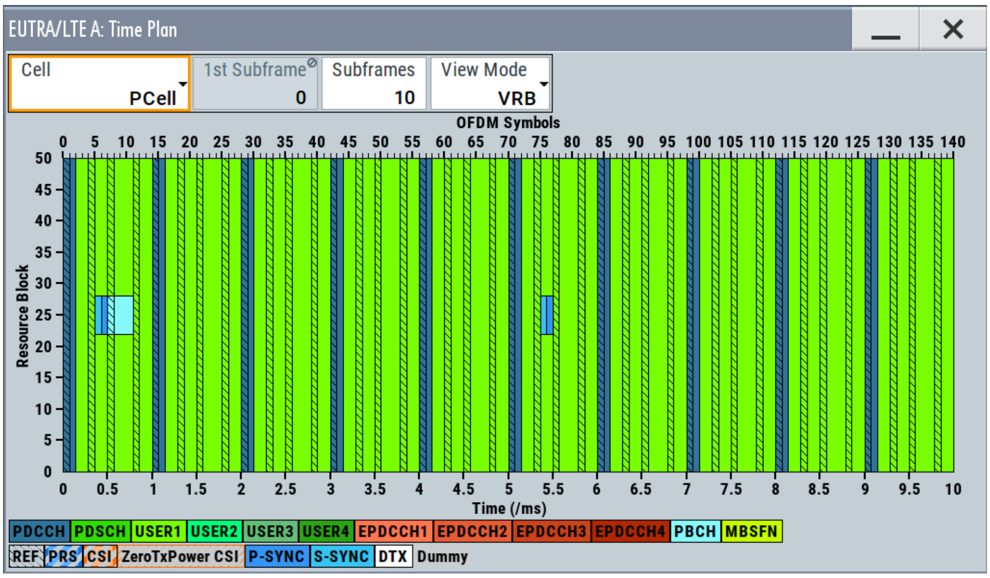
	User	UE_ID n_RNTI	Cell Index	CIF	(E)PDCCH	DCI Format	Search Space	Content	(E)PDCCH Format	Number (E)CCEs	(E)CCE Index	No.Dummy (E)CCEs	Conflict
0	User1	0	0	0	PDCCH	2C	Auto	Config...	0	1	9	0	
1	User1	0	0	0	PDCCH	2C	Auto	Config...	0	1	10	12	

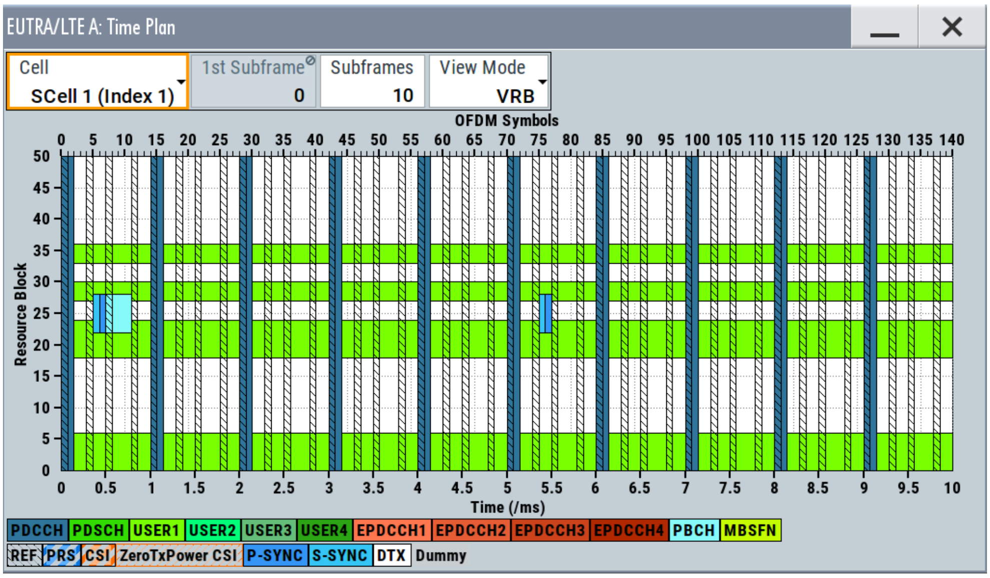
e) Select "Content > Config".
   Adjust the settings for the component carriers as required, for example:

   For the PCell set:
   - "Carrier Indicator Field = 0"
   - "Resource Block Assignments = 131071"

   For the SCell set:
   - "Carrier Indicator Field = 1"
   - "Resource Block Assignment = 100000"
f) Use the "Copy/Paste" function to fill the subframes with the settings of sub-frame#0.

11. Select "DL Frame Configuration > Time Plan".
    Compare the configuration of both cells: toggle the display with the parameter "Cell = PCell" and "Cell = SCell (Index 1)".





12. Select "EUTRA/LTE State > On".
13. If necessary, use the Fading simulator to configure the propagation conditions.
    For example, for both entities, select "Fading > Fading Settings".
    Select "Standard > LTE-MIMO > ETU 70Hz Medium".
    Set "State > On".
14. Adjust the RF frequency of both RF outputs.
15. Activate the RF outputs.

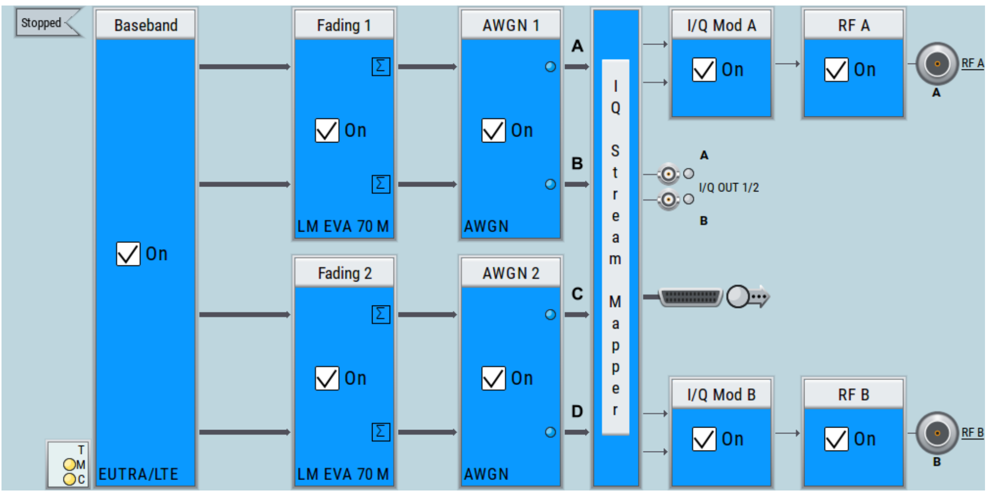


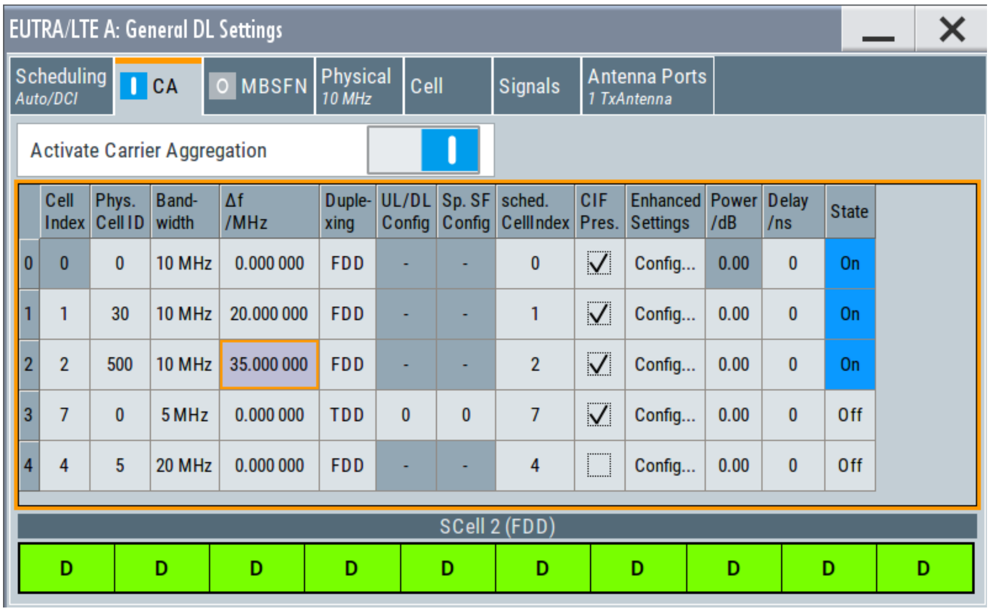
Figure 4-2: Example: Intra-band 2x2x2 LTE carrier aggregation

To enable carrier aggregation and cross-carrier scheduling

The instrument generates the required signal in system configuration with *separate baseband sources*.

In the following, a general example is provided. Only the related settings are discussed.

1. Select "System Config > Fading and Baseband Configuration > BB Source Config > Separate Sources"
2. Select "Baseband > EUTRA/LTE".
   Configure the settings of the PCell as required. For example, select one of the predefined "Test Setups/Models".
3. To enable carrier aggregation:
   a) Select "General DL Settings > DL Carrier Aggregation Configuration > Activate Carrier Aggregation > On"
   b) Select "DL Frame Configuration > User Configuration".
      Enable "Activate CA" per user as required.
4. In the "General DL Settings > DL Carrier Aggregation Configuration > Component Carrier Table" dialog, configure the settings of the SCells (see example on the following figure).



5. To enable cross-carrier scheduling for a certain component carrier:
   a) Set the "DL Carrier Aggregation Configuration > SCell# > schedCell Index = 0"
      In the example, the component carriers SCell#1, SCell#2 and SCell#4 can be cross-scheduled over the PCell
   b) Enable the "DL Carrier Aggregation Configuration > SCell# > CIF Present" parameter.
      In this example, the component carriers SCell#1 and SCell#2 is cross-scheduled over the PCell.
   c) To enable a component carrier, set "DL Carrier Aggregation Configuration > SCell# > State > On".

6. Enable LTE signal generation "EUTRA/LTE State > On".
7. If necessary, use the Fading simulator to configure the propagation conditions.
8. If necessary, adjust the RF frequency of the path to the middle frequency of the resulting total signal bandwidth.
9. Activate the RF output.

   The instrument generates the signal in the path as multicarrier signal. The signal is composed of three carriers, the PCell, the SCell#1 and SCell#2. Each of the component carriers spans "Channel Bandwidth = 10 MHz"; the SCells use carrier frequency offset of 20 MHz and 35 MHz.
   The SCell#4 is disabled.
   Tip: How to configure an LTE-A signal with independent fading per component carrier

   - If independent fading is required for each of the component carriers:
   - Configure one component carrier per path
   - Use the "Save/Recall" function to transfer the settings file to further instruments
   - Adjust the component carrier settings as necessary.

4.2.2.3 Carrier aggregation settings

Provided are the following settings:

Activate Carrier Aggregation
Enables/disables the generation of several component carriers.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:STATe` on page 758

Component Carrier Table
The table provides the settings of the component carriers. The first row displays the settings of the PCell; the following four rows provide the configurable settings of the up to four SCells.

The PCell settings resemble the settings configured in the

The PCell settings resemble the settings configured in the "General DL Settings" dialog.

Cell Index ← Component Carrier Table
Sets the cell index of the corresponding SCell, as specified in TS 36.331. The SCell index is required for signaling on the DCI DCI format configuration field.

The cell index of the PCell is always 0.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:INDex` on page 761

Physical Cell ID ← Component Carrier Table
Sets the physical Cell ID of the corresponding SCell.

The physical Cell ID of the PCell is set by the parameter "General DL Settings" > Cell ID".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:ID` on page 760

Bandwidth ← Component Carrier Table
Sets the bandwidth of the corresponding component carrier/SCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BW` on page 759

Baseband ← Component Carrier Table
In "System Configuration > BB Source Config > Separate Sources", displays the baseband block that generates the selected component carrier. The LTE-A signal is generated as multi-carrier waveform by one baseband.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BB` on page 759

delta f / MHz ← Component Carrier Table
(enabled in "System Configuration > BB Source Config > Separate Sources" configuration)

Sets the frequency offset between the central frequency of the SCell and the frequency of the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DFReq` on page 760

Duplexing ← Component Carrier Table
Selects the duplexing mode of the PCell.

- Without R&S SMW-K113
  The duplexing mode of the SCells is set accordingly.

- Option: R&S SMW-K113
  If "PDSCH Scheduling > Auto/DCI and Auto Sequence", combination of FDD and TDD is supported
- Option: R&S SMW-K119
  If "PDSCH Scheduling > Auto/DCI and Auto Sequence", SCells can work in LAA mode.
  LAA cells use FDD duplexing.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DUPLexing on page 760

TDD UL/DL Configuration ← Component Carrier Table
Option: R&S SMW-K112

In TDD duplexing mode, sets the uplink-downlink configuration number. That is, defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

In "PDSCH Scheduling > Auto/DCI and Auto Sequence" mode, the individual carriers can use different "UL/DL Configuration". The frame configuration of the selected carries and the used duplexing are also displayed. Alternatively, use the SC-FDMA time plan to visualize them.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:UDConf on page 761

TDD Special Subframe Config ← Component Carrier Table
Option: R&S SMW-K112

In TDD duplexing mode, sets the special subframe configuration number.

Together with the parameter Cyclic Prefix, this parameter defines the lengths of the DwPTS, the guard period and the UpPTS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:SPSConf on page 761

CIF Present ← Component Carrier Table
Defines whether the Carrier Indicator Field (CIF) is included in the PDCCH DCI formats transmitted from the corresponding SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:CIF on page 759

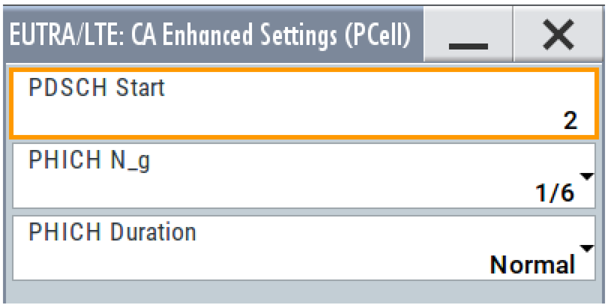
sched. Cell Index ← Component Carrier Table
Defines the component carrier/cell that signals the UL and DL grants for the selected SCell. The signaling cell is determined by its Cell Index.

According to the LTE-A specification, cross-carrier scheduling has to be enabled per user and per component carrier.

To enable signaling for one particular SCell on the PCell, i.e. cross-carrier scheduling, set the "schedCell Index" to 0.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:SCINdex on page 762

Enhanced Settings ← Component Carrier Table
Opens the "CA Enhanced Settings" dialog per component carrier.



PDSCH Start ← Enhanced Settings ← Component Carrier Table
Sets the starting symbol of the PDSCH for the component carrier and determines the "Control Region for PDCCH".

Note: All subframes of a particular component carrier use the same "Control region for PDCCH" as defined here, regardless of the settings of the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PSTart` on page 762

PHICH N_g ← Enhanced Settings ← Component Carrier Table
Sets the parameter N_g according to TS 36.211, section 6.9.

If Activate Carrier Aggregation > "On", you can define the PHICH duration per component carrier.

"1/6, 1/2, 1, 2" The used Number of PHICH Groups for the different subframes is calculated according to the following formula:

$$N_{PHICH}^{group} = \begin{cases} \lceil N_g (N_{RB}^{DL}/8) \rceil & \text{for normal cyclic prefix} \\ 2 . \lceil N_g (N_{RB}^{DL}/8) \rceil & \text{for extended cyclic prefix} \end{cases}$$

In FDD mode, the calculated value corresponds directly to the parameter "Number of PHICH Groups".
In TDD mode, the number of PHICH groups is calculated as the product of the N^{group}_{PHICH} value multiplied with a coefficient selected from the following table.

UL/DL	Subframe number									
Configuration	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	2	1	-	-	-	2	1	-	-	-
1	0	1	-	-	1	0	1	-	-	1
2	0	0	-	1	0	0	0	-	1	0
3	1	0	-	-	-	0	0	0	1	1
4	0	0	-	-	0	0	0	0	1	1
5	0	0	-	0	0	0	0	0	1	0
6	1	1	-	-	-	1	1	-	-	1

The parameter Number of PHICH Groups is read-only.

"Custom" (for Activate Carrier Aggregation > "Off")
The parameter Number of PHICH Groups is configurable.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PHICh:NGParameter`
on page 763

PHICH Duration ← Enhanced Settings ← Component Carrier Table

Sets the PHICH duration, i.e. the allocation of the PHICH resource element groups over the OFDM symbols.

The value selected puts the lower limit of the size of the PCFICH settings that is signaled by the PCFICH.

If Activate Carrier Aggregation > "On", you can define the PHICH duration per component carrier.

"Normal" All resources element groups of PHICH (see Number of PHICH Groups) are allocated on the first OFDM symbol (OFDM Symbol 0).

"Extended" The resources element groups of PHICH are distributed over three OFDM symbols for a normal subframe or over two symbols within a special one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PHICh:DURation` on page 763

Power / dB ← Component Carrier Table
(enabled in "System Configuration > BB Source Config > Separate Sources" configuration)

Sets the RS EPRE (reference signal energy per resource element) of the SCell relative to the RS EPRE of the PCell.

The absolute power of the RS of a cell is calculated according to the following formula:

$Absolute\_RS\_EPRE_{Cell\_X}$ = RS Power per RE relative to Level Display + "Level Display" + $CA\_Power_{Cell\_X}$

Example:

Set "EUTRA/LTE > Set to Default"

Set Activate Carrier Aggregation > On

For the SCell1, set $CA\_Power_{Cell\_1}$ = Power / dB = -5 dB

Enable SCell1, i.e. set State > On

The value of the parameter "General DL Settings" > RS Power per RE relative to Level Display" is -30.736 dB

The power displayed in the status bar of the instrument is "Level = -30 dBm"

$Absolute\_RS\_EPRE_{Cell\_1}$ = (-30.736 dB) + (-30.00 dBm) + (-5 dB) = -65.736 dBm

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:POFFset` on page 762

Delay / ns ← Component Carrier Table
(enabled in "System Configuration > BB Source Config > Separate Sources" configuration)

Sets the time delay of the SCell relative to the PCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:TDELay` on page 762

State ← Component Carrier Table
Activates/deactivates the component carrier/SCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:STATe` on page 763

4.2.3 MBSFN settings

Configuration of the "MBSFN Settings" requires the additional software option R&S SMW-K84.

The "MBSFN Settings" section comprises the parameters necessary to configure an MBSFN transmission. Refer to Chapter 2.2.4, "LTE MBMS concepts", on page 46 for background information.

According to the MBMS LTE concept, one eNodeB may serve more than one MBSFN areas. In this implementation, the simulated cell belongs to only one MBSFN area. Hence, all radio resources reserved for MBSFN subframes are assigned to one MBSFN area.

In an LTE network, the MBSFN information is transmitted only during the specially reserved MBSFN subframes. Almost all MBMS control information is carried by a special control channel, the MCCH. There is one MCCH per MBSFN area. In this implementation, the MCCH is always mapped to the first active MBSFN subframe within one MCCH repetition period (see figure in Example"MBSFN Resource Allocation" on page 89).

A configurable "MCCH repetition period" determines how frequent the control information is transmitted within a defined "MCCH modification period" (see Figure 4-3).

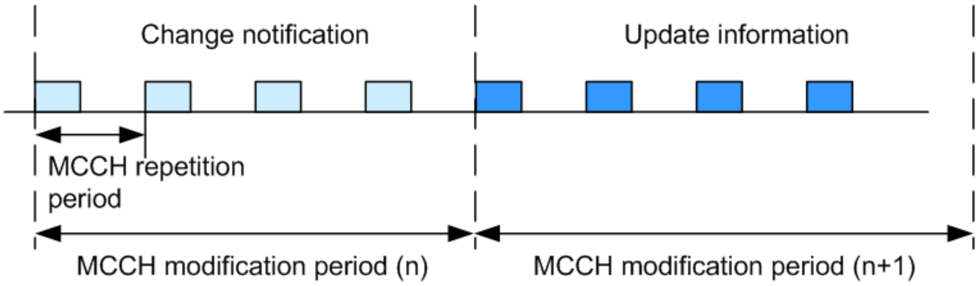


Figure 4-3: Change of MCCH information

The MCCH carries a single message, the *MBSFNAreaConfiguration* message, which provides information on the ongoing MBMS sessions and the corresponding radio resources, i.e. the mapping of the PMCHs. The BCCH also carries some of the MBMS control information by the special System Information Blocks SIB Type 13 and SIB Type 2.

For exact definition of control elements and messages such as *MBSFNAreaConfiguration*, refer to TS 36.331.

The following table provides an overview of the steps an UE performs to acquire the information about the resource configuration of reserved MBSFN subframes, the position of the MCCH within the MBSFN subframes as well as information necessary to demodulate the MCCH and to retrieve the information about the PMCH scheduling.

Table 4-2: Acquiring MBSFN information

Step	Information provided by	Description	User Interface
1	BCCH > SIB#2 ● *MBSFN-SubframeConfiguration*	The SIB#2 contains common radio configuration information and among other things a list (*mbsfn_SubframeConfigList*) with scheduling information for up to 8 MBSFN allocations (*MBSFN-SubframeConfiguration*). Hence, after receiving the SIB#2 each UE, also the MBSFN incapable UEs, are informed about the subframes that are reserved for MBSFN in the downlink.	Subframe Conf. (SIB Type 2)
2	BCCH > SIB#13 ● *MBSFN-AreaInfoList* ● *MBMS-NotificationConfiguration*	The SIB#13 carries the information necessary to acquire the MBMS control information for up to 8 MBSFN areas (*MBSFN-AreaInfoList*), as well as the common MBMS notification scheduling information (*MBMS-NotificationConfiguration*). After receiving the SIB#13 the MBSFN capable UE is able to find the MBSFN reference signals (*mbsfn-AreaID*) and to detect and demodulate the MCCH (*mcch-Config* and *MBMS-NotificationConfiguration*).	MBSFN-AreaInfoList Parameters MBSFN-Notification-Config Parameters
3	MCCH > *MBSFNAreaConfiguration* ● *PMCH-InfoList* ● *CommonSF-Allocation-PatternList*	The MCCH carries the single message *MBSFNAreaConfiguration* that determines which of the reserved MBSFN subframes (compare SIB#2) belong to which MBSFN area and provides a list with configuration information for up to 15 PMCHs (*PMCH-InfoList*) per an MBSFN area. **Note:** The *MBSFN-SubframeConfiguration* is equivalent to the summary of all *CommonSF-AllocationPatternList*. In this implementation, all MBSFN subframes are assigned to one MBSFN area. Hence, *MBSFN-SubframeConfiguration* equates the *CommonSF-AllocationPatternList* and configuration of the later one is done with the parameters of SIB#2. The *PMCH-InfoList* specifies the individual PMCHs, including MBMS sessions, used MCS, allocated subframes (*sf-AllocEnd*), and the periodicity for providing MCH scheduling information on MAC layer (*mch-SchedulingPeriod*).	Common Subframe Allocation Period PMCH-InfoList Parameters
4	PMCH	The UE receives the PMCHs.	

The illustrations on Figure 4-4 and Figure 4-5 show the signaling of MBSFN information during the acquisition steps.

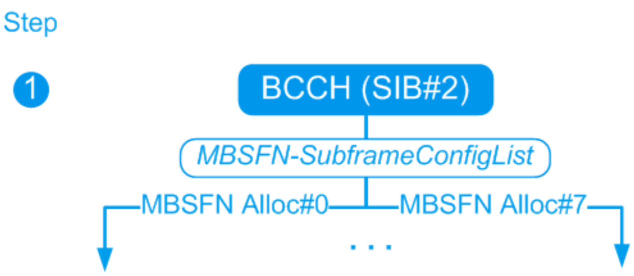


Figure 4-4: MBSFN Signaling (step 1)

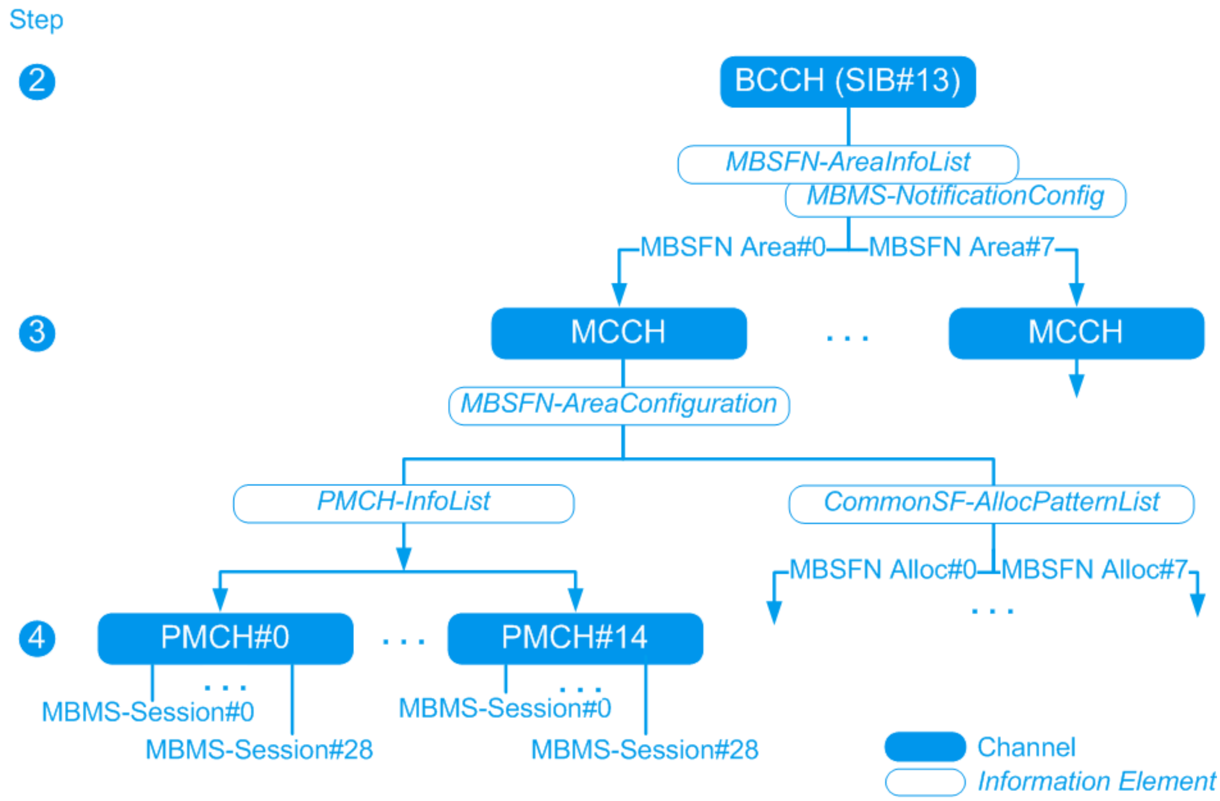


Figure 4-5: MBSFN Signaling (steps 2 to 4)

Example: MBSFN Resource Allocation

This example shows the MBSFN resource allocation for the settings listed in the following table. Use the default values for the other parameters.

ARB Sequence Length

The generation of a signal with cyclically repeating MBSFN pattern requires an "ARB sequence length" equal to the "MCCH repetition period" or to the "MCCH modification period".

The maximum value of the ARB sequence length depends on the selected channel bandwidth and on the memory size option of the generator.

Parameter	Value
EUTRA/LTE > Duplexing	FDD
EUTRA/LTE > Sequence Length	512 Frames
General DL Settings > Channel Bandwidth	1.4 MHz
General DL Settings > MBSFN Mode	Mixed
Radio Frame Allocation Period	8 Frames
Radio Frame Allocation Offset	2 Frames

Parameter	Value
Subframe Allocation Mode	4 Frames
Allocation value (HEX)	AAAAAA
MCCH State	On
MCCH Repetition Period	128 Frames
MCCH Modification Period	512 frames
Notification Repetition Coefficient	2 Frames
Notification Subframe Index	4, i.e. the MCCH change notification on PDCCH is transmitted on subframe#6
Common Subframe Allocation Period	64 Frames, i.e. the PMCH scheduling is repeated after 64 frames
Number of PMCHs	3
PMCH#0: SF Alloc Start/SF Alloc EndSF Alloc End	5
PMCH#0: MCH Scheduling Period	8
PMCH#1: SF Alloc End	7
PMCH#1: MCH Sched. Period	8
PMCH#2: SF Alloc End	95 (automatically calculated)
PMCH#2: MCH Sched. Period	8

See Figure 4-6 for an illustration of the resource allocation.

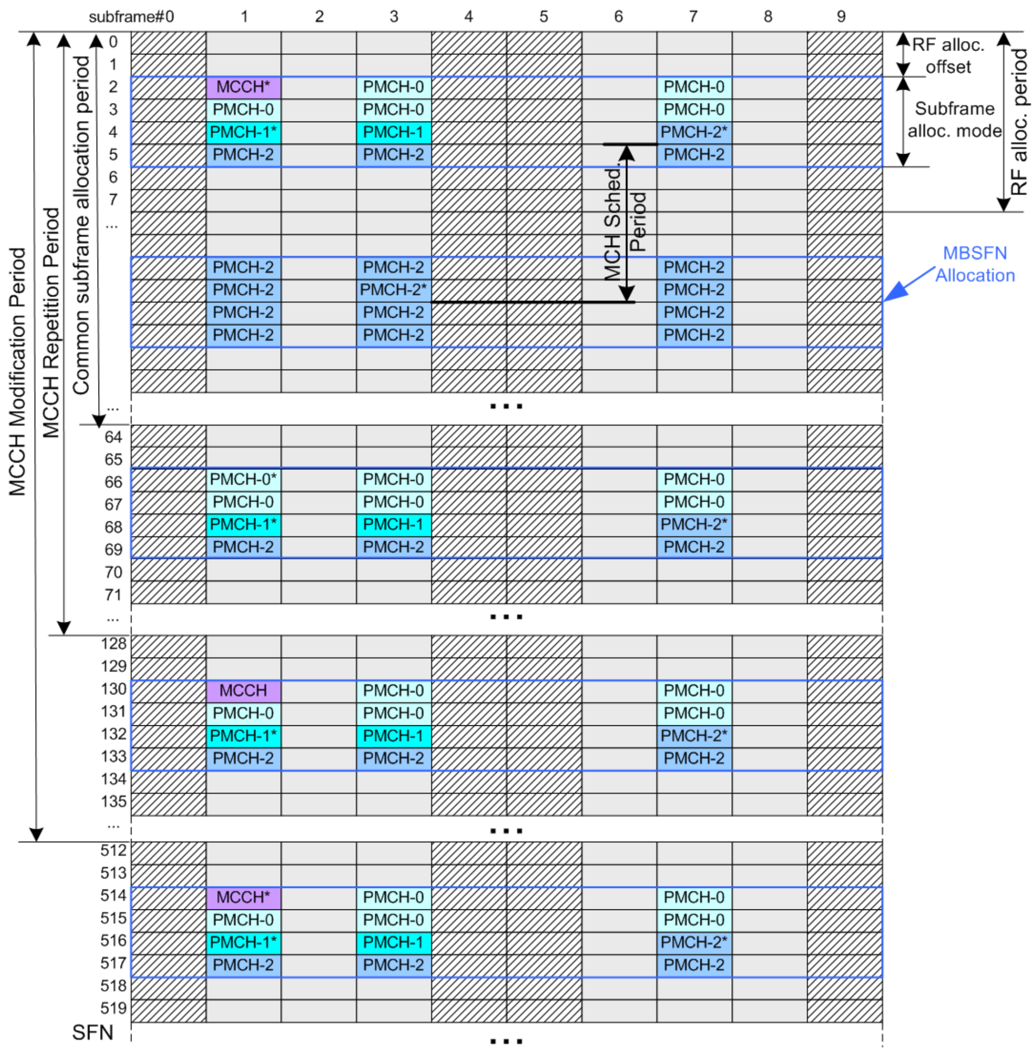


Figure 4-6: Example of MBSFN resource allocation

SFN	= System Frame Number
Pattern subframes	= Subframes not allowed to be scheduled as MBSFN subframes
Grey subframes	= MBSFN subframes not used for MBMS transmission, i.e. regular LTE subframes that can be used for allocation of DL signal
MCCH*	= First MCCH in a new MCCH modification period
PMCH-0*/PMCH-1*/ PMCH-2*	= First PMCH of one MCH scheduling period.

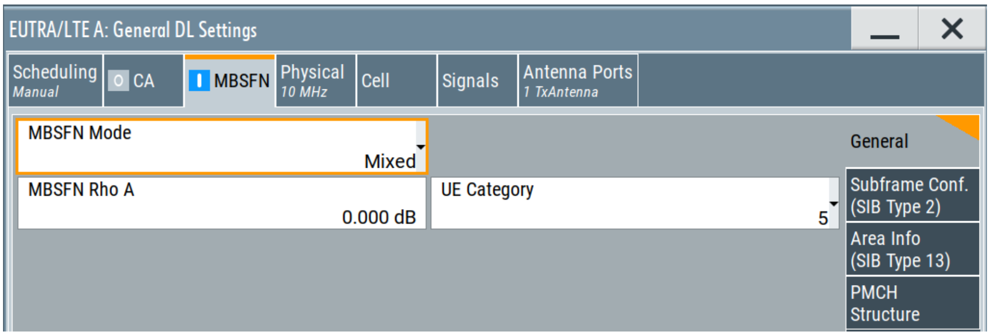
By default, the SFN (System Frame Number) starts with 0. Use the parameter SFN Offset to adjust the start value.

If PRS and MBSFN are configured to be in the same subframe, MBSFN is skipped and PRS is transmitted solely (see Example"Overlapping PDSCH, PRS and MBSFN" on page 113).

To access the MBSFN dialog:

1. Select "General > Link Direction > Downlink (OFDMA)".

2. Select "General DL Settings > MBSFN > General" tab.
3. Select "MBSFN Mode > Mixed".



This dialog comprises the parameters necessary to configure an MBSFN transmission:

MBSFN Mode

Enables the MBSFN transmission and selects a mixed MBSFN Mode, i.e. the available subframes are shared between MBSFN and regular LTE operation.

Note: Dedicated MBSFN Mode (i.e. all subframes are used for MBSFN solely) will be supported in a later version.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MODE` on page 752

MBSFN Rho A

Defines the power of the MBSFN channels relative to the common Reference Signals.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:RHOA` on page 755

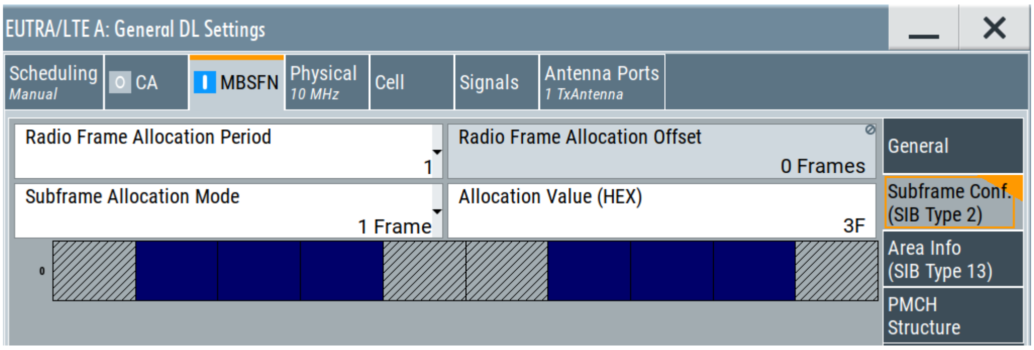
UE Category

Defines the UE category as defined in TS 36.306.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:UEC` on page 756

Subframe Conf. (SIB Type 2)

Access: "MBSFN > Subframe Conf. (SIB Type 2)" tab.



This section comprises settings for configuration of the general MBSFN structure, i.e. it defines which subframes are used for MBSFN transmission. In the “real” system, these values are transmitted via the System Information Block (SIB) Type 2.

The parameters in this section correspond to the MBMS information element *MBSFN-SubframeConfig*, as defined in TS 36.331.

The graph in this section displays the currently reserved MBSFN subframes. To select a subframe as MBSFN subframe, click on this subframe.

Note: The here described parameters are for configuration of the MBSFN structure only, the coding of the SIB#2 and the SIB#13 is not done automatically.

Also, the content of the MCCH is not generated automatically, but has to be set manually, by selecting the data source.

Radio Frame Allocation Period ← Subframe Conf. (SIB Type 2)
Radio-frames that contain MBSFN subframes occur when the following equation is satisfied:

`SFN mod radioFrameAllocationPeriod = radioFrameAllocationOffset`

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:APER` on page 756

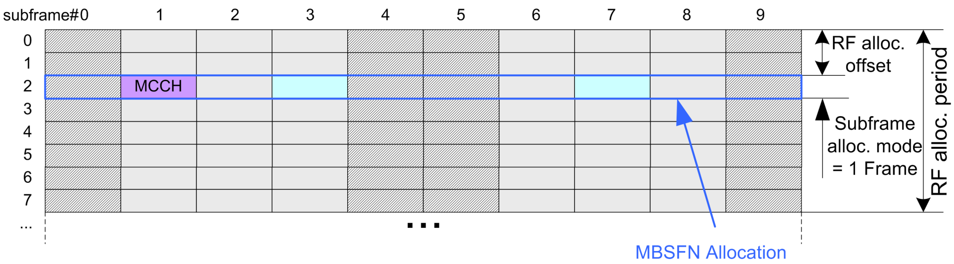
Radio Frame Allocation Offset ← Subframe Conf. (SIB Type 2)
Radio-frames that contain MBSFN subframes occur when the following equation is satisfied:

`SFN mod radioFrameAllocationPeriod = radioFrameAllocationOffset`

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AOFFset` on page 755

Subframe Allocation Mode ← Subframe Conf. (SIB Type 2)
Defines whether MBSFN periodic scheduling is 1 or 4 frames.

The figure in Example"MBSFN Resource Allocation" on page 89 shows an MBSFN allocation composed of 4 frames. The following figure displays an MBSFN allocation with "Subframe allocation mode" set to 1 frame.



Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AMODe` on page 755

Allocation value (HEX) ← Subframe Conf. (SIB Type 2)
Defines which MBSFN subframes are allocated.

This parameter is identical to the bitmap defined by the field *subframeAllocation* of the MBMS information element *MBSFN-SubframeConfig*.

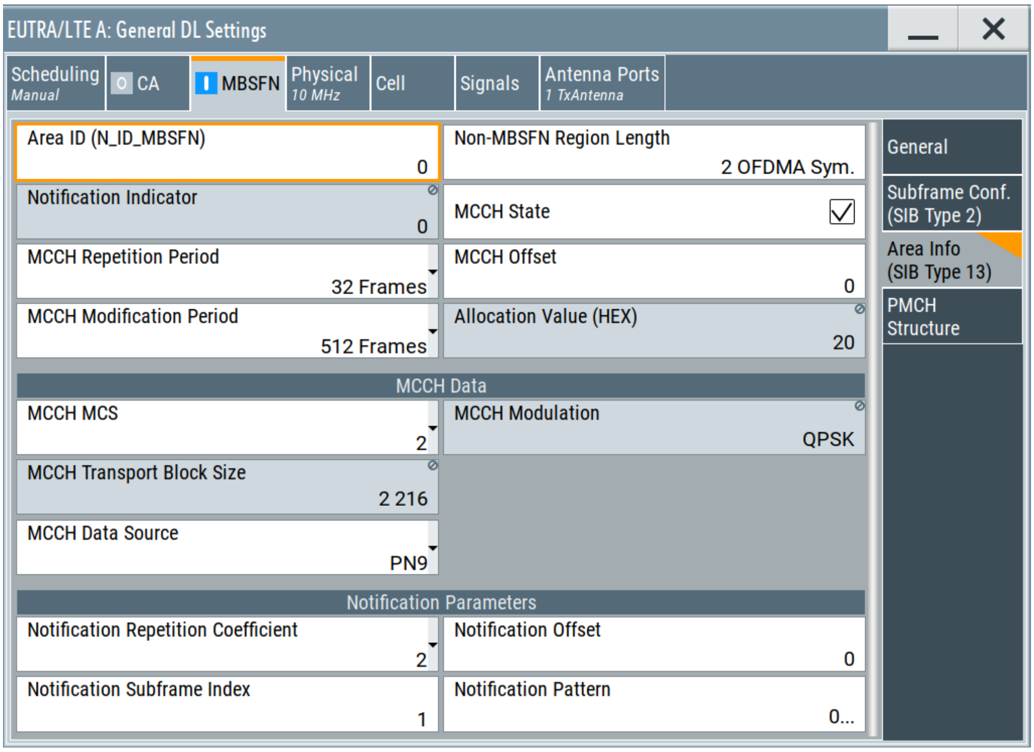
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AVAL` on page 756

Area Info (SIB Type 13)
Access: "MBSFN > Area Info (SIB Type 13)" tab.

This section comprises settings for configuration of the general MBSFN area info, i.e. it defines where to find the MCCH. In the “real” system, these values are transmitted via the System Information Block (SIB) Type 13.

The parameters in this section correspond to the MBMS information elements *MBSFN-AreaInfoList* and *MBSFN-NotificationConfig*, as defined in TS 36.331.

Note: The here described parameters are for configuration of the MBSFN structure only, the coding of the SIB#2 and the SIB#13 is not done automatically.
Also the content of the MCCH is not generated automatically, but has to be set manually, by selecting of a data source.



MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
This section comprises the scheduling parameters of the MBMS information element *MBSFN-AreaInfoList*.

Area ID (N_ID_MBSFN) ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines the MBSFN area ID, parameter N_{id}^{MBSFN}.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:ID` on page 747

Non-MBSFN Region Length ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines how many symbols from the beginning of the subframe constitute the non-MBSFN region.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NMRL` on page 751

Notification Indicator ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines which PDCCH bit is used to notify the UE about change of the MCCH applicable for this MBSFN area. Value 0 corresponds to the least significant bit as defined for the DCI Format 1C.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NIND` on page 751

MCCH State ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Enables/disables the MCCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:STATe` on page 750

MCCH Repetition Period ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines the interval between transmissions of MCCH information in radio frames.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER` on page 750

MCCH Offset ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Indicates, together with the "MCCH repetition period", the radio frames in which MCCH is scheduled. MCCH is scheduled in radio frames for which:

SFN mod "MCCH repetition period" = "MCCH offset"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:OFFS` on page 750

MCCH Modification Period ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Defines periodically appearing boundaries, i.e. radio frames for which the following equation is fulfilled:

SFN mod "MCCH modification period" = 0

The contents of different transmissions of MCCH information can only be different if there is at least one such boundary in-between them.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MPER` on page 748

Allocation Value (HEX) ← MBSFN-AreaInfoList Parameters ← Area Info (SIB Type 13)
Indicates the subframes of the radio frames indicated by the "MCCH repetition period" and the "MCCH offset" that may carry MCCH.

Note: In the current implementation, the MCCH is always mapped to the first active MBSFN subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:AVAL?` on page 747

MCCH Data ← Area Info (SIB Type 13)
This section configures MCCH parameters of the MBMS information element *MBSFN-AreaInfoList*.

MCCH MCS ← MCCH Data ← Area Info (SIB Type 13)
Defines the Modulation and Coding Scheme (MCS) applicable for the subframes indicated by the "MCCH Allocation value" and for the first subframe of each MCH scheduling period (which may contain the MCH scheduling information provided by MAC).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS on page 748

MCCH Modulation ← MCCH Data ← Area Info (SIB Type 13)
Displays the values as determined by the "MCCH MCS".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MODulation? on page 748

MCCH Transport Block Size ← MCCH Data ← Area Info (SIB Type 13)
Displays the values as determined by the "MCCH MCS".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:TBSize? on page 751

MCCH Data Source ← MCCH Data ← Area Info (SIB Type 13)
Sets the data source used for the MCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DATA on page 747
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DLISt on page 747
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:PATTern on page 750

MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
This section comprises the parameters of the MBMS information element *MBSFN-NotificationConfig*.

Notification Repetition Coefficient ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)
Selects the current change notification repetition period common for all MCCHs that are configured. The notification repetition period is calculated as follows:

change notification repetition period = shortest modification period/ "Notification repetition coefficient"

Where the *shortest modification period* corresponds with the value of the selected "MCCH modification period".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC on page 749

Notification Offset ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)

Defines, together with the "Notification Repetition Coefficient", the radio frames in which the MCCH information change notification is scheduled, i.e. the MCCH information change notification is scheduled in radio frames for which:

SFN mod notification repetition period = "Notification offset"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NOFFset` on page 748

Notification Subframe Index ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)

Defines the subframe used to transmit MCCH change notifications on PDCCH.

In FDD: Values 1, 2, 3, 4, 5 and 6 correspond with subframe #1, #2, #3, #6, #7 and #8 respectively.

In TDD: Values 1, 2, 3, 4 and 5 correspond with subframe #3, #4, #7, #8 and #9 respectively.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NSI` on page 749

Notification Pattern ← MBSFN-NotificationConfig Parameters ← Area Info (SIB Type 13)

Sets the pattern for the notification bits sent on PDCCH DCI format 1c.

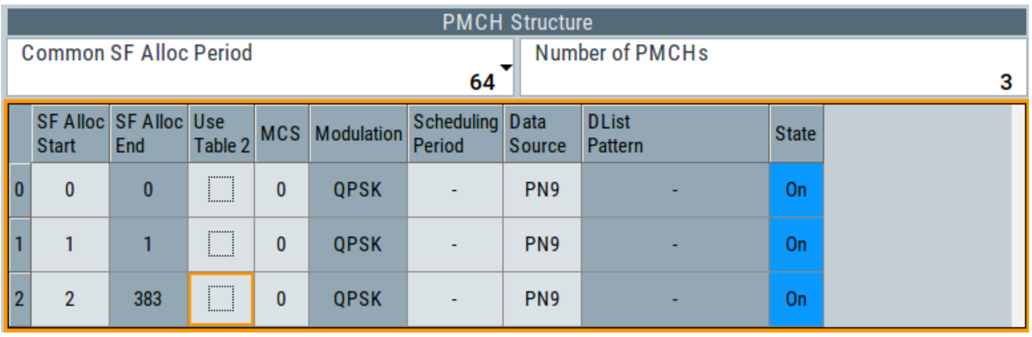
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NPATtern` on page 749

PMCH Structure

Access: "MBSFN > PMCH Structure" tab.

This section comprises settings for configuration of the PMCH structure, i.e. where to find a PMCH carrying a certain MTCH. In the “real” system, these values are transmitted via the MCCH (*MBSFNAreaConfiguration*).

The parameters in this section correspond to the MBMS information elements *MBSFNAreaConfiguration* and *PMCH-InfoList*, as defined in TS 36.331.



Common Subframe Allocation Period ← PMCH Structure

Defines the period during which resources corresponding with field *commonSF-Alloc* are divided between the (P)MCHs that are configured for this MBSFN area.

The subframe allocation patterns, as defined by *commonSF-Alloc*, repeat continuously during this period.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:CSAP on page 752

PMCH-InfoList Parameters ← PMCH Structure
Comprises the parameters of the *PMCH-InfoList*.

Number of PMCHs ← PMCH-InfoList Parameters ← PMCH Structure
Defines the number of PMCHs in this MBSFN area.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:NPMChs on page 752

SF Alloc Start/SF Alloc End ← PMCH-InfoList Parameters ← PMCH Structure
Defines the first/last subframe allocated to this (P)MCH within a period identified by field *commonSF-Alloc*.

The subframes allocated to (P)MCH corresponding with the n^{th} entry in *pmch-InfoList* are the subsequent subframes starting from either the subframe identified by "SF Alloc End" of the $(–1)^{th}$ listed (P)MCH or, for n=1, the first subframe, through the subframe identified by "SF Alloc End" of the n^{th} listed (P)MCH. Value 0 corresponds with the first subframe defined by field *commonSF-Alloc*.

Note: Configuring the MCHs ("SF Allocation Start" values) from bottom to top.
Although the 3GPP specification defines the "SF Alloc End" parameter as the only one required, in this implementation it is mandatory to define the "SF Alloc Start" instead. The implemented algorithm uses the selected "SF Alloc Start" and calculates automatically the "SF Alloc End" of the corresponding MCH. The algorithm applies the internal rule, that there is no gap between two consequent MCHs.

It is therefore recommended to configure the MCHs, i.e. define the "SF Alloc Start" values, from bottom to the top. This workaround prevents the configuration of overlapping MCHs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SASTart on page 755
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SAENd on page 755

Use Table 2 ← PMCH-InfoList Parameters ← PMCH Structure
(requires option R&S SMW-K113)

Defines which of the two tables defined in TS 36.213 is used to specify the used modulation and coding scheme (see MCS and Modulation):
- "Use Table 2 > Off": Table 7.1.7.1-1 is used
- "Use Table 2 > On": Table 7.1.7.1-1A is used.

Example:

For "MCS = 5" and "Use Table 2 > Off", the used modulation is "Modulation > QPSK".

If "Use Table 2 > On", the used modulation changes to "Modulation > 16QAM".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MCSTwo on page 753

MCS ← PMCH-InfoList Parameters ← PMCH Structure
Defines the value for parameter according to TS 36.213 Table 7.1.7.1-1 or Table 7.1.7.1-1A, which defines the Modulation and Coding Scheme (MCS) applicable for the subframes of this (P)MCH as indicated by the field *commonSF-Alloc*. The MCS does however neither apply to the subframes that may carry MCCH, i.e. the subframes indicated by the field *sf-AllocInfo* within System Information Block Type 13, nor for the first subframe of each MCH scheduling period (which may contain the MCH scheduling information provided by the MAC).

To select which one of the two tables Table 7.1.7.1-1 or Table 7.1.7.1-1A is used, use the parameter Use Table 2. Using Table 7.1.7.1-1A requires option R&S SMW-K113.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MCS` on page 754

Modulation ← PMCH-InfoList Parameters ← PMCH Structure
Indicates the used modulation, as defined with:
- Use Table 2
- MCS

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MOD?` on page 754

MCH Scheduling Period ← PMCH-InfoList Parameters ← PMCH Structure
Defines the MCH scheduling period, i.e. the periodicity used for providing MCH scheduling information at lower layers (MAC) applicable for an MCH.

Note: The first subframe of the scheduling period may contain the MAC control element and therefore uses MCS of MCCH (however, the data source from PMCH is still used).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SPERiod` on page 754

Data Source ← PMCH-InfoList Parameters ← PMCH Structure
Sets the data source for this PMCH/MTCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DATA` on page 753
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DLISt` on page 753
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:PATTern` on page 753

State ← PMCH-InfoList Parameters ← PMCH Structure
Enables/disables the selected PMCH/MTCH.

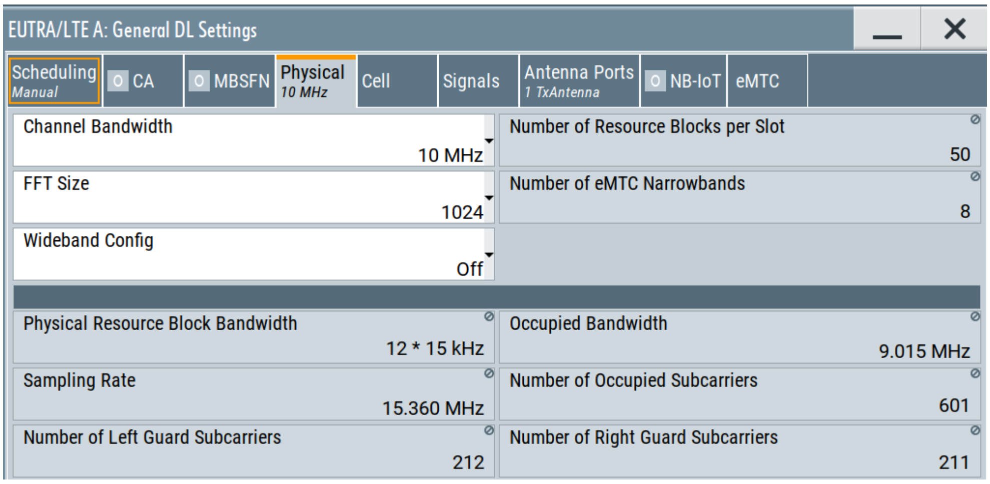
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:STATe` on page 752

4.2.4 Physical settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".

2. Select "General DL Settings > Physical".



In this dialog, the channel bandwidth respectively the number of resource blocks per slot is selected. The other parameters are fixed and read-only.

Channel Bandwidth

Sets the channel bandwidth of the EUTRA/LTE system.

The 3GPP specification defines bandwidth agonistic layer 1 where the channel bandwidth is determined by specifying the desired number of resource blocks. However, the current EUTRA standardization focuses on six bandwidths.

- "1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"
  Select a predefined channel bandwidth.
  The parameter "Number of Resource Blocks Per Slot" is internally calculated for the selected "Channel Bandwidth" and "Physical Resource Block Bandwidth".
  The sampling rate, occupied bandwidth and FFT size are therefore determined by the parameter "Number of Resource Blocks Per Slot". If necessary, adjust the "FFT Size".
  See also Table 2-1 for an overview of the cross-reference between the parameters.
  If "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected, the "1.4 MHz" bandwidth is supported by LTE and eMTC; the NB-IoT-specific settings are not available for configuration.
- "200 kHz"
  Option: R&S SMW-K115

This channel bandwidth is **dedicated to NB-IoT**. It is available, if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.
If channel bandwidth of 200 kHz is used, the LTE or eMTC-specific settings are not available for configuration. Available is only one NB-IoT carrier which works in standalone mode (Mode = "Standalone").

- "User"
  Option: R&S SMW-K55
  Provided for backward compatibility with previous version of this software, this parameter allows you to select a user-defined bandwidth as number of resource blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:BW on page 716

Number of Resource Blocks Per Slot
Indicates the number of used resource blocks for the selected "Channel Bandwidth".

"Channel Bandwidth"	"Number of Resource Blocks Per Slot (UL)"
"1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"	Read-only value, set automatically as function of the "Channel Bandwidth" and "Physical Resource Block Bandwidth"
"User"	"Channel Bandwidth" depends on the "Number of Resource Blocks Per Slot" and "Physical Resource Blocks Bandwidth"

The sampling rate and the occupied bandwidth are determined by the parameter "Number of Resource Blocks Per Slot". If necessary, adjust the value of "FFT Size".

See also Table 2-1.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NORB on page 716

FFT Size
Sets the FFT (Fast Fourier Transformation) size.

You can change the FFT size for all bandwidth definitions if the following conditions are met:

- For a specific bandwidth, all FFT sizes are applicable as long as the size is greater than the number of occupied subcarriers.
  By default, the smallest available FFT size is selected.
- To decrease the number of unused guard subcarriers and the resulting sampling rate, for channel bandwidth of 15 MHz an FFT size of 1536 is provided, too.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:FFT on page 717

Number of eMTC Narrowbands
Option: R&S SMW-K115

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates amount of eMTC narrowbands N_{RB}^{DL} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 366.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NNBands?` on page 965

Number of eMTC Widebands
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" and Wideband Config > "5 MHz/20 MHz" is selected.

It indicates the number of eMTC widebands N_{WB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Widebands" = "Channel Bandwidth" / Wideband Config

For more information, see "Widebands" on page 367.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NWBands?` on page 965

Wideband Config
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

If enabled, the available channel bandwidth is split into eMTC widebands with the selected bandwidth. The resulting number of widebands is indicated by the parameter Number of eMTC Widebands.

For more information, see "Widebands" on page 367.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:WBCFg` on page 965

Physical Resource Block Bandwidth
Displays the bandwidth of one physical resource block. The value is fixed to 12 x 15 kHz.

Remote command:
n.a.

Occupied Bandwidth
Displays the occupied bandwidth, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:OCCBandwidth?` on page 717

Sampling Rate
Displays the sampling rate, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SRATe?` on page 717

Number Of Occupied Subcarriers
Displays the number of occupied subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:OCCSubcarriers?` on page 717

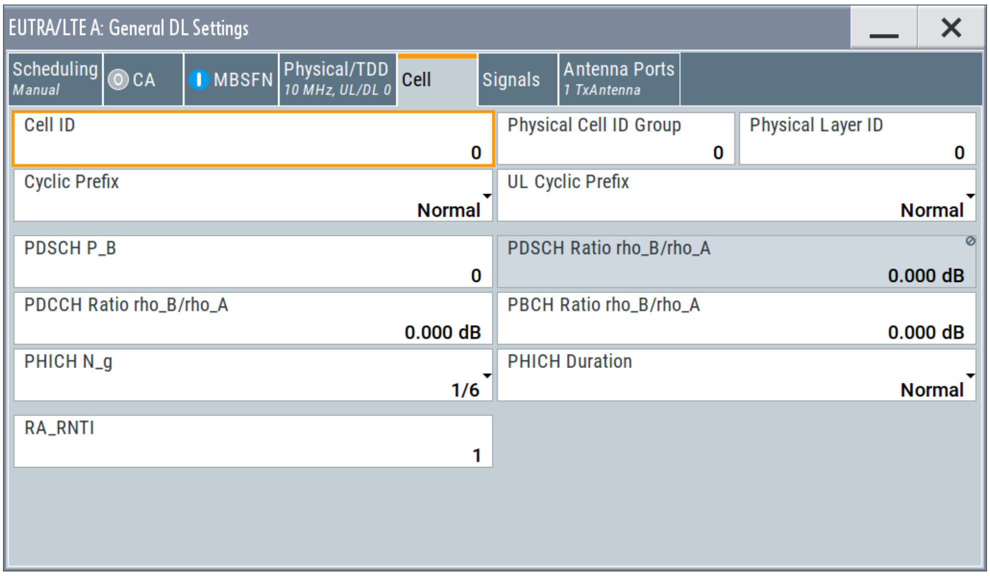
Number Of Left/Right Guard Subcarriers
Displays the number of left/right guard subcarriers, calculated form the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LGS?` on page 718
`[:SOURce<hw>]:BB:EUTRa:DL:RGS?` on page 718

4.2.5 Cell-specific settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Cell".



The "Cell-Specific Settings" section comprises the physical layer cell identity settings and the DL power control settings.

The TDD settings are available only, if the TDD is selected as a duplexing mode. The TDD frame is configured by adjusting the UL/DL configuration and the special subframe configuration.

Cell ID

Sets the cell identity.

There are 504 unique physical layer cell identities (Cell ID), grouped into 168 unique physical cell identity groups that contain three unique identities each. The Cell ID is calculated as following:

Cell ID = 3*Physical Cell ID Group + Physical Layer ID

There is a cross-reference between the values of these three parameters and changing of one of them results in adjustment in the values of the others.

The Cell ID determinates:

- The downlink reference signal pseudo-random sequence
- The frequency shifts of the reference signal
- The S-SYNC sequence
- The cyclic shifts for PCFICH, PHICH and PDCCH mapping
- The pseudo-random sequence used for scrambling

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CID` on page 718

Physical Cell ID Group

Sets the physical cell identity group.

To configure these identities within a cell ID group, set the parameter Physical Layer ID.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CIDGroup` on page 719

Physical Layer ID

Sets the identity of the physical layer within the selected physical cell identity group, set with parameter Physical Cell ID Group .

The physical layer ID determinates the Zadoff-Chu orthogonal sequence carried by the PSS (P-SYNC) and used for cell search.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:PLID` on page 719

Cyclic Prefix (General DL Settings)
Sets the cyclic prefix length for all subframes.

The number of the OFDM symbols is set automatically.

"Normal" Normal cyclic prefix, i.e. the DL slot contains seven OFDM symbols.

"Extended" Extended cyclic prefix, i.e. the DL slot contains six OFDM symbols.
The extended cyclic prefix is defined to cover large cell scenarios with higher delay spread and MBMS transmission.
NB-IoT allocations cannot be activated.

"User Defined" To set the cyclic prefix length per subframe, use the parameter "DL Frame Configuration" > "Cyclic Prefix".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CPC` on page 719

UL/DL Cyclic Prefix
In "Duplexing > TDD", determines the cyclic prefix for the appropriate opposite direction.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:DLCPc` on page 728
`[:SOURce<hw>]:BB:EUTRa:DL:ULCPc` on page 720

PDSCH P_B
Defines the cell-specific ratio rho_B/rho_A according to TS 36.213 (Table 5.2-1).

The following table gives an overview of the resulting values of the parameter "PDSCH Ratio rho_B/rho_A" as function of the values for the parameter [PDSCH P_B] and the number of configured antennas.

PDSCH P_B	1 Tx antenna	2 or 4 Tx antennas
0	0.000 dB	0.969 dB
1	-0.969 dB	0.000 dB
2	-2.218 dB	-1.249 dB
3	-3.979 dB	- 3.010 dB

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:PB` on page 720

PDSCH/PDCCH/PBCH Ratio rho_B/rho_A
Displays or sets the transmit energy ratio among the resource elements allocated for PDSCH/PDCCH/PBCH in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

The PDSCH value is calculated form the parameter PDSCH P_B. It also depends on the number of configured antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:RATBa` on page 720
`[:SOURce<hw>]:BB:EUTRa:DL:PDCCh:RATBa` on page 720
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa` on page 720

PHICH Duration

Sets the PHICH duration, i.e. the allocation of the PHICH resource element groups over the OFDM symbols.

The value selected puts the lower limit of the size of the PCFICH settings that is signaled by the PCFICH.

If Activate Carrier Aggregation > "On", you can define the PHICH duration per component carrier.

"Normal" All resources element groups of PHICH (see Number of PHICH Groups) are allocated on the first OFDM symbol (OFDM Symbol 0).

"Extended" The resources element groups of PHICH are distributed over three OFDM symbols for a normal subframe or over two symbols within a special one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PHICh:DURation` on page 763

PHICH N_g

Sets the parameter N_g according to TS 36.211, section 6.9.

If Activate Carrier Aggregation > "On", you can define the PHICH duration per component carrier.

"1/6, 1/2, 1, 2" The used Number of PHICH Groups for the different subframes is calculated according to the following formula:

$$N_{PHICH}^{group} = \begin{cases} \lceil N_g (N_{RB}^{DL}/8) \rceil & \text{for normal cyclic prefix} \\ 2 \cdot \lceil N_g (N_{RB}^{DL}/8) \rceil & \text{for extended cyclic prefix} \end{cases}$$

In FDD mode, the calculated value corresponds directly to the parameter "Number of PHICH Groups".
In TDD mode, the number of PHICH groups is calculated as the product of the N^{group}_{PHICH} value multiplied with a coefficient selected from the following table.

UL/DL Configuration	Subframe number									
	0	1	2	3	4	5	6	7	8	9
0	2	1	-	-	-	2	1	-	-	-
1	0	1	-	-	1	0	1	-	-	1
2	0	0	-	1	0	0	0	-	1	0
3	1	0	-	-	-	0	0	0	1	1
4	0	0	-	-	0	0	0	0	1	1
5	0	0	-	0	0	0	0	0	1	0
6	1	1	-	-	-	1	1	-	-	1

The parameter Number of PHICH Groups is read-only.

"Custom" (for Activate Carrier Aggregation > "Off")
The parameter Number of PHICH Groups is configurable.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PHICh:NGParameter
on page 763

RA_RNTI
Sets the random-access response identity RA-RNTI for the users.

The value selected here determined the value of the parameter UE_ID/n_RNTI in case a RA_RNTI "User" is selected.

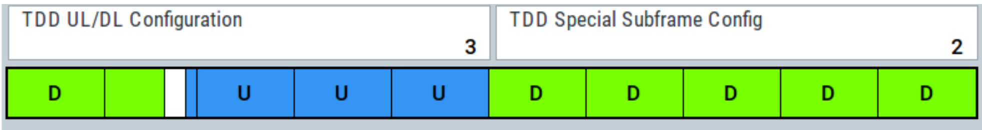
See UE_ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSETtings:RARNti on page 719

4.2.6 TDD frame structure settings

Access:

► Select "EUTRA/LTE > Duplexing > TDD".



The TDD frame is configured by adjusting the UL/DL configuration and the special subframe configuration (see also Chapter 2.2.1.1, "OFDMA parameterization", on page 21).

TDD UL/DL Configuration
Sets the UL/DL configuration number and defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDD:UDConf on page 710

TDD Special Subframe Config
Sets the special subframe configuration number and together with the parameter "Cyclic Prefix" defines the lengths of the DwPTS, the guard period (GP) and the UpPTS.

The DwPTS length selected with this parameter determines the maximum number of the OFDM symbols available for PDSCH in the special subframe.

The UpPTS length selected with this parameter determines the maximum number of the SC-FDMA symbols available for SRS in the special subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf on page 709

Number of UpPTS Symbols
Option: R&S SMW-K119 (if "Mode = LTE")

Option: R&S SMW-K143 (if "Mode = eMTC/NB-IoT")

For TDD Special Subframe Config = 10, sets the number of UpPTS symbols.

In all other configurations, the number of UpPTS symbols is set automatically depending on:

- "TDD UL/DL Configuration" on page 108
- "TDD Special Subframe Config" on page 108.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDD:UPTS` on page 710

4.2.7 Downlink signals settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Signals".

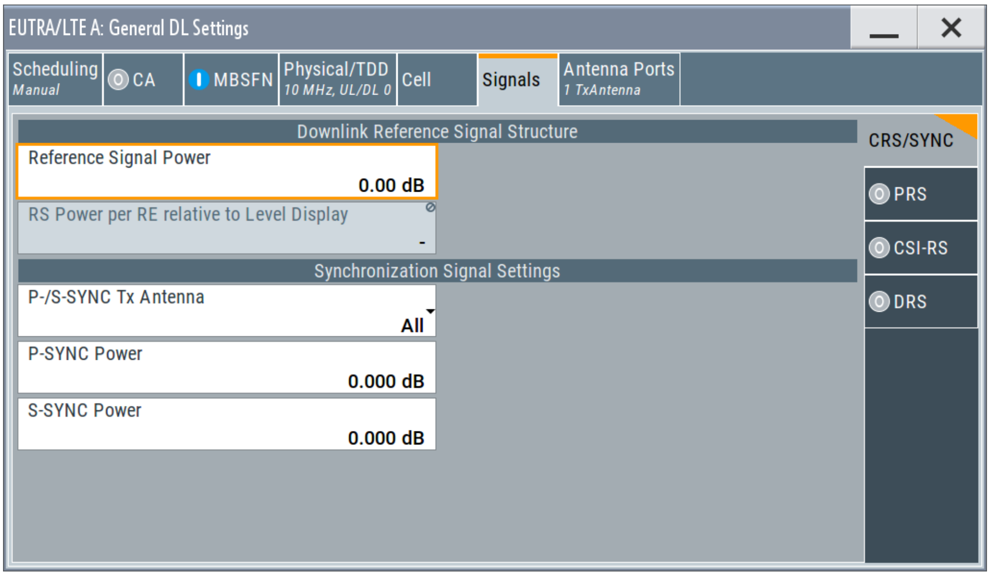
   The "Signals" dialog comprises the settings of all DL signals.

4.2.7.1 Synchronization and cell-specific reference signals (CRS/SYNC) settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".

2. Select "General DL Settings > Signals > CRS/SYNC".



The dialog comprises the "Downlink Reference Signal Structure" and the "Synchronization Signal Settings" sections. Use these settings to set the power level of the reference signals and the P-/S-SYNC and to enable/disable the P-/S-SYNC.

Downlink Reference Signal Structure
Comprises the downlink reference signal settings, like the power of the reference signals.

For an overview of the provided power settings and detailed information on how to adjust them, refer to Chapter 10.3, "Adjusting the signal power", on page 664.

Reference Signal Power ← Downlink Reference Signal Structure
Sets the power of the reference signal (PRS relative).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer` on page 714

RS Power per RE relative to Level Display ← Downlink Reference Signal Structure
If "EUTRA/LTE > State = On", displays the power of the reference signal (RS) per resource element (RE) relative to the power value, displayed in the status bar ("Level").

If a MIMO configuration is enabled, the value of this parameter is equal for all antennas; this applies also for the antenna configured in the path B.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:EPRE?` on page 715

Synchronization Signal Settings
In the "Synchronization Signal Settings" section, the power of the P-SYNC/S-SYNC is set.

P-/S-SYNC Tx Antenna ← Synchronization Signal Settings
Defines on which antenna port the P-/S-SYNC is transmitted.

The available values depend on the number of configured antennas.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:TXANtenna on page 715

P-SYNC Power ← Synchronization Signal Settings
Sets the power of the P-SYNC allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:PPOWer on page 715

S-SYNC Power ← Synchronization Signal Settings
Sets the power of the S-SYNC allocations.

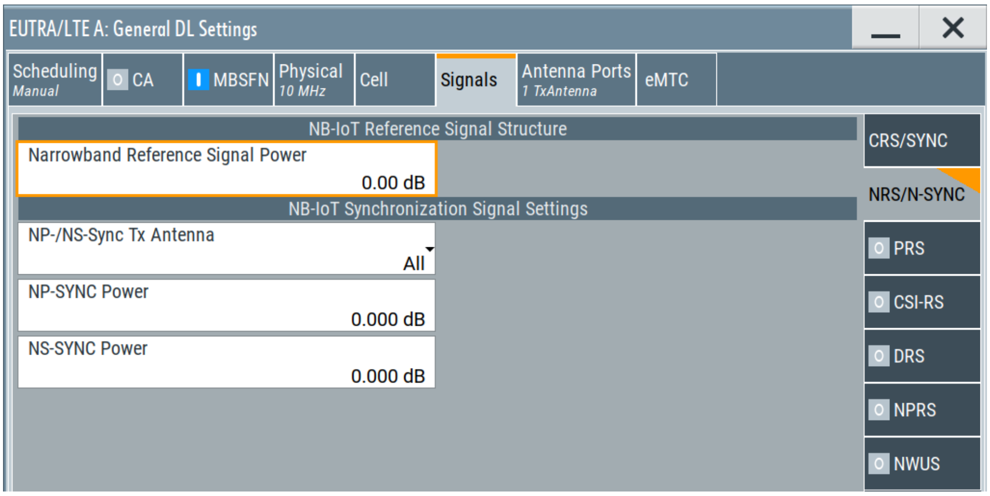
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:SPOWer on page 716

4.2.7.2 NB-IoT synchronization and cell-specific reference signals (NRS/N-SYNC) settings

Option: R&S SMW-K115

Access:

1. Select "Mode > LTE/eMTC/NB-IoT"
2. Select "General > Link Direction > Downlink (OFDMA)".
3. Select "General DL Settings > Physical > Channel Bandwidth ≥ 1.4 MHz"
4. Select "General DL Settings > Signals > NRS/N-SYNC".



NRS/N-SYNC (NPSS/NSSS)
Option:R&S SMW-K115

Access: "General DL Settings > Physical > Channel Bandwidth ≥ 3 MHz" and "Signals > NRS/N-SYNC".

Comprises the NB-IoT Signals NRS and NPSS/NSSS settings.

Narrowband Reference Signal Power ← NRS/N-SYNC (NPSS/NSSS)
Sets the power of the narrowband reference signal (NRS).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:REFSig:NIOT:POWer` on page 966

NP-/NS-Sync Tx Antenna ← NRS/N-SYNC (NPSS/NSSS)
Defines on which antenna port the NPSS/NSSS are transmitted.

The available values depend on the number of configured antennas, see NB-IoT MIMO Configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:TXANtenna` on page 966

NP-SYNC Power/NS-SYNC Power ← NRS/N-SYNC (NPSS/NSSS)
Sets the power of the NPSS/NSSS allocations.

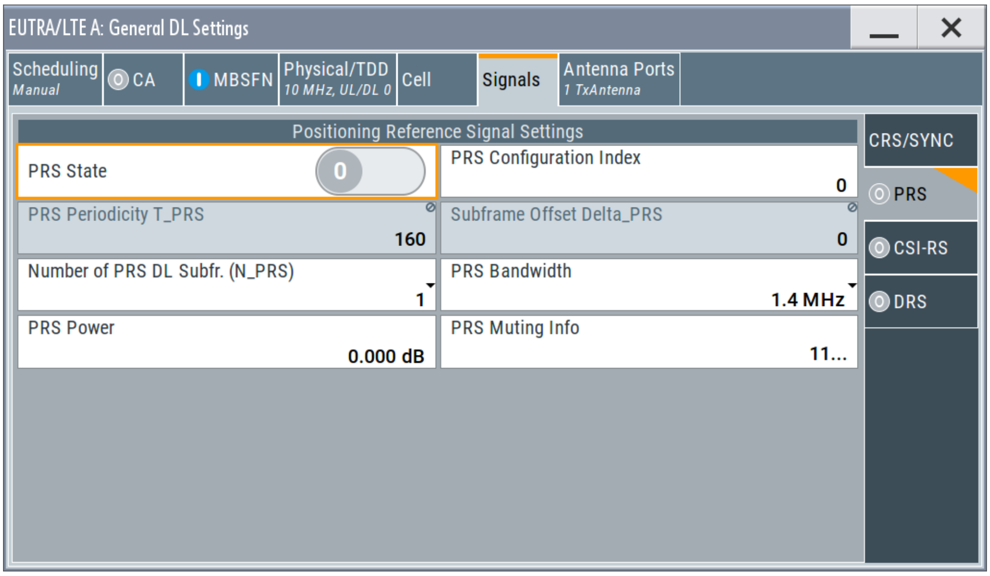
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NPPWr` on page 966
`[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NSPWr` on page 966

4.2.7.3 Positioning reference signal (PRS) settings

Option: R&S SMW-K84.

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Signals > PRS".



This section comprises the setting necessary to configure the positioning reference signals (PRS). See also "Positioning reference signals" on page 32.

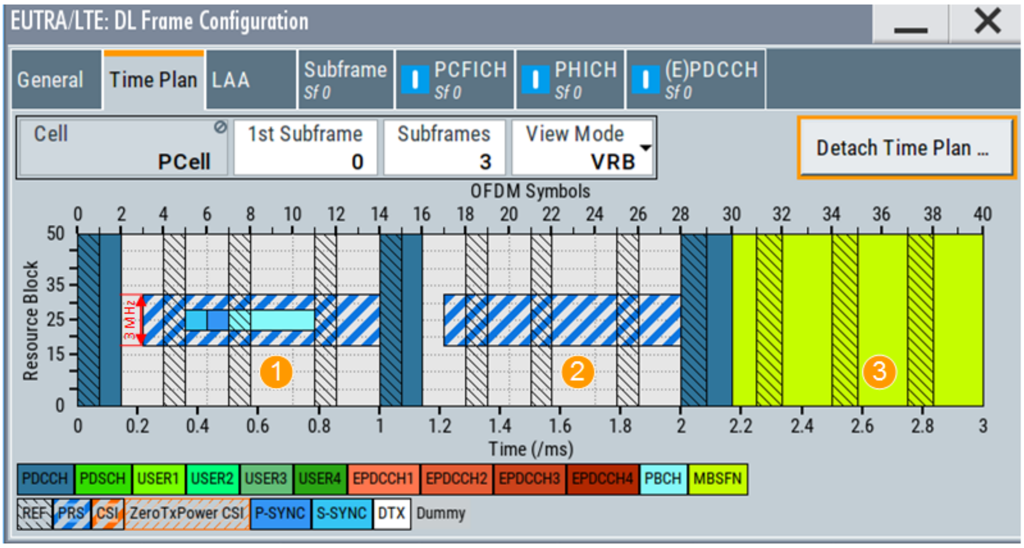
If PRS and MBSFN are configured to be in the same subframe, MBSFN is skipped and PRS is transmitted solely.

If a PDSCH is configured to overlap partially with the PRS bandwidth in a PRS subframe, the PRS in these resource blocks is skipped then.

Example: Overlapping PDSCH, PRS and MBSFN

Perform the following settings:

- PRS State = ON
- PRS Configuration Index = 0
- Number of PRS DL Subframes (N_PRS) = 2
- PRS Bandwidth = 3 MHz
- MBSFN Mode = Mixed
- Use the OFDMA time plan to visualize the allocation of the PRSs.



1 = PDSCH and PRS are overlapping in the subframe#0
2 = MBSFN is ignored in subframe#1
1+2 = two consequent PRS subframes with 3 MHz Bandwidth, i.e. one PRS occasion
3 = first MBSFN subframe

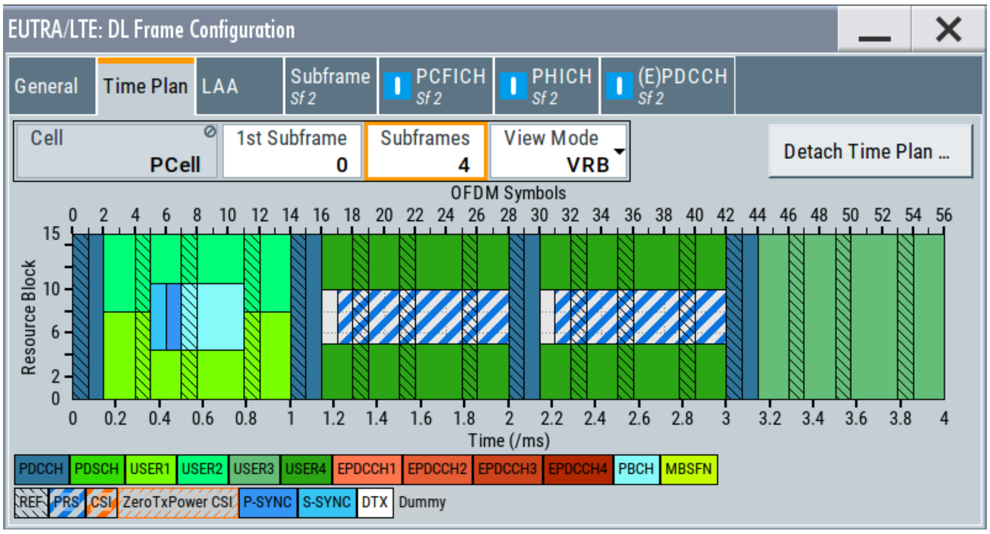
Example: How to visualize the effect of muting and omitting PRS transmission

Perform the following settings:

- Select "EUTRA/LTE > General DL Settings > Physical > Channel Bandwidth = 3 MHz"
- Select "EUTRA/LTE > DL Frame Configuration > Subframe Config" and configure the subframes.
- Select "EUTRA/LTE > General DL Settings > Signals > PRS", use the default settings, and enable the following:

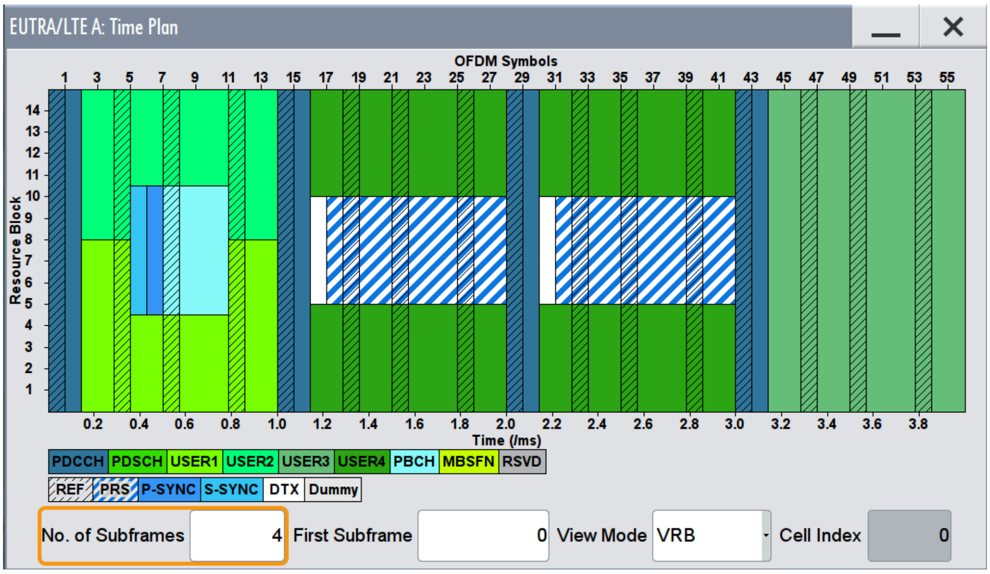
– "PRS Configuration Index = 1"
– "Number of PRS DL Subframes (N_PRS) = 2"
– "PRS State > On"

- Select "EUTRA/LTE > General DL Settings" and open the OFDMA time plan to visualize the configured allocations.
Tip: Select "Show Time Plan in Dialog" to easy switch between dialogs with settings and the time plan.



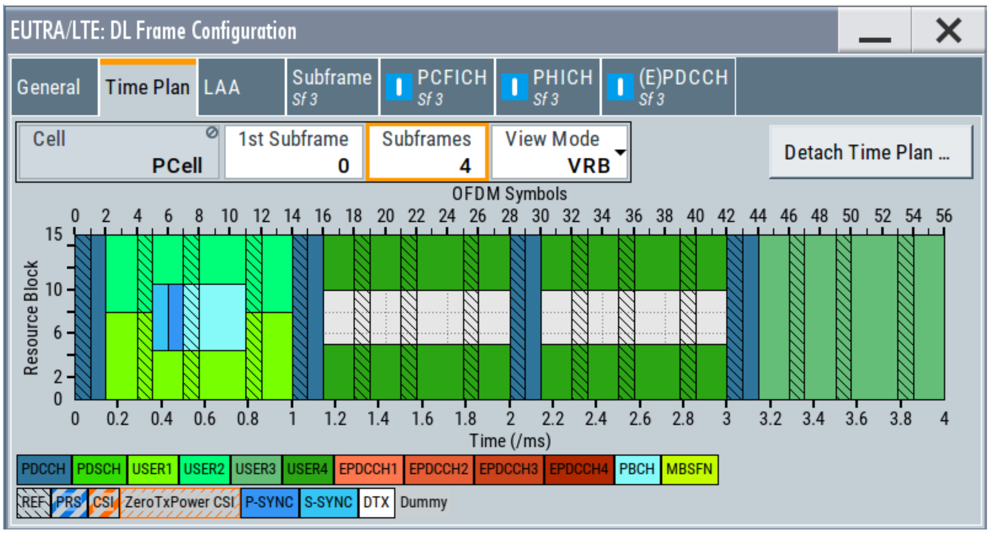
The time plan confirms the transmission of one PRS occasion, consisting of two consequent PRS subframes with 1.4 MHz bandwidth, transmitted in subframe#1 and subframe#2.

- Select "EUTRA/LTE > DL Frame Configuration > Behavior in Unsch. RE (OCGN) > Dummy Data"
- Select "EUTRA/LTE > DL Frame Configuration > Dummy Data Configuration > Omit PRS Subframes"
- Observe the allocations displayed on the time plan.



The time plan confirms that the PRS subframes are *not* filled in with DTX.

- Select "EUTRA/LTE > General DL Settings > PRS" and set "PRS Muting Info = 01"
- Observe the allocations displayed on the time plan.



The time plan confirms that the PRS is muted; there is no transmission of PRS in the subframe#1 and subframe#2. The muted PRS subframes are not omitted; the allocation-free resource blocks in these subframes are filled with DTX.

PRS State

Enables the generation of the PRS.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe` on page 722

PRS Configuration Index

Sets the PRS Configuration Index I_{PRS} as defined in TS 36.211 (table 6.10.4.3-1).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:CI` on page 721

PRS Periodicity T_PRS

Displays the periodicity of the PRS generation (T_{PRS}) as defined in TS 36.211 (table 6.10.4.3-1).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:TPRS?` on page 723

PRS Subframe offset Delta_PRS
Displays the subframe offset of the PRS generation ($Delta_{PRS}$) as defined in TS 36.211 (table 6.10.4.3-1).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:DPRS?` on page 721

Number of PRS DL Subframes (N_PRS)
Defines the number of consecutive DL subframes in that PRS are transmitted. Several consecutive DL subframes build one PRS occasion.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:NPRS` on page 722

PRS Bandwidth
Defines the RBs in which the PRS is transmitted.

Note: The PRS Bandwidth must not be bigger than channel bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:BW` on page 721

PRS Power
Sets the power of a PRS resource element relative to the power of a common reference signal resource element.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:POW` on page 722

PRS Muting Info
Specifies a bit pattern that defines the muted and not muted PRS. The bit pattern can be 2, 4, 8 or 16 bit long, where each bit defines the PRS state of one PRS occasion. The parameter Number of PRS DL Subframes (N_PRS) defines the length of the PRS occasions.

See Example"How to visualize the effect of muting and omitting PRS transmission" on page 113

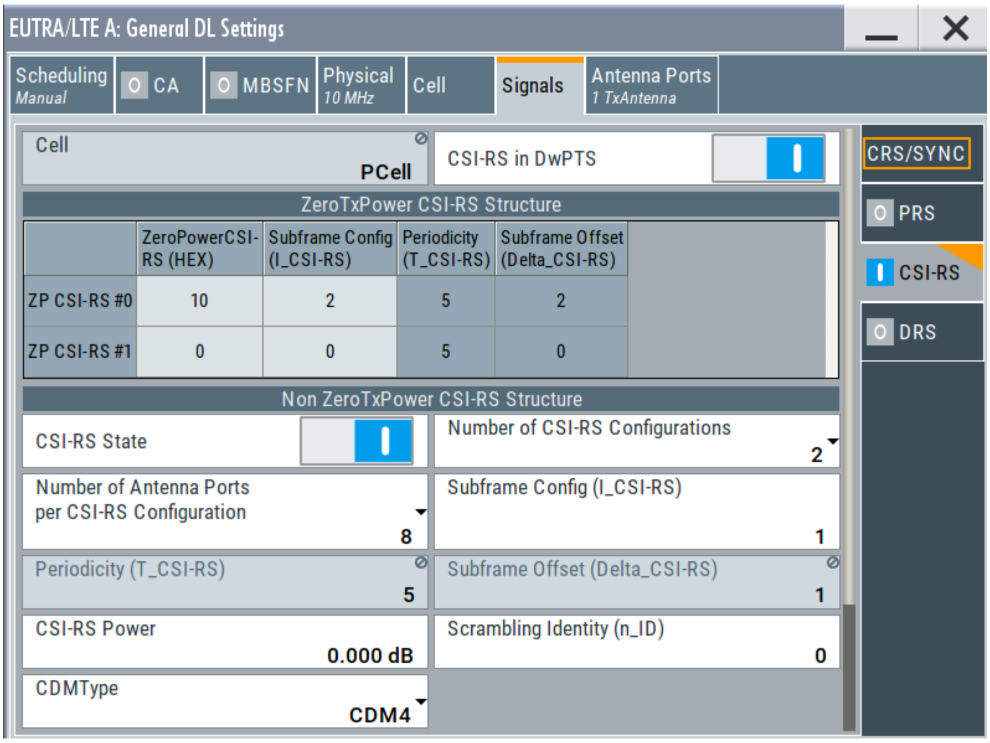
"0"	PRS is muted in the corresponding PRS occasion.
"1"	PRS is not muted, i.e. PRS is transmitted in the corresponding PRS occasion.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PRSS:MIPattern` on page 723

4.2.7.4 CSI-RS settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Signals > CSI".



This dialog comprises the settings for configuring the channel-state information reference signal (CSI-RS) structure. For detailed information, see "CSI reference signals" on page 33.

The TS 36.211 specifies the occurrence of the CSI reference signal in the subframes as function of the subframe configuration period T_{CSI-RS} and the subframe offset $Delta_{CSI-RS}$. The available value ranges are listed in Table 4-3 [TS 36.211]. The parameter I_{CSI-RS} can be configured separately for the zero (ZeroTxPower CSI-RS Structure) and non-zero transmission power ("NonZeroTxPower CSI-RS Structure" on page 120) cases.

Table 4-3: CSI reference signal structure configuration

CSI-RS subframe configuration I_{CSI-RS}	CSI-RS periodicity T_{CSI-RS} (subframes)	CSI-RS subframe offset $Delta_{CSI-RS}$ (subframes)
0 to 4	5	I_{CSI-RS}
5 to 14	10	I_{CSI-RS} - 5
15 to 34	20	I_{CSI-RS} - 15
35 to 74	40	I_{CSI-RS} - 35
75 to 154	80	I_{CSI-RS} - 75

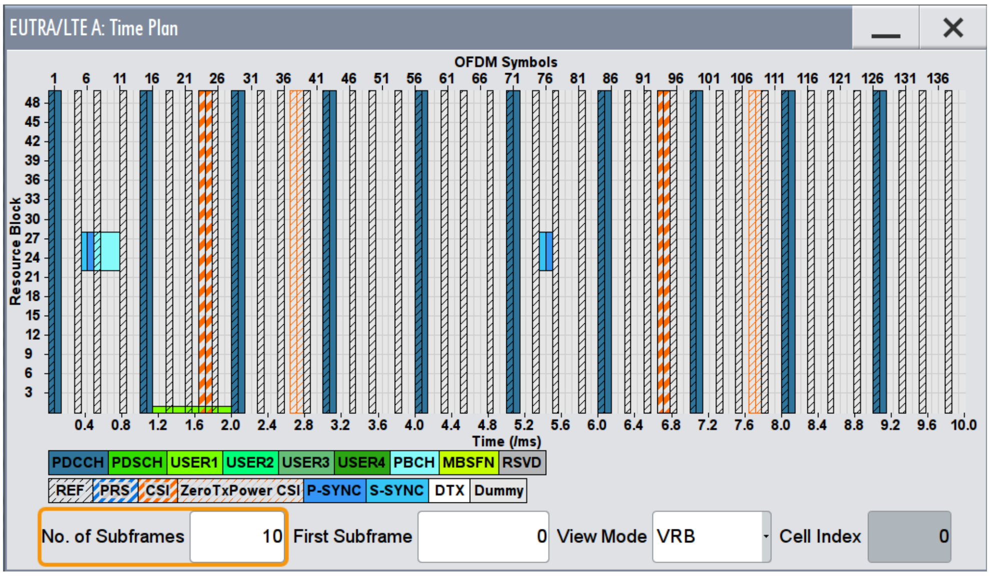
How to enable and visualize a CSI-RS transmission

1. Select "EUTRA/LTE > Set to Default".

2. Select "EUTRA/LTE > Link Direction > Downlink (OFDMA)".
3. Select "EUTRA/LTE > State > On".
4. Select "EUTRA/LTE > General Downlink Settings".
5. Select "General Downlink Settings > Signals > CSI-RS".
   Configure the settings as required.
   For example, enable the settings displayed in the figure above.
6. Enable "Cell-specific CSI-RS Structure > Subframe Config (I_CSI-RS) = 1".
7. Select "Cell-specific CSI-RS Structure > CSI-RS State > On".
   Close the dialog.
8. Select "EUTRA/LTE > Frame Configuration".
9. LAA is disabled in this example. If LAA is configured and thus "Scheduling > PDSCH Scheduling = Auto/DCI" is used, the "Subframe" setting are automatically configured. To observe the allocation of the physical resources, open the time plan (see step 10). Otherwise proceed as follows:
   Configure the subframe selected for the CSI-RS transmission:
   a) Select "Frame Configuration > Subframe > Subframe Selection = 1" to configure the subframe selected for the CSI-RS transmission.
   b) Set "No. of Used Allocations = 2".
      The allocation table displays the activated PDSCH allocation with the corresponding number of used "Phys. Bits".
   c) In the allocation table, for this PDSCH allocation, select "Ench. Settings > Config".
   d) In the "Enhanced Settings" dialog, select "CSI-RS > Awareness > On".
   e) In the allocation table, select the PDSCH allocation. Compare the number of used "Phys. Bits".

   The displayed information confirms, that less physical bits are allocated for the PDSCH, because some resources are reserved for the CSI-RS transmission.

   Tip: Use the parameter CSI Awareness State to inform an UE that a CSI-RS transmission is used.
10. Select "Frame Configuration > Time Plan".
    Set "No of Subframes = 10".



Cell

With enabled "General DL Settings > CA > Activate Carrier Aggregation > On" state, indicates to which cell (i.e. component carrier) the settings apply.

Remote command:
n.a

CSI-RS in DwPTS

Enables transmission of the CSI-RS in the Downlink Pilot Time Slot (DwPTS) parts of the TDD frame.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:DWPTs on page 769

ZeroTxPower CSI-RS Structure
Option: R&S SMW-K113

From LTE Rel. 12 on, eNBs support one (ZP CSI-RS #0) primary and one additional (ZP CSI-RS #1) zero-power CSI reference signal for each cell.

ZeroPowerCSI-RS (HEX) ← ZeroTxPower CSI-RS Structure
Sets the used CSI-RS configurations in the zero transmission power subframes. Required is a 16-bit-long hexadecimal value (bitmap). The UE assumes a zero transmission power for each bit set to one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZP on page 767

Subframe Config (I_CSI-RS) ← ZeroTxPower CSI-RS Structure
Sets the parameter I_{CSI-RS} for CSI-RS with zero transmission power, see Table 4-3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZPI on page 768

Periodicity (T_CSI-RS) ← ZeroTxPower CSI-RS Structure
Sets the parameter subframe configuration period T_{CSI-RS} for CSI-RS with zero transmission power, see Table 4-3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZPT? on page 768

Subframe Offset (Delta_CSI-RS) ← ZeroTxPower CSI-RS Structure
Sets the parameter subframe offset $Delta_{CSI-RS}$ for CSI-RS with zero transmission power, see Table 4-3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZPDelta? on page 767

NonZeroTxPower CSI-RS Structure
Comprises the following cell-specific parameters:

CSI-RS State ← NonZeroTxPower CSI-RS Structure
Enables the transmission of a CSI-RS, see also "How to enable and visualize a CSI-RS transmission" on page 117.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:STATe on page 767

Number of CSI-RS Configurations ← NonZeroTxPower CSI-RS Structure
Option: R&S SMW-K119

Enables using multiple CSI-RS configurations and sets the value of the parameter N_{res}^{CSI}.

To define the individual configurations, use the parameters Resource Configuration, Frequency Density and Transmission Comb.

See also Chapter 2.2.8.4, "Full dimension MIMO (FD-MIMO)", on page 59.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NCFG on page 769

Number of AP per CSI-RS Configuration ← NonZeroTxPower CSI-RS Structure
Defines (or indicates) the number of antenna ports (one, two, four or eight) the CSI-RS are transmitted on.

Option: R&S SMW-K119

- This field is configured automatically, if Number of CSI-RS Configurations≥ 2 is selected.
  The value indicates the number of antenna ports per CSI-RS configuration N_{ports}^{CSI} and is selected to comply with the aggregation rule, given in Table 2-8.
- The value displayed in the "DRS" > "CSI-RS" on page 126 dialog resembles the value set in the "CSI-RS" dialog.

Use the Cell-Specific Antenna Port Mapping and configure the cell-specific antenna port mapping.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NAP on page 765

Subframe Config (I_CSI-RS) ← NonZeroTxPower CSI-RS Structure
Sets the parameter I_{CSI-RS} for cell-specific CSI-RS, see Table 4-3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SFI on page 766

Periodicity (T_CSI-RS) ← NonZeroTxPower CSI-RS Structure
Indicates the parameter subframe configuration period T_{CSI-RS} for cell-specific CSI-RS, see Table 4-3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SFT? on page 766

Subframe Offset (Delta_CSI-RS) ← NonZeroTxPower CSI-RS Structure
Indicates the parameter subframe offset $Delta_{CSI-RS}$ for cell-specific CSI-RS, see Table 4-3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SFDelta? on page 766

CSI-RS Power ← NonZeroTxPower CSI-RS Structure
Boosts the CSI-RS power compared to the cell-specific reference signals.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:POW on page 765

Scrambling Identity (n_ID) ← NonZeroTxPower CSI-RS Structure
Option: R&S SMW-K112

Sets the additional scrambling identity n_ID used to generate the NonZeroTxPower CSI-RS, as specified in LTE Rel. 11.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SCID` on page 769

CDMType ← NonZeroTxPower CSI-RS Structure
Option: R&S SMW-K119

Sets the higher-level parameter `CDMType` that influence the antenna port mapping of the CSI-RS.

CDM8 type is available if the product of Number of CSI-RS Configurations * Number of AP per CSI-RS Configuration = {24 or 32}

See also Chapter 2.2.8.4, "Full dimension MIMO (FD-MIMO)", on page 59.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:CDMType` on page 770

CSI-RS Configurations ← NonZeroTxPower CSI-RS Structure
Table with several rows, where the number of rows depends on the Number of CSI-RS Configurations.

CSI-RS Configuration # ← CSI-RS Configurations ← NonZeroTxPower CSI-RS Structure
Option: R&S SMW-K119

Indicates the configuration number, where the number of configurations is set with Number of CSI-RS Configurations.

Resource Configuration ← CSI-RS Configurations ← NonZeroTxPower CSI-RS Structure
Defines the CSI-RS configuration used for the current cell and for which the UE assumes non-zero transmission power. The zero transmission power subframes are determined by the ZeroPowerCSI-RS (HEX).

Option: R&S SMW-K119

From LTE Rel. 13 on, cells can use multiple CSI-RS configurations. Select Number of CSI-RS Configurations ≥ 2 to enable this feature and be able to select an individual CSI-RS configuration value for each of the enabled configurations.

The Number of AP per CSI-RS Configuration and the CDMType are set automatically. All other CSI-RS configuration settings are common for all CSI-RS configurations.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:CONFig[<st>]`
on page 765

Frequency Density ← CSI-RS Configurations ← NonZeroTxPower CSI-RS Structure
Option: R&S SMW-K119

Sets the parameter `NZP-FrequencyDensity` and thus defines the CSI-RS mapping to resource elemets according to TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:FRDensity[<st>]`
on page 770

Transmission Comb ← CSI-RS Configurations ← NonZeroTxPower CSI-RS Structure
Option: R&S SMW-K119

Sets the parameter `NZP-TransmissionComb` and thus defines the CSI-RS mapping to resource elemets according to TS 36.211.

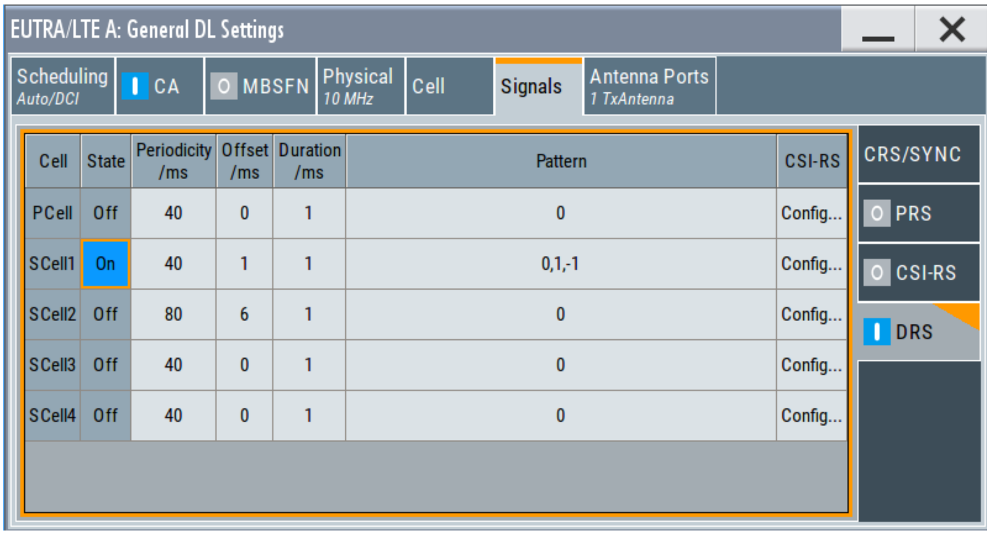
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:TRANscomb[<st>]`
on page 770

4.2.7.5 Discovery reference signals (DRS) settings

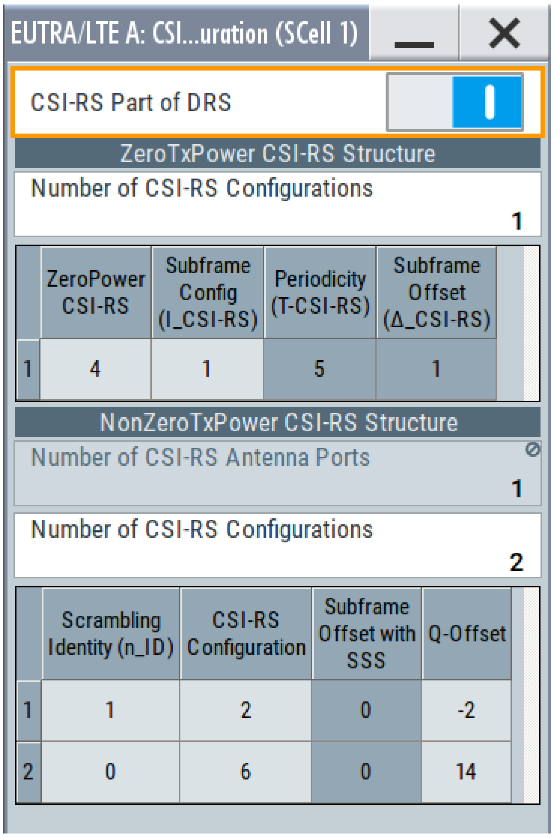
Option: R&S SMW-K119

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Scheduling > PDSCH Scheduling" > **"Auto/DCI or Auto Sequence"**.
3. Select "General DL Settings > CA" > **"SCell"** > "Duplexing" > **"LAA"**.
4. Select "General DL Settings > Signals > DRS".



5. To access the CSI-RS settings, select "CSI-RS > Config".



6. During a discovery signal occasion, the eNB can configure up to 5 zero-power CSI reference signals (CSI-RS) and up to 96 non-zero-power CSI reference signals within the DRS period.
   To configure the CSI-RS:
   a) Set "CSI-RS Part of DRS = On"
   b) Set "ZeroTxPower/NonZeroTxPower > Number of CSI-RS Configurations ≥ 1"
   c) Configure the CSI-RS structures as required.

   This dialog comprises settings, necessary to configure the discovery reference signals occasions for the LAA cells.
   For configuration of the LAA burst, see Chapter 4.3.8, "LAA settings", on page 167.
   See also "Discovery reference signal (DRS)" on page 58.

How to set the ARB sequence length for signals composed of DRSs with different periodicity

Per default, the R&S SMW uses an ARB sequence length of 1 frame. Thus the generated signal is 10 ms long and comprises the first LAA frame. This frame is then repeated cyclically.

If DRS signals with different periodicity are configured, you have to adjust the length of the generated signal so that it contains the whole DRS periodicity of all DRSs.

1. Select "LTE > Filter/Clipping/ARB/TDW/Power Settings > ARB" to observe the current signal length.

2. Calculate the required ARB sequence length as follows:
"ARB Sequence Length" = k*LCM("Periodicity"$_{PCell}$, "Periodicity"$_{SCell\#1}$, ... "Periodicity"$_{SCell\#4}$)/10

Where:
- k is a multiplier and k≥ 1
- LCM is the standard least common multiple mathematical function
- "Periodicity"$_{PCell/SCell\#n}$ is the DRS periodicity in milliseconds of each of the active cell with enabled DRS signals.

3. Set "ARB > ARB Sequence Length" to the calculated value.

Settings:

Cell
Indicates the cell (PCell or SCell) the displayed settings belong to.

Remote command:
n.a.

State
For LAA SCells, enables the selected discovery reference signal occasion configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:STATe on page 773

Periodicity
Defines how often the DRS measurement timing configuration (DMTC) occasion appears.

A DMTC occasion lasts 6 ms and can appear each 40 ms, 80 ms or 160 ms.

See also "Discovery reference signal (DRS)" on page 58.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:PERiodicity on page 773

Offset
Offsets the DRS within the periodical DRS occasion, see Figure 2-35.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:OFFSet on page 773

Duration
Sets or indicates the DRS duration.

- For LAA SCells, "Duration = 1 ms"
- In FDD mode, "Duration = 2 to 5 ms"

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:DURation on page 774

Pattern
A DRS is 1ms long (see Duration) and is transmitted **zero times or at most once** in any subframe during the DMTC occasion.

For LAA SCells, this parameter defines the DRS subframes for 20 DMTC occasions.

The values are set as a sequence of up to 20 values within the range -1 to 5 and indicate the following situations:
- -1: no DRS transmission
- 0, 1, 2, 3, 4, 5: DRS transmitted in the first/second/third/fourth/sixth subframe of the DMTC occasion

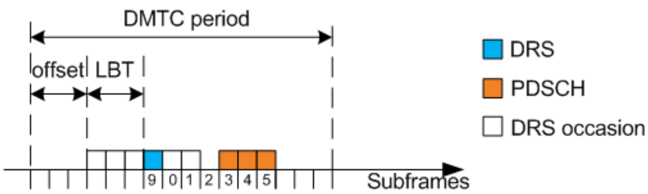


Figure 4-7: DRS allocation

DRS	= Discovery reference signal
LBT	= Listen-before-talk
DMTC	= DRS measurement timing configuration
DRS occasion	= Subframes during the DMTC period where DRS can occur
PDSCH	= Physical DL shared channel

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:PATTern on page 774

CSI-RS
During a discovery signal occasion, the eNB can configure up to 5 zero-power CSI reference signals (CSI-RS) and up to 96 non-zero-power CSI reference signals within the DRS period.

To configure the CSI-RS:
- Set "CSI-RS Part of DRS = On"

- Set "ZeroTxPower/NonZeroTxPower > Number of CSI-RS Configurations ≥ 1"
- Configure the CSI-RS structures as required.
- In the "Signals > CSI-RS" dialog, define the parameter Number of AP per CSI-RS Configuration for the LAA "Cell".

CSI-RS that is part of the DRS uses the same antenna ports (APs) as the CSI-RS, see "Mapping table" on page 225.

Provided are the following ZeroTxPower and NonZeroTxPower parameters:

CSI-RS Part of DRS ← CSI-RS

Enables defining the CSI-RS part of the DRS.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CDSTate` on page 774

ZeroTxPower/NonZeroTxPower CSI-RS Structure>Number of CSI-RS Configurations ← CSI-RS

Enables up to 5 ZeroTxPower CSI-RS and up to 96 NonZeroTxPower CSI-RS within the DRS period.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:ZPNum` on page 774

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:NZPNum` on page 775

ZeroPower CSI-RS ← CSI-RS

Sets the used CSI-RS configurations in the zero transmission power subframes. Required is a 16-bit-long hexadecimal value (bitmap). The UE assumes a zero transmission power for each bit set to one.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZP` on page 775

Subframe Config (I_CSI-RS) ← CSI-RS

Sets the parameter I_{CSI-RS} for CSI-RS with zero transmission power.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZPI` on page 775

Periodicity (T_CSI-RS) ← CSI-RS

Indicates the parameter subframe configuration period T_{CSI-RS} for CSI-RS with zero transmission power.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZPT?` on page 776

Subframe Offset (Delta_CSI-RS) ← CSI-RS

Indicates the parameter subframe offset Δ_{CSI-RS} for CSI-RS with zero transmission power.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZPDelta?` on page 776

Number of AP per CSI-RS Configuration ← CSI-RS
Defines (or indicates) the number of antenna ports (one, two, four or eight) the CSI-RS are transmitted on.

Option: R&S SMW-K119

- This field is configured automatically, if Number of CSI-RS Configurations≥ 2 is selected.
  The value indicates the number of antenna ports per CSI-RS configuration N_{ports}^{CSI} and is selected to comply with the aggregation rule, given in Table 2-8.
- The value displayed in the "DRS" > "CSI-RS" on page 126 dialog resembles the value set in the "CSI-RS" dialog.

Use the Cell-Specific Antenna Port Mapping and configure the cell-specific antenna port mapping.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NAP` on page 765

Scrambling Identity (n_ID) ← CSI-RS
From LTE Rel. 12 on, eNBs can generate the individual NonZeroTxPower CSI-RS with separate scrambling identity n_{ID} (`scramblingIdentity`) [TS 36.331].

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZSCid`
on page 777

CSI-RS Configuration ← CSI-RS
Defines the CSI-RS configuration used for the current cell and for which the UE assumes non-zero transmission power.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZConfig`
on page 777

Subframe Offset with SSS ← CSI-RS
Indicates the parameter subframe offset (`subframeOffset`) between the secondary synchronization signal (SSS) and the CSI-RS resource in a discovery signal occasion [TS 36.331].

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZSFoffset`
on page 777

Q-Offset ← CSI-RS
Sets the parameter Q-offset for cell-specific CSI-RS [TS 36.331].

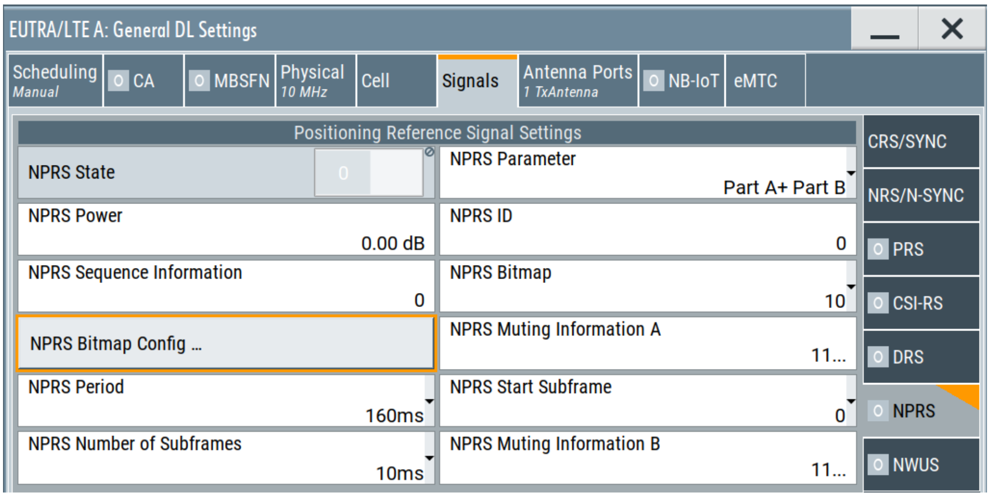
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZQoffset`
on page 778

4.2.7.6 Narrowband positioning reference signals (NPRS) settings

Option: R&S SMW-K143

Access:

1. Select "Mode > LTE/eMTC/NB-IoT"
2. Select "General > Link Direction > Downlink (OFDMA)".
3. Select "General DL Settings > Physical > Channel Bandwidth ≥ 3 MHz"
4. Select "General DL Settings > Signals > NPRS".



Comprises the settings for configuring the content of the `PRS-Info-NB` message, as defined in TS 36.355. This message contains information related to the configuration of the NB-IoT narrowband positioning reference signals (NPRS) in a cell.

NPRS State

Enables using the narrowband positioning reference signals (NPRS).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STATe` on page 967

NPRS Parameter

Defines which type of NPRS is used.

"Part A" Indicates a NPRS that is configured based on a bitmap of subframes, which are not NB-IoT downlink subframes.

"Part B"	Enabled if "General DL Settings > NB-IoT > Carrier Type = Anchor" and "Carrier Mode = Standalone/Guard Band". Indicates that a NPRS is configured based on a NPRS Period, subframe offset (NPRS Start Subframe) and a number of consecutive NPRS DL subframes per position occasion (NPRS Number of Subframes).
"Part A+B"	A subframe contains NPRS if both conditions for part A and Part B are fulfilled.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:CONF` on page 967

NPRS Power
Sets the power of the narrowband positioning reference signal (NPRS).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:POW` on page 967

NPRS ID
Sets the NPRS-ID used for the generation of the NPRS instead of using the physical cell ID (PCI).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:ID` on page 968

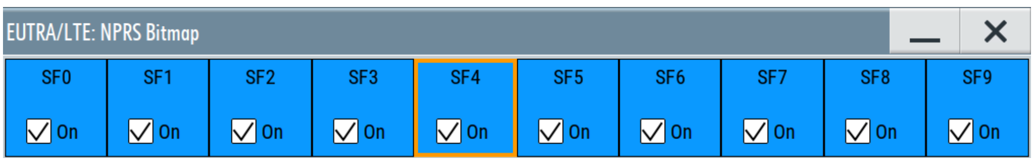
NPRS Sequence Information
Sets the parameter `nprsSequenceInfo` that specifies the index of the physical ressource block (PRB) containing the NPRS.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SEIN` on page 968

NPRS Bitmap
Sets if the NPRS subframe Part A configuration lasts 10 ms or 40 ms (`subframePattern10`, `subframePattern40`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:CONF` on page 968

NPRS Bitmap Config
Opens a configuration dialog and sets the NPRS bitmap.



The dialog indicates whether a subframe (SF) is used for NPRS transmission. If an SF is disabled, it does not contain NPRS; such subframes are indicated with value `'0'` in the bitmap.

The selected subframes influence the scheduling of the NPRS transmissions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:VALSubframes<ch>
on page 968

NPRS Muting Information A/B
Sets the nprs-MutingInfoA/nprs-MutingInfoB parameter, required if muting is used for the NPRS part A (and Part B) configurations.

"NPRS MutingInfo B" is displayed if NPRS Parameter = "Part B" or "Part A+B".

The nprs-MutingInfo field is a periodically repeating bit sequence with a length of 2, 4, 8 or 16 NPRS position occurrences, where:

"1" indicates that the NPRS is transmitted in the corresponding occasion; a "0" indicates a muted NPRS.

For Type A configuration, a NPRS position occasion comprises one radio frame (10 subframes). The muting sequence is applied to all subframes that follow the nprs-MutingInfoA message.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIA on page 969
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIB on page 969

NPRS Period
For NPRS Part B configuration, sets the parameter nprs-Period, that defines the NPRS occasion period T_{NPRS}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:PERiod on page 969

NPRS Start Subframe
For NPRS Part B configuration, sets the parameter nprs-startSF, that defines the subframe offset α_{NPRS}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STSFrame on page 970

NPRS Number of Subframes
For NPRS Part B configuration, sets the parameter nprs-NumSF, that defines the number of consecutive DL subframes N_{NPRS} within one NPRS positioning occasion.

If $N_{NPRS} > T_{NPRS}$, the UE should that NPRS is not transmitted in the cell.

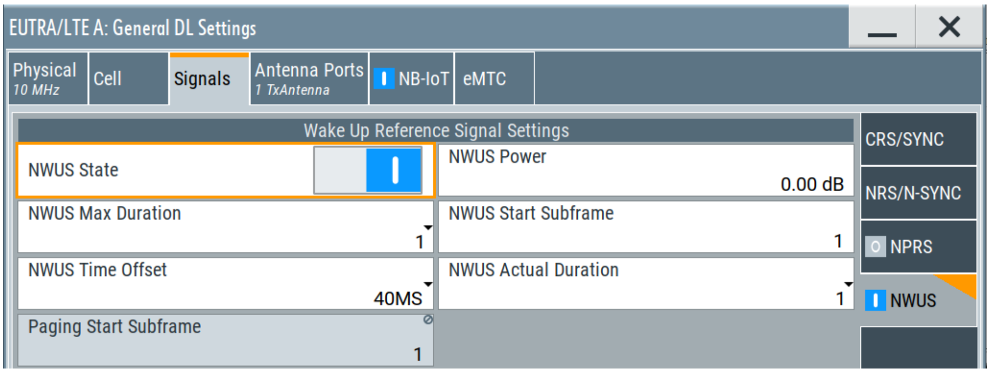
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SFNM on page 970

4.2.7.7 NB-IoT wake-up signal (NWUS) settings

Access:

1. Select "General > Link Direction > Downlink".

2. Select "General DL Settings > Signals > NWUS".



Option: R&S SMW-K146

Settings:

NWUS State

Enables the NB-IoT wake up signal. If enabled, the wake-up signal (WUS) configuration is provided in system information.

WUS events are displayed in logging data.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:STATe` on page 972

NWUS Max Duration

Sets the maximum WUS duration, expressed as a ratio of R_{max}.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:MAXDuration` on page 971

NWUS Power

Sets the transmit power of NB-IoT wake up signal

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:POW` on page 971

NWUS Start Subframe

Specifies the first subframe for paging associated with a WUS transmission.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:SF` on page 971

NWUS Time Offset
Sets the offset from the end of the configured maximum WUS duration to the associated paging occasion.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:TO on page 972

NWUS Actual Duration
Sets the duration of WUS in subframes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:ACD on page 970

Paging Start Subframe
Queries the first paging occasion in subframes associated with WUS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:PSF? on page 971

4.2.8 Antenna ports settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Antenna Ports".

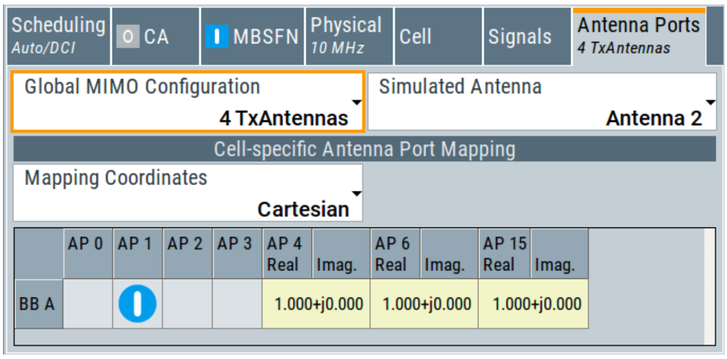
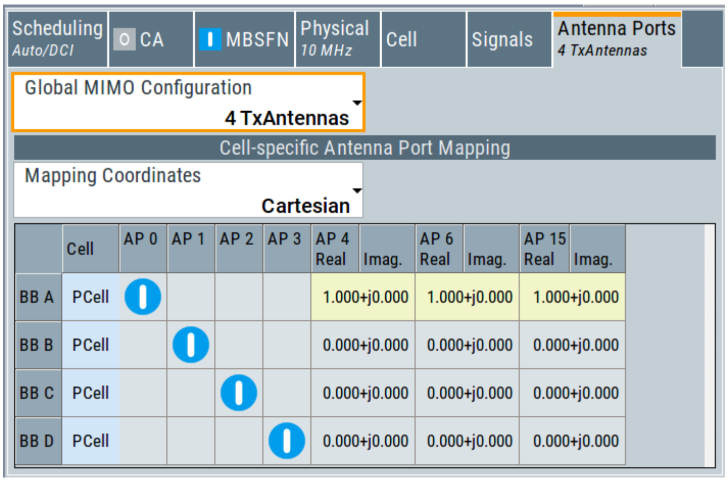
   In the "Antenna Ports" section, the MIMO configuration and the simulated antennas are defined.

The provided settings depend on the selected "System Configuration > Fading and Baseband Configuration > Mode" and the enabled LxMxN MIMO scenario, i.e. the number of enabled "Entities", "Basebands" and "Streams".

For details, see R&S SMW User Manual.

See Table 4-4. Compare the displayed settings for the same 4x4 MIMO configuration.

Table 4-4: Antenna ports settings depending on the enabled MxN MIMO configuration and System Configuration > Fading/Baseband Configuration > BB Source Config mode

<table>
<tr><th>Mode</th><th>"System Configuration > Fading/Baseband Configuration > 1x4x4"</th></tr>
<tr><td>"Separate"</td><td>
</td></tr>
<tr><td>"Coupled"</td><td>
</td></tr>
</table>

Global MIMO Configuration

Determines the number of transmit antennas of the simulated EUTRA/LTE system.

The Downlink Reference Signal Structure is set accordingly (see also Figure 2-9).

Note: One baseband simulates one antenna.

"1 TxAntenna" Enables single antenna port transmission.

"2 TxAntennas/4 TxAntennas"
Enables a multiple antenna transmission. The transmission mode, transmit diversity or spatial multiplexing, is determined per allocation with the parameter Precoding Scheme.

"SISO + BF" This mode combines the 1 transmit antenna Single Input Single Output (SISO) transmission with beamforming (BF).
This is the default mode in "System Configuration = 1x8x2", i.e. if the instrument is configured to generate a sharp beamformed signal with 8 Tx and 2 Rx antennas.
Beamforming is a method to increase the SNR of the signal received by the UE. In this mode, beamforming is implemented as a single layer PDSCH which is mapped to the different antennas with individual phase offsets. To simplify the configuration and to fulfill the requirements as specified in TS 36.101, Annex A, the same precoding vector as in a MIMO case can be used.

Note: While generating signal in this mode, the antennas simulated by path A and Path B are **not** MIMO antennas. The signal at the output of both paths is the same SISO signal with the same **cell-specific reference signals**.
To enable the instrument to generate a **transmission using antenna port 5** signal (transmission corresponding to the UE-specific reference signal) as defined in the 3GPP specification, set the parameter Precoding Scheme to "Beamforming (UE-spec.RS)".

In this case, the generated signal carries a combination of common signal part (PBCH, PDCCH, cell-specific RS,...), which is identical on all antennas, and UE-specific PDSCH, which is different on the antennas due to the applied precoding.

Note that, although the generation of a beamformed signal requires more than one antenna, for the UE it appears as a SISO signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 712

Simulated Antenna
In "System Configuration > Fading/Baseband Configuration > Mode > Standard", determines the antenna to be simulated in the current baseband.

The configuration of the Downlink Reference Signal structure is set accordingly (see Figure 2-9).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTenna on page 712

NB-IoT MIMO Configuration
Option: R&S SMW-K115

For "Channel Bandwidth = 200 kHz or ≥ 3 MHz", sets the number of transmit antennas used for the simulated NB-IoT system.

The NRS structure is set automatically.

To use Tx diversity:
- Select "NB-IoT MIMO Configuration = 2 Tx Antennas"
- In the mapping table, define the antenna port: select AP2000 or AP20001

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:MIMO:NIOT:CONFig on page 973

Cell-Specific Antenna Port Mapping
Option: R&S SMW-K84/K85

Comprises the settings for defining the mapping of the logical antenna ports to the available physical Tx antennas (Basebands).

Refer to Chapter 4.5, "DL antenna port mapping settings", on page 222 for description of the provided settings.

4.3 DL frame configuration settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Scheduling > Manual".
3. Select "General > Frame Configuration".

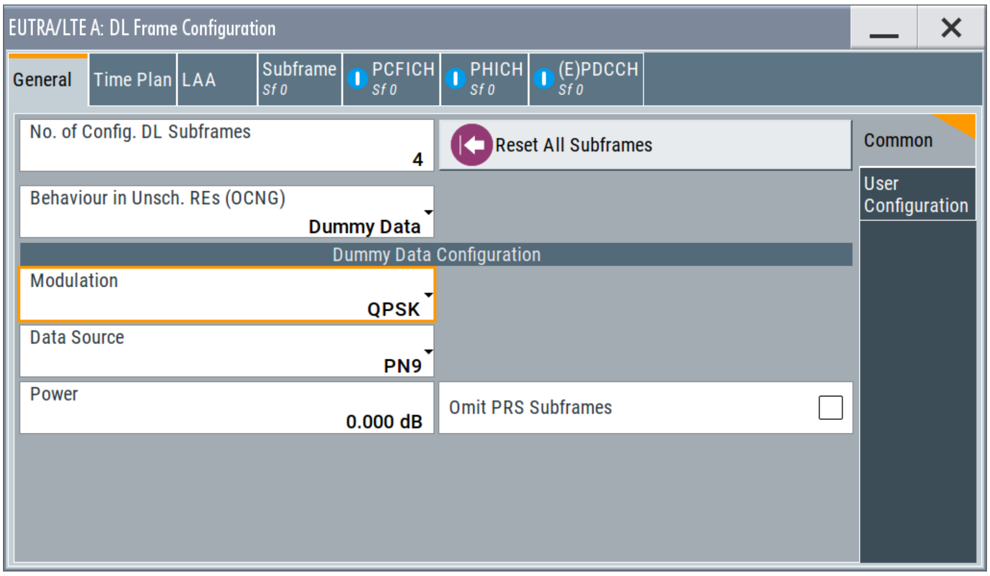
   The "DL Frame Configuration" dialog allows you to configure the subframes and the OFDMA resource allocations. The dialog consists of several tabs.

4.3.1 General frame configuration settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > General".

3. Select "General DL Settings > Scheduling > Manual".



This dialog comprises the general settings that can be configured in the OFDMA mode.

Provided are the following settings:

No Of Configurable (DL) Subframes

Sets the number of configurable subframes. Only the downlink and the special subframes are enabled for configuration if TDD mode is selected.

All downlink/special subframes are filled periodically with the configured subframes except for the P-SYNC/S-SYNC. The last are set globally in the "General DL Settings" dialog. The PBCH can only be configured in subframe 0.

For more detailed information about the maximum number of configurable subframes and for description of the dependencies between the parameters, see Chapter B.3, "Four configurable frames in uplink and downlink direction", on page 1105.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CONSubframes` on page 737

Reset All Subframes

Resets settings of all subframes including cyclic prefix and number of used allocations to the default values.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:RSTFrame` on page 737

Behavior In Unscheduled REs (OCNG)

Selects either to fill unscheduled resource elements and subframes with dummy data or DTX.

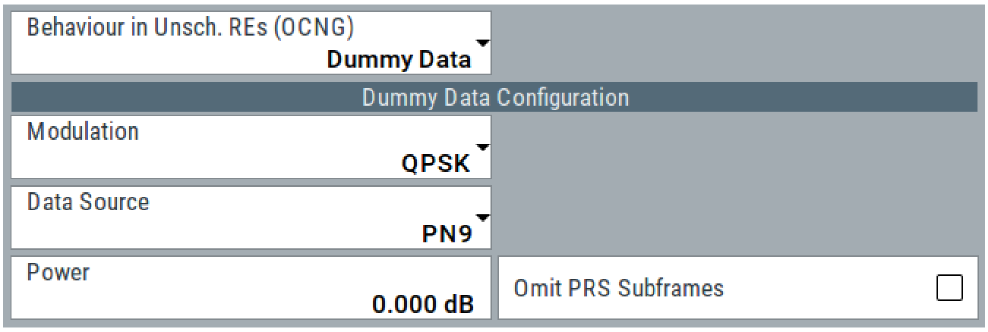
This function can be used as an OFDMA Channel Noise Generator (OCNG) according to TS 36.101.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:BUR on page 736

4.3.2 Dummy data configuration settings

Access:

► Select "Frame Configuration > Behavior in Unsch. REs (OCNG) > Dummy Data".



In this section, the dummy data for filling the unscheduled resource blocks and sub-frames are configured.

Modulation
Selects the modulation of the dummy data.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:MODulation on page 876

Data Source
Selects the data source for the dummy data configuration.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.

- Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
- Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
- Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DATA on page 877
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:PATTern on page 878
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DSELect on page 877

Power (Dummy Data)
Sets the power of the subcarriers allocated with dummy data.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:POWer on page 877

Omit PRS Subframes
(requires R&S SMW-K84)

If the OCNG (OFDM Channel Noise Generator) is used, you can disable (omit) the OCNG transmission in the non-muted PRS subframes, as required for RSTD Performance Tests (TS 36.133, section A.9.8.1).

Tip: Use the OFDMA time plan to visualize the allocated resources.

See also Example"How to visualize the effect of muting and omitting PRS transmission" on page 113.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:DUMD:OPSubframes on page 878

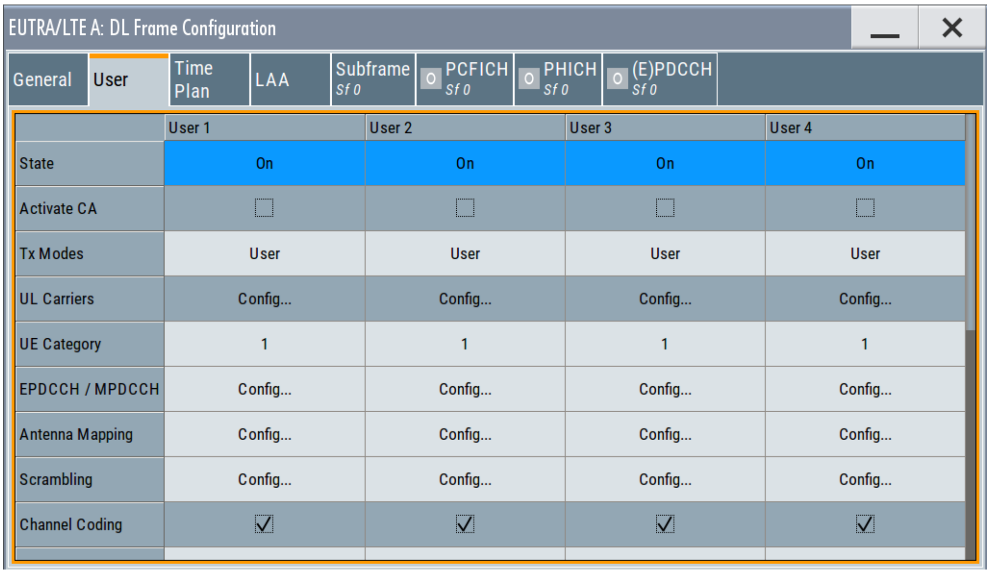
4.3.3 User configuration settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)"

2. Select "General DL Settings > Scheduling > Manual".

3. Select "Frame Configuration > General > User"



Use the provided settings to configure up to four scheduled UEs. To distribute them over the whole frame, set the data source of a certain allocation to "User x".
This approach ensures that a common data source is used for allocations of one user equipment also in case that these allocations are non-adjacent.

In one subframe, all allocations belonging to the same "User" use identical settings. Changing, for example, the modulation of one of the allocations of "User 1", changes the modulation in all other allocations of this user in the current subframe.

The aforementioned applies for the following settings:

- Modulation
  Different modulations can be selected for the two codewords of an allocation.

	CW	Modu-lation	Enhanced Settings	VRB Gap	No. RB	No. Sym.	Offset RB	Offset Sym.	Auto	Phys. Bits	Data Source	DList / Pattern	p A /dB	Content Type	State	Con-flict
0	1/1	QPSK	Config...	-	6	4	22	7(1/0)	☐	480	MIB	-	0.000	PBCH	On	
1	1/1	QPSK		-	50	2	0	0(0/0)	☐	-	PDCCH	-	0.000	PDCCH	Off	
2	1/1	QPSK	Config...	-	1	12	0	2(0/2)	☑	256	PN9	-	0.000	PDSCH	On	
3	1/1	QPSK	Config...	-	1	12	1	2(0/2)	☑	512	PN9	-	0.000	PDSCH	On	
4.1	1/2	16QAM	Config...	-	1	12	2	2(0/2)	☑	1024	User3	-	0.000	PDSCH	On	
4.2	2/2	QPSK	Config...	-	1	12	2	2(0/2)	☑	512		-			On	
5.1	1/2	16QAM	Config...	-	1	12	3	2(0/2)	☑	1024	User3	-	0.000	PDSCH	On	
5.2	2/2	QPSK	Config...	-	1	12	3	2(0/2)	☑	512		-			On	

- Complete Precoding settings
- Scrambling settings (Scrambling State, UE ID/n_RNTI) and Channel Coding Statetemporarily.
  See also the "Enhanced Settings" dialog of each allocation (Chapter 4.4, "Enhanced PBCH, PDSCH and PMCH settings", on page 211).

Settings:

User

Displays the consecutive number of the users.

Remote command:

n.a.

State

Enables/disables a user.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STATe` on page 861

3GPP Release

Option: R&S SMW-K115

Sets the 3GPP release version the UE supports.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:RELease` on page 1004

Activate CA

Option: R&S SMW-K85

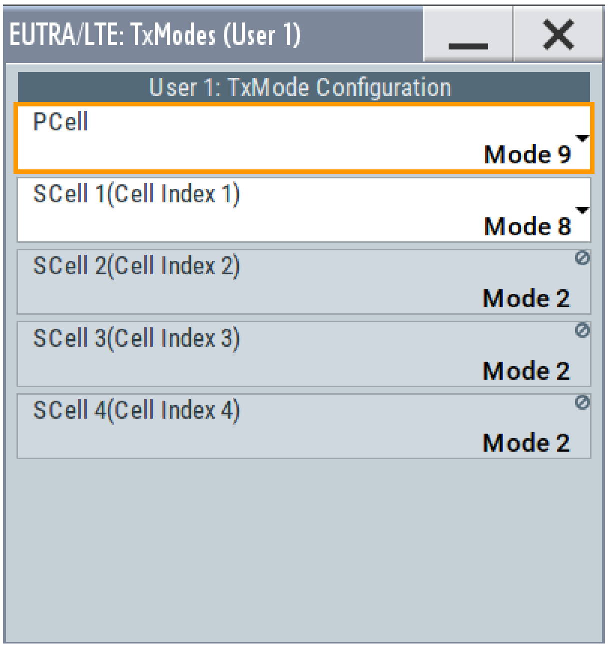
Enables/disables carrier aggregation for the selected user.

If Activate Carrier Aggregation is enabled, carrier aggregation is activated automatically for all users, but can be deactivated afterwards.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CA:STATe on page 862

Tx Modes
Sets the transmission mode of the user as defined in TS 36.213.

Consider the following prerequisites and interdependencies:
- "Tx Mode 8" and "Tx Mode 9" require R&S SMW-K84/K85.
- "Tx Mode 10" requires option R&S SMW-K112.
- The selected "Tx Mode" determines the range of allowed DCI formats, that is you can only assign valid DCI formats to this user.
  For any PDSCH allocation, the software configures its "Precoding" as a function of the selected "Tx Mode" and the selected "DCI Format".
- In "Tx Mode > User", the range for valid DCI formats is not affected.
- If a carrier aggregation is enabled (Activate Carrier Aggregation = On and Activate CA = On), you access the "TxModes Configuration" dialog.

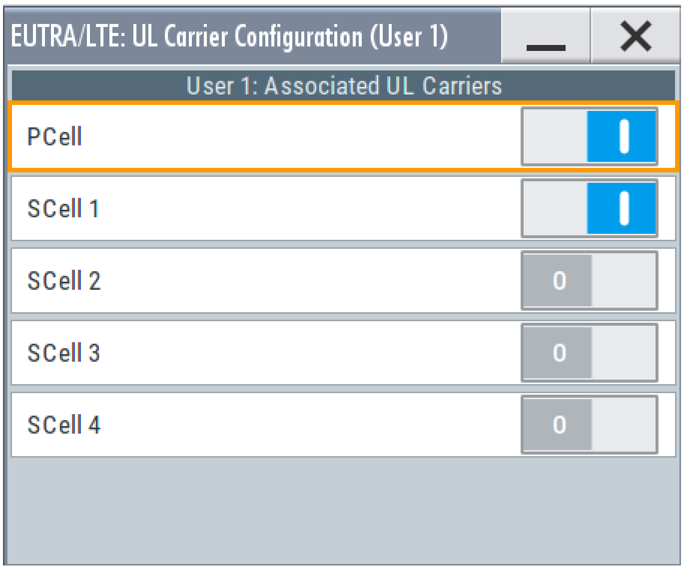


  You can define the transmission mode a UE uses in the primary and the secondary cells.
- Option: R&S SMW-K119
  SCells configured as LAA cells cannot use transmission modes "Tx Mode 5/6/7"
- Option: R&S SMW-K115
  Available are "Tx Mode = User" and "Tx Mode = Mode 1, 2, 6 and 9".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TXM on page 862
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TXM on page 862

UL Carriers Configuration
Option: R&S SMW-K85

If a carrier aggregation is enabled (Activate Carrier Aggregation = On), you can set the state of the associated UL carriers.



Option: R&S SMW-K119:

LAA SCells cannot be associated with UL carriers. For SCells using "CA > SCell x > Duplexing > LAA", the corresponding "SCell x > State = Off".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ULCA<st0>:STATe on page 863

Configure Auto Sequence
Option: R&S SMW-K112

If "General DL Settings > PDSCH Scheduling > Auto Sequence", access the "Auto Sequence" settings.

See Chapter 4.3.4, "Auto sequence configuration", on page 147.

UE Category
Sets the UE category.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEC on page 862

EPDCCH Config
Option: R&S SMW-K112/K115

Opens the "EPDCCH Configuration" dialog, see Chapter 4.3.5, "EPDCCH configuration settings", on page 156.

Antenna Mapping Configuration
Use the DL antenna port mapping settings dialog to define the mapping of the logical antenna ports to the available physical Tx antennas, in one of the following cases:
- "Tx Mode = Tx Mode 7 to 10/User"
- "EPDCCH > Activate EPDCCH > On"

Scrambling Configuration
Opens the "Scrambling Configuration" dialog, see Chapter 4.3.6, "Scrambling configuration settings", on page 161.

Channel Coding State
Sets channel coding for all allocations belonging to the selected user.

That is, the parameter "Channel Coding State" determines the "Enhanced Settings > Channel Coding State" of all allocations for which you select the Data Source = "User x".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CCODing:STATe` on page 866

UE ID
Sets the user equipment ID.

This UE ID is used for the generation of the scrambling sequence for the allocations, for which you select the DL frame configuration settings > "Allocation Table" > Data Source = "User x".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEID` on page 866

Data Source, DList/Pattern
Selects the data source for the selected user.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA` on page 867
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect` on page 867
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PATTern` on page 867

Data Source Init

Selects the starting seed for data sources for the PDSCH allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:INITpattern on page 867

eIMTA-RNTI

Option: R&S SMW-K113

Sets the dedicated eIMTA-RNTI used for CRC scrambling of the PDCCH.

See also "Enhanced interference mitigation & traffic adaption (eIMTA)" on page 54.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EIMTarnti on page 868

P_A

Sets PDSCH power factor according to TS 36.213, chapter 5.2.

This power value is applied to all allocations that belong to the corresponding user. The power of an allocation is also determined by the parameter "PDSCH Scheduling Mode". In a normal operation, the power values in the allocation table are configurable parameters. In the "Auto/DCI" mode however, the power value is fixed and cannot be adjusted.

For the DCI format 1D, an additional level offset has to be considered.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PA on page 868

SPS Configuration

Accesses the SPS configuration settings dialog to configure a semi-persistence scheduling for the selected user.

Aperiodic SRS State

Configures if the UE supports aperiodic transmission of SRS.

The aperiodic SRS transmission is a single (one-shot) transmission. Activate this parameter to be able to trigger SRS transmissions of the user by the DCIs.

Use the parameter DCI Format 1A > "SRS Request" to select one of the three SRS parameter sets.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ASRS:STATe on page 868

CSI Awareness State

Enables/disables the CSI awareness for the selected user, i.e. informs the UE that a CSI-RS are transmitted. See also "CSI reference signals" on page 33.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CAW:STATe on page 869

MSC Table

Option: R&S SMW-K113/-K119

Defines which of the MSC tables defined in TS 36.213 is used to specify the used modulation and coding scheme:

"1" Option: R&S SMW-K113
Table 7.1.7.1-1

"2" Option: R&S SMW-K113
Table 7.1.7.1-1A

"3" Option: R&S SMW-K119
Table 7.1.7.1-1B

"4" Option: R&S SMW-K119
Table 7.1.7.1-1C

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:MCS on page 869

TBS Alt. Index
Option: R&S SMW-K113/-K119

If "General DL Settings > PDSCH Scheduling > Auto DCI", enables using the extended TBS range for the PDSCH allocations scheduled by DCI format 1/1B/1D/2/2A/2B/2C/2D.

Sets the which of the transport block size (TBS) tables defined in TS 36.213 is used:

"0" Option: R&S SMW-K113
Table 7.1.7.1-1, up to TBS Index I_{TBS} = 26

"1" Option: R&S SMW-K113
Alternative TBS Index I_{TBS} = 26A in table 7.1.7.1-1, TBS Index I_{TBS} = 33A in tables 7.1.7.1-1A/B/C

"2" Option: R&S SMW-K119
Alternative TBS Index I_{TBS} = 33B in tables 7.1.7.1-1A/B/C

"3" Option: R&S SMW-K119
Alternative TBS Index I_{TBS} = 37A in tables 7.1.7.1-1B/C

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TBAL on page 869

DMRS Alt Table
Option: R&S SMW-K119

For Tx Modes = "TM9/TM10", sets the value of the higher-layer parameter `dmrs-tableAlt`.

With "Scheduling > Auto DCI/Auto Sequence", it defines the antenna port mapping and the value range of the parameter DCI Format 2/2A/2B/2C/2D > "Ant. Port(s), Layers, SCID".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:DMRS:STATe on page 870

Semi Open Loop
Option: R&S SMW-K119

For Tx Modes = "TM9/TM10", sets the value of the higher-layer parameter `semiOpenLoop`.

With "Scheduling > Auto DCI/Auto Sequence", it defines the antenna port mapping and the value range of the parameter DCI Format 2/2A/2B/2C/2D > "Ant. Port(s), Layers, SCID".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:SEOL:STATe`
on page 870

Support two HARQ Processes
Indicates if a NB-IoT UE is capable of understanding the HARQ process bit.

- Option: R&S SMW-K115
  The parameter is disabled and cannot be changed.
- Option: R&S SMW-K143
  Enables the UE to support the HARQ process bit.
  To set the HARQ process number bit (`twoHARQ-Processes`), use the DCI parameter "DL Frame Configuration > NB-IoT > DCI table > DCI Format = 0 > User = User x > Content > Config > HARQ Process Number", see"DCI Format N0" on page 417.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STHP:STATe` on page 871

4.3.4 Auto sequence configuration

The "Auto Sequence" mode requires the additional software option R&S SMW-K112. This mode supports you to generate EUTRA/LTE signals from a sequence perspective.

In "Auto Sequence" mode, you configure the sequence-related settings once per active User; all related parameters are calculated automatically.

Impact of the "Auto Sequence" mode on the configuration of DCIs

The following applies for each active user (State > On) and for every active cell:

- There is one DL DCI and one UL DCI for the user and the cell in the PDCCH DCI table. Comprehend these DCIs as template DCIs. The DCIs which are used for the generated subframes are derived from them, with modifications according to the auto sequence DCI tables.
  See Figure 4-8
- Suitable DCI formats are selected automatically, according to the Tx Modes.
- If Activate Carrier Aggregation is enabled, the Cell Index for the DL-DCI and UL-DCI is set to the selected sched. Cell Index
- Several parameters of the DCI formats are automatically varied throughout the subframes (see DCI format configuration).

  For example:

  – The modulation and coding scheme (MCS) and HARQ-related parameters are indicated as "Auto"

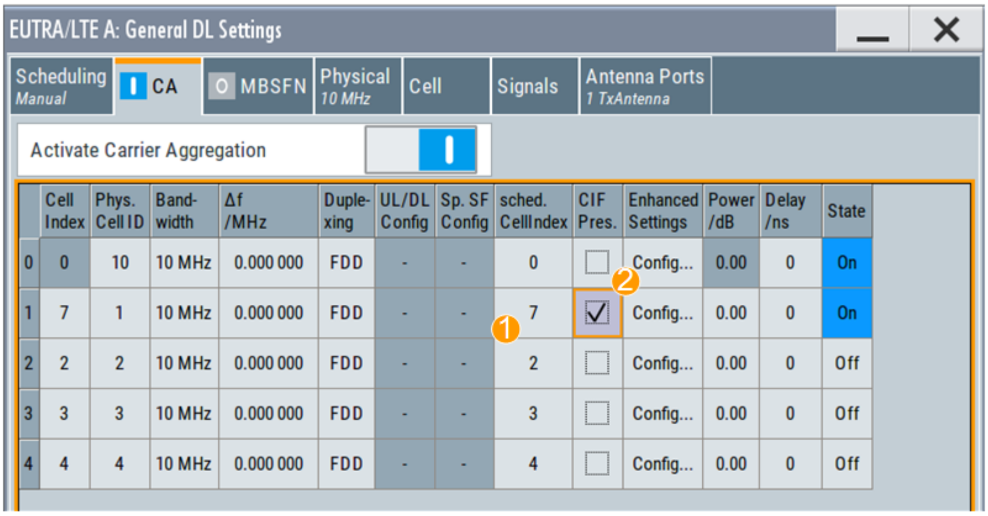
  – If CIF Present is enabled, the CIF parameter in the DL-DCI and UL-DCI is set to the selected Cell Index

4.3.4.1 How to enable and use the auto sequence mode

In the following, we generate an LTE-A signal with DL carrier aggregation and 2x2 MIMO to explain the "Auto Sequence" mode.

This example focuses on the "Auto Sequence" settings and their impact. For step-by-step instruction on how to enable the required configuration, see Chapter 4.2.2.2, "How to enable carrier aggregation and cross-carrier scheduling", on page 76.

1. Enable a 2x2x2 "System Configuration" with coupled basebands.
2. Select "Baseband > EUTRA/LTE > General DL Setting > CA".
   Enable for example the following settings:



1 = Cross-carrier scheduling is disabled (SCell#1 uses "schedCellIndex = 7")
2 = "CIF Preset > On"

3. Select "General DL Setting > Scheduling > PDSCH Scheduling > Auto Sequence".
4. Select "EUTRA/LTE > DL Frame Configuration > General".
   Enable "User > User 1/User 2 > State > On".

   The subframe-related settings are not displayed. Compare these settings to the settings described in Chapter 4.3, "DL frame configuration settings", on page 136.

5. Select "DL Frame Configuration > PDCCH > DCI Table".
   Observe the settings.

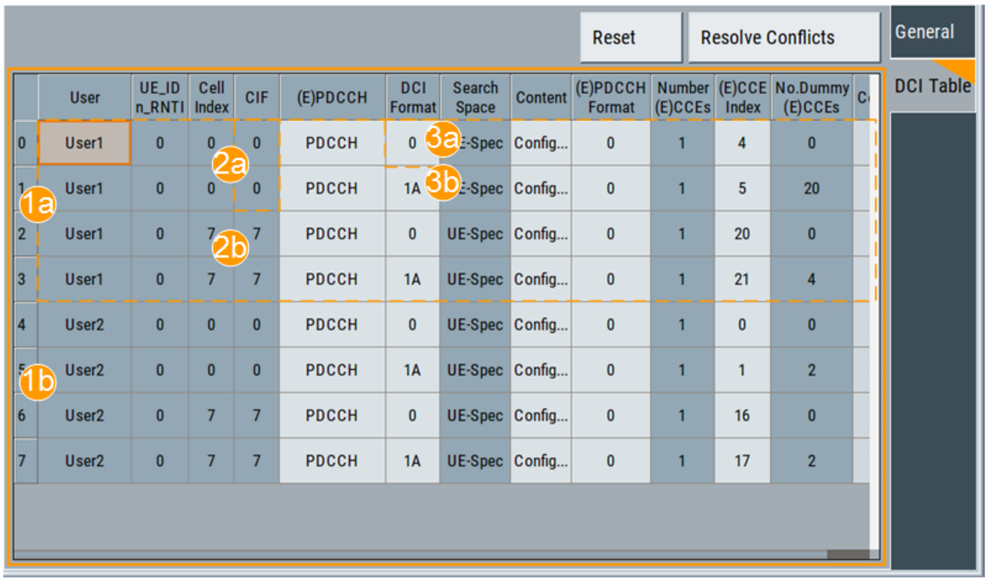


Figure 4-8: DCI table in PDSCH Scheduling > Auto Sequence mode

1a, 1b = Two active users, "User1" and "User2"
2a, 2b = Two active cells with "schedCell Index = 0 and 7"
3a, 3b = Automatically selected "DCI format = 0 and 1A" per cell, see "Impact of the "Auto Sequence" mode on the configuration of DCIs" on page 147

6. In "DCI Table", select "User1 > DCI Format 1A > Content > Config" for the DCI with "Cell Index = 7".

   The "DCI Format Configuration" confirms the configuration: "CIF = 7", MCS and HARQ-related settings are set to "Auto".

7. To configure the HARQ transmission:

   a) Open the "DL Frame Configuration > General > User Configuration > User1 > Auto Sequence > Config" dialog.

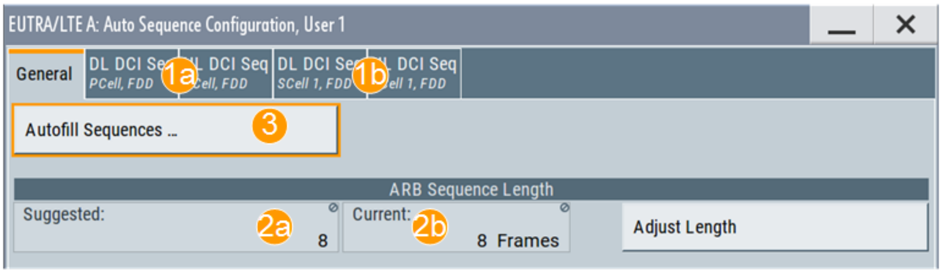


Figure 4-9: Auto Sequence settings: Understanding the displayed information

1a, 1b = Automatically selected DL DCI and UL DCI per cell, see "Impact of the "Auto Sequence" mode on the configuration of DCIs" on page 147
2a, 2b = Suggested and current ARB sequence length

   b) Select "Auto Sequence > Autofill Sequences".
   Configure the HARQ transmission. Select "Apply".
   See Figure 4-10.

   c) If the current ARB sequence length deviates form the suggested one, select "Adjust Sequence Length".

   The "Auto Sequence > DL/UL DCI Seq" display the resulting sequences.

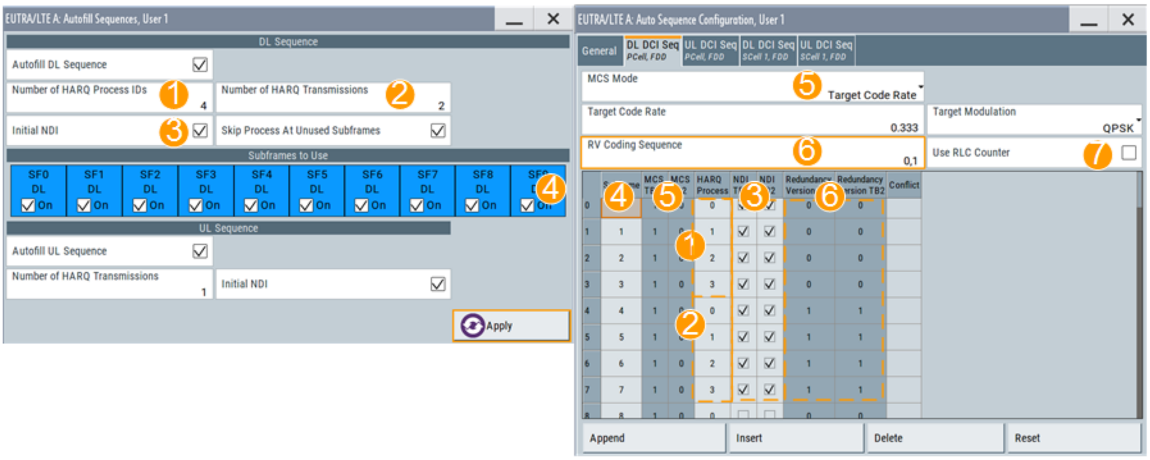


Figure 4-10: "Autofill Settings" and "Auto Sequence Configuration": Understanding the displayed information

1 = "Number of HARQ Processes = 4"; the HARQ Processes IDs change cyclically form 0 to 3
2 = "Number of HARQ Transmissions = 2"; the four HARQ Processes are transmitted 2 times
3 = "Initial NDI = On"; the New Data Indicator (NDI) is enabled for "Number of HARQ Transmissions = 2" times and starting with the first HARQ process

4	= "Subframes to use = all DL subframes"
5	= "MCS Mode = Target Code Rate"; the modulation and coding scheme values (MCS) are set automatically to fulfill the required "Target Code Rate" for the selected "Target Modulation"
6	= "RV Coding Sequence = 0,1", where each the redundancy version value is used for one HARQ transmission
7	= "Use RLC Counter = On"
TB1, TB2	= NDI, RV and RLC values are provided per transport block (TB), where the number of TBs depends on the MIMO configuration

4.3.4.2 Auto sequence settings

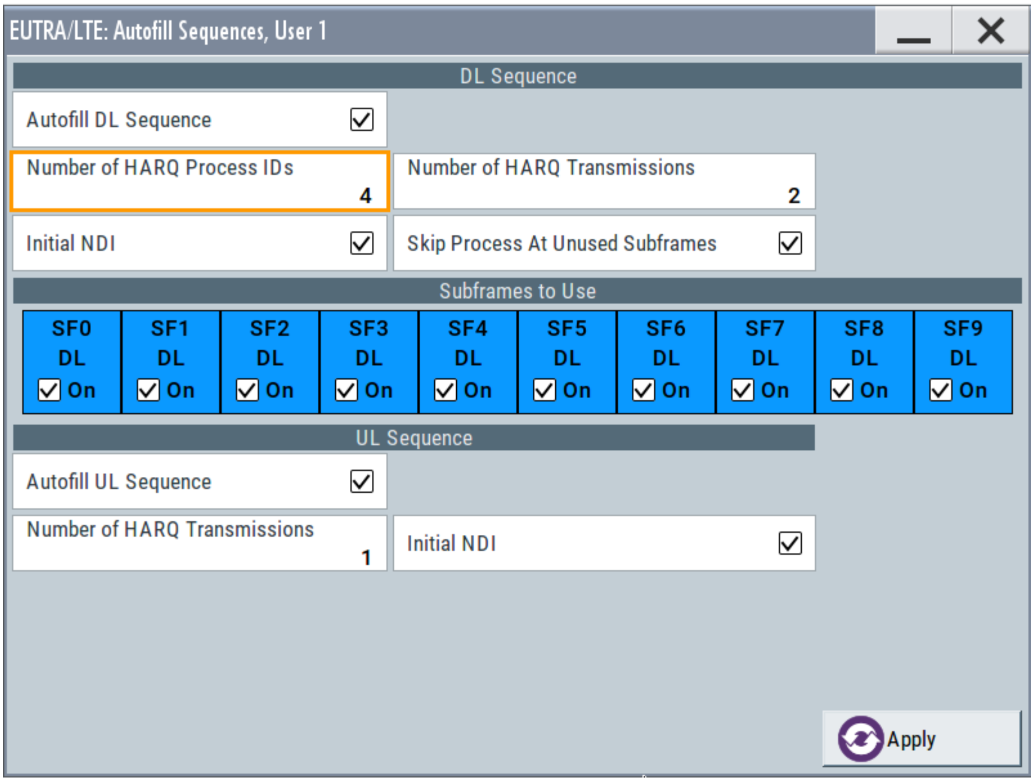
To access this dialog:

1. Select "EUTRA/LTE > General DL Setting > Scheduling > PDSCH Scheduling > Auto Sequence".
2. Select "DL Frame Configuration > General > User Configuration > User1 > Auto Sequence > Config."

   The "Auto Sequence" dialog opens.
   See Figure 4-9.

   For instruction on how to use these settings, see Chapter 4.3.4.1, "How to enable and use the auto sequence mode", on page 148.

Autofill Sequences...
Access a dialog with settings to configure the DL and UL DCIs.



To configure the Auto Sequence DCI tables of the user automatically, enable the "Autofill DL/UL Sequence" parameters, adjust the settings, and confirm with "Apply".

See Figure 4-10 for illustration on how these settings are processed.

Autofill DL/UL Sequence ← Autofill Sequences...
Automatically fill the auto sequence DCI tables of the user in a meaningful and standard-compliant way.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:AFSeq` on page 826
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:AFSeq` on page 826

Number of HARQ Process IDs ← Autofill Sequences...
Sets the number of HARQ process IDs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHIDs` on page 827

Number of HARQ Transmissions ← Autofill Sequences...
Sets the number of HARQ transmissions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHTRans` on page 827
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:NHTRans` on page 827

Initial NDI ← Autofill Sequences...
Defines whether the "New Data Indicator" flag is set at the beginning of the sequence or cleared.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:INDI on page 827
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:INDI on page 827

Skip Process at Unused Subframes ← Autofill Sequences...
Defines how the HARQ processes are distributed throughout the used subframes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:SKPRocess on page 827

Subframes to Use: ← Autofill Sequences...
Sets the downlink subframes to be used for the HARQ transmission as a pattern of "0" and "1", where 1 enables a subframe.

Do not set the uplink subframes; in FDD duplexing mode, used are all subframes and in TDD mode, all downlink and special subframes that are allowed to schedule uplink transmissions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL[:CELL<ccidx>]:USUBframe<dir0> on page 828

Apply ← Autofill Sequences...
Applies the settings

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:APPLy on page 828

ARB Sequence Length > Suggested, Adjust Length
Displays the suggested and currently used ARB sequence length.

If the current ARB sequence length deviates form the suggested one, select "Adjust Sequence Length". The ARB sequence length is set automatically.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ARBLen? on page 826
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ASLength on page 826

DL DCI Sequence
The DL DCIs are defined in table form that can be filled in manually, by adding rows and configuring them, or automatically, with the Autofill Sequences... settings.

See Figure 4-10 for illustration on how these settings are processed.

MCS Mode ← DL DCI Sequence
Sets how the Modulation and Coding Scheme is configured.

"Manual" Enter the MCS value in the corresponding column

"Fixed" The MCS value is fixed and configured with the parameter MCS

"Target Code Rate"
The required MCS value is calculated based on the selected "Target Code Rate" and "Target Modulation".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:MCSMode
on page 828

MCS ← DL DCI Sequence
In "MCS Mode > Fixed", sets the MCS value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:FMCS
on page 828

Target Code Rate, Target Modulation ← DL DCI Sequence
In "MCS Mode > Target Code Rate", sets the target code rate and modulation (QPSK, 16QAM, 64QAM).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TCR on page 829
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TMOD
on page 829

RV coding Sequence ← DL DCI Sequence
Sets the redundancy version sequence to be used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RVCSequence
on page 829

Use RLC Counter ← DL DCI Sequence
Enables/disables the use of radio link control (RLC) counter.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:URLCounter
on page 832

DL DCI Sequence Table ← DL DCI Sequence
The DCIs are configured in table form. If the Autofill Sequences... function is used, several parameters are preconfigured.

In TDD mode, the DCI table lists only the DL and special subframes.

A conflict indicates an erroneous situation, like for example if the selected "Target Code Rate" cannot be achieved.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SLENgth?
on page 830
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:SUBFrame on page 831
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:MCS on page 831
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:HARQ on page 830
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:NDI on page 831

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RV on page 832
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RLCCounter on page 832
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:PDRE on page 830
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:CONFlict? on page 832

UL DCI Sequence
The UL DCIs are defined in table form, that can be filled in manually, by adding rows and configuring them, or automatically, with the Autofill Sequences... settings.

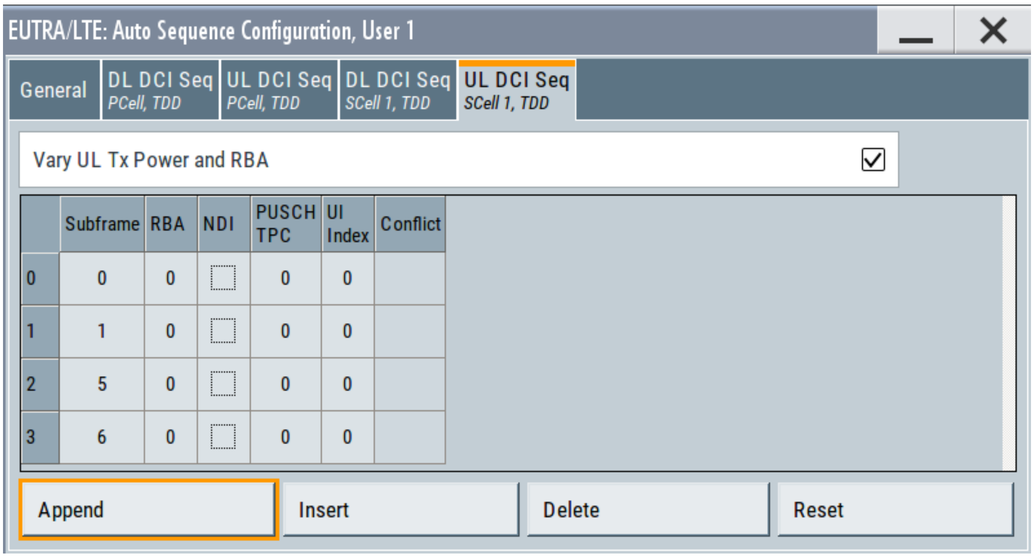


Figure 4-11: UL DCI Sequence settings in TDD mode ("UL/DL Configuration = 0")

Vary UL TX Power and RBA ← UL DCI Sequence
Enables the "PUSCH TPC" column in the table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:VULTxpow on page 834

UL DCI Sequence Table ← UL DCI Sequence
The DCIs are configured in table form. If the Autofill Sequences... function is used, several parameters are preconfigured.

In TDD mode, the DCI table lists only the DL and special subframes. The "UL Index" parameter is displayed if a TDD UL/DL Configuration = 0 is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SLENgth? on page 830
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:SUBFrame on page 831

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:RBA on page 833
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:NDI on page 831
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:PTPC on page 833
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:ULINdex on page 833
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:CONFlict? on page 832

Append, Insert, Delete, Reset
Standard functions for handling of table elements.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 834
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:APPend on page 834
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:INSert on page 834
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:DELete on page 835
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RESet on page 835
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SELement on page 834
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:APPend on page 834
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:INSert on page 834
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:DELete on page 835
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:RESet on page 835

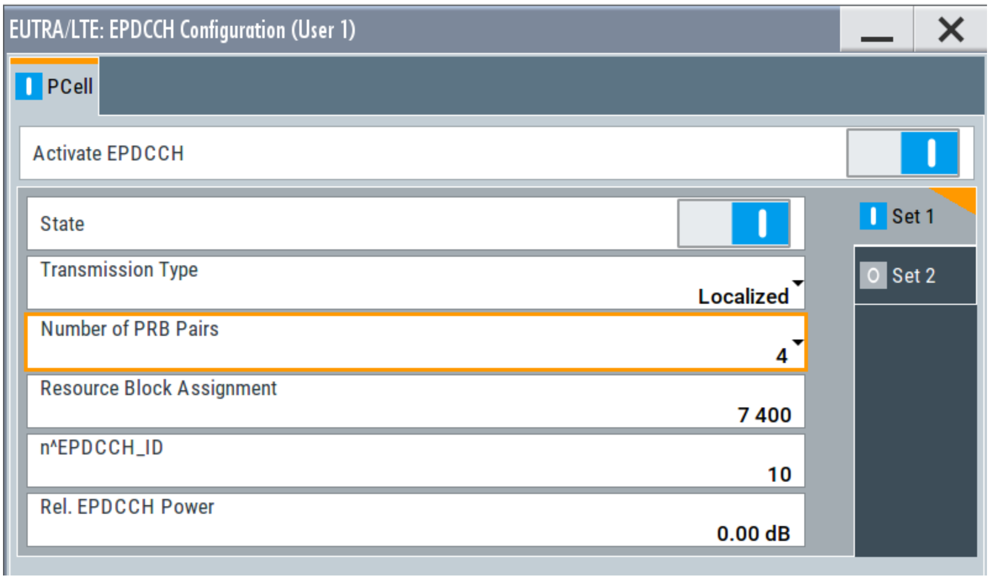
4.3.5 EPDCCH configuration settings

Option: R&S SMW-K112/K115

Access:

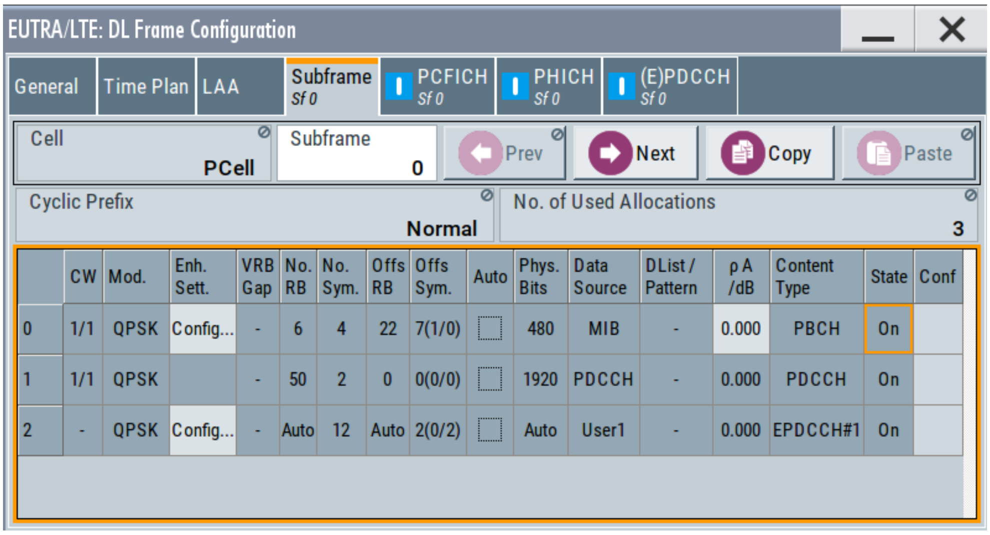
1. Select "General > Link Direction > Downlink (OFDMA)"
2. Select "General DL Settings > Scheduling" > **"Auto/DCI"**
   EPDCCH cannot be activated in manual mode ("Scheduling > Manual")
3. Select "Frame Configuration > General > User"
4. Select "User# > EPDCCH > Config"

5. Set "Activate EPDCCH > On".



You can enable and configure the EPDCCH parameters for the selected user and, if DL carrier aggregation is used, also per component carrier.

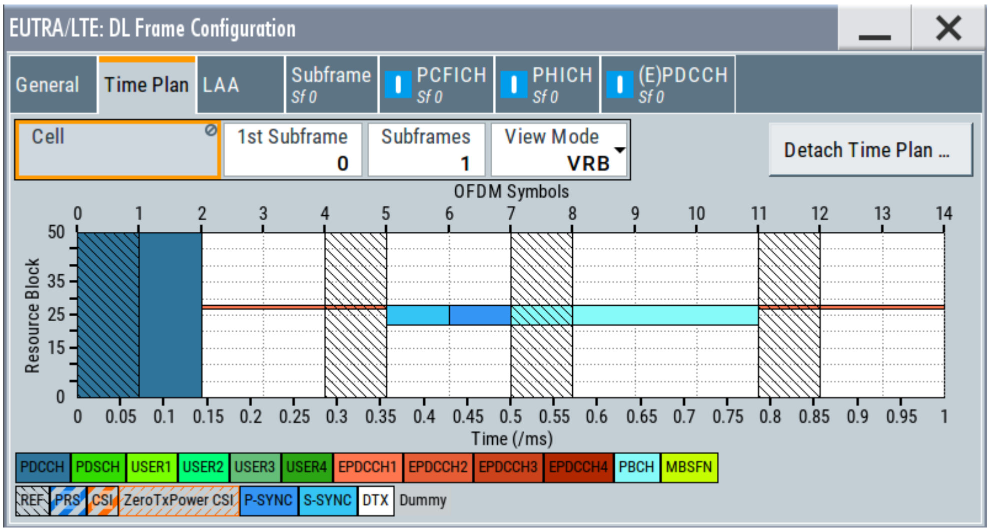
6. Select "Frame Configuration > E(DPCCH)".
7. In the "DCI Table", select "User 1 > (E)EPDCCH > EPDCCH Set 1".
8. Select "Frame Configuration > Subframe > Subrame#0 > Allocation Table" to observe the EPDCCH allocation.



The parameters of the EPDCCH#1 allocation and the most of the available parameters are set automatically.

9. Select "EPDCCH > Enhanced Settings > Config" to observe the percoding information, i.e. the used antenna ports.

10. Select "Frame Configuration > Timeplan" to observe the EPDCCH configuration.



The display confirms that the EPDCCH is transmitted in the data region of the frame and it does not span the full system bandwidth. The EPDCCH is transmitted over a set of four narrow non-contiguous physical resource blocks (PRB).

The number of displayed EPDCCH pairs per UE depends on the following:

- Number of PRB pairs per EPDCCH set.
- Number of active EPDCCH sets.
  The two EPDCCH sets of one UE are indicated with the same color.
- If and which EPDCCH set is allocated ("Frame Configuration > E(DPCCH) > User x > (E)EPDCCH > EPDCCH Set x")
  At least one DCI must be assigned to an EPDCCH.
- EPDCCH transmission type
- Resource block allocation per EPDCCH set.
  EPDCCH may partly overlap.
- Amount of DCI information (assigned ECCEs) carried in an EPDCCH with two PRB pairs and localized transmission.
  If the DCI information is not sufficient to fill all available EPDCCH PRBs, the unallocated PRBs can be used for PDSCH transmission.

Settings:

Activate EPDCCH

If "General DL Settings > Scheduling" > **"Auto/DCI"**, enables the EPDCCH transmission for the select user and component carrier.

EPDCCH cannot be activated in manual mode ("Scheduling > Manual").

Option: R&S SMW-K115

The EPDCCH and EPDCCH set 1 are always active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:STATe` on page 874

Set 1/2 State

Enables the EPDCCH set.

To allocate an EPDCCH set, select "Frame Configuration > E(DPCCH) > User x > (E)EPDCCH > EPDCCH Set 1/2".

Option: R&S SMW-K115

The EPDCCH and EPDCCH set 1 are always active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STATe` on page 874

Transmission Type

Select whether localized or distributed EPDCCH transmission is used.

"Localized" Subsequent EREGs are allocated within the same PRB as long as there are physical resources available.
Localization transmission is useful if the channel conditions are known, so that the scheduling and MIMO precoding can be optimized.

"Distributed" EREGs are allocated in the separate (subsequent) PRBs.
This transmission type applies frequency diversity and distributed the REGs among the available channel bandwidth. Distributed transmission is used if the channel conditions are unknown.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:TTYP` on page 874

Number of PRB Pairs

Sets the number of physical resource block (PRB) pairs.

Per PRB pair, there are 16 enhanced resource element groups (EREG), that are numbered from 0 to 15.

Observe the OFDMA time plan

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:PRBS on page 875

Resource Block Assignment
Shifts the EPDCCH allocations in the frequency domain and defines the resource blocks used for the EPDCCH transmission.

The EPDCCH PRBs are distributed among the available resource blocks according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:RBA on page 875

N^EPDCCH_ID
Unlike the PDCCH that is a cell-specific control channel, the EPDCCH is a user-specific control channel.

This parameter sets the user-specific identifier $n^{EPDCCH}_{ID,m}$ used to initialize the DMRS scrambling sequences of the EPDCCH sets.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:NID on page 875

Relative EPDCCH Power
Sets the power of the EPDCCH allocations.

The value is applied relative to the value of the parameter Reference Signal Power.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:POWer on page 876

Hopping
Option: R&S SMW-K115

Enables MPDCCH hopping.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:HOPPing on page 1033

Starting NB
Option: R&S SMW-K115

Sets the first narrowbands in which MPDCCH is allocated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STNB on page 1034

Max. Repetitions MPDCCH (Rmax)
Option: R&S SMW-K115

Sets the maximum number the MPDCCH is repeated.

The actual number of repetitions is calculated as function ofhte repetition level, as described in "MPDCCH repetition number" on page 373.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:REPMpdcch` on page 1033

Search Space Start Subframe
Option: R&S SMW-K115

Sets the first subframe of the search space.

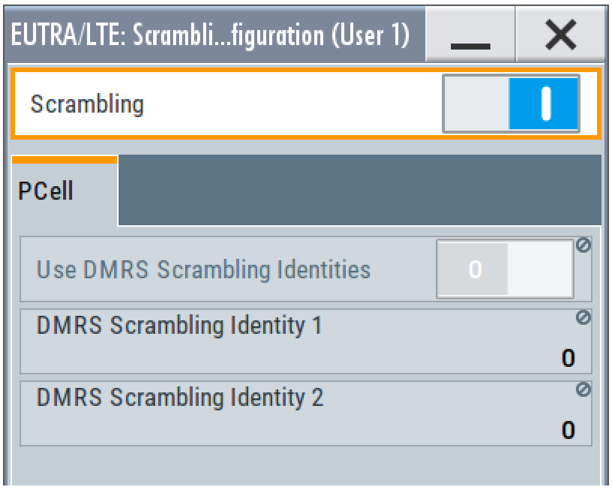
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STSF` on page 1034

4.3.6 Scrambling configuration settings

(requires R&S SMW-K112)

Access:

1. Select "General > Link Direction > Downlink (OFDMA)"
2. Select "Frame Configuration > General > User"
3. Select "User# > Tx Modes > Mode 10"
4. Select "User# > Scrambling > Config"



With option R&S SMW-K112, you can enable and configure the scrambling parameters for the selected user.
If DL carrier aggregation is used, the scrambling parameters are configured per component carrier. The scrambling state, however, applies to all component carriers.

Settings:

Scrambling State

Enables/disables scrambling for all allocations belonging to the selected user.

The parameter "Scrambling State" determines the "Enhanced Settings > Scrambling State" of all allocations for which you select the Data Source = "User x".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe` on page 871

Use DMRS Scrambling Identities

Sets if one or two scrambling identities are used for the demodulation reference signals (DMRS).

See "Coordinated multi-point operation for LTE (CoMP)" on page 52.

To set the n_{CSID}, use the parameters DCI Format 2/2A/2B/2C/2D and Scrambling Identity n_SCID.

"Off" The DRMS sequence is generated with the variable $n_{ID} = N_{ID}^{cell}$, where N_{ID}^{cell} is the physical cell identity (PCI).

"On" $n_{ID} = n_{ID}^{DMRS,i}$, i.e. two DRMS scrambling identities are used.
Set the values with the parameters DMRS Scrambling Identity 1/2.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:USE`
on page 871

DMRS Scrambling Identity 1/2

Sets the DMRS scrambling identities $n_{ID}^{DMRS,i}$.

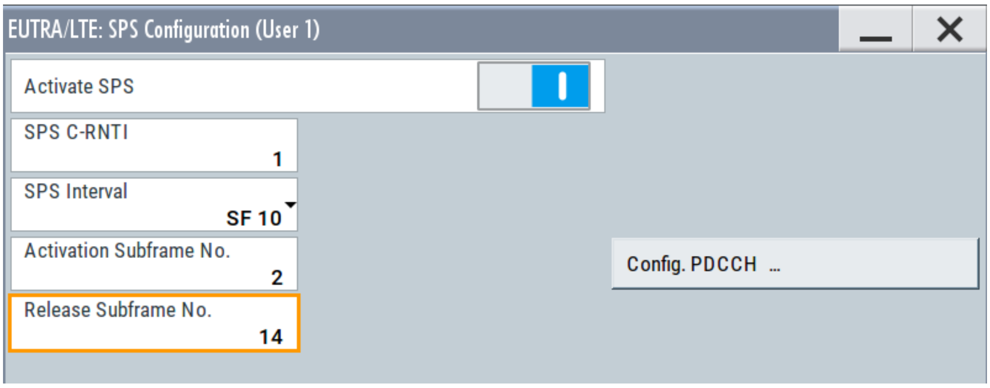
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:ID1`
on page 872
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:ID2`
on page 872

4.3.7 SPS configuration settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)"
2. Select "Frame Configuration > General > User"

3. Select "User# > SPS > Config"



With the provided settings, you can enable and configure a semi-persistent scheduling (SPS) for the selected user.

Semi-persistent scheduling is a scheduling method used to reduce the control signaling overhead for regularly occurring services and transmissions of relative small payloads, see "Uplink scheduling" on page 41.

Related parameters

In this firmware, the configuration, the activation and the deactivation of an SPS transmission is implemented as following:

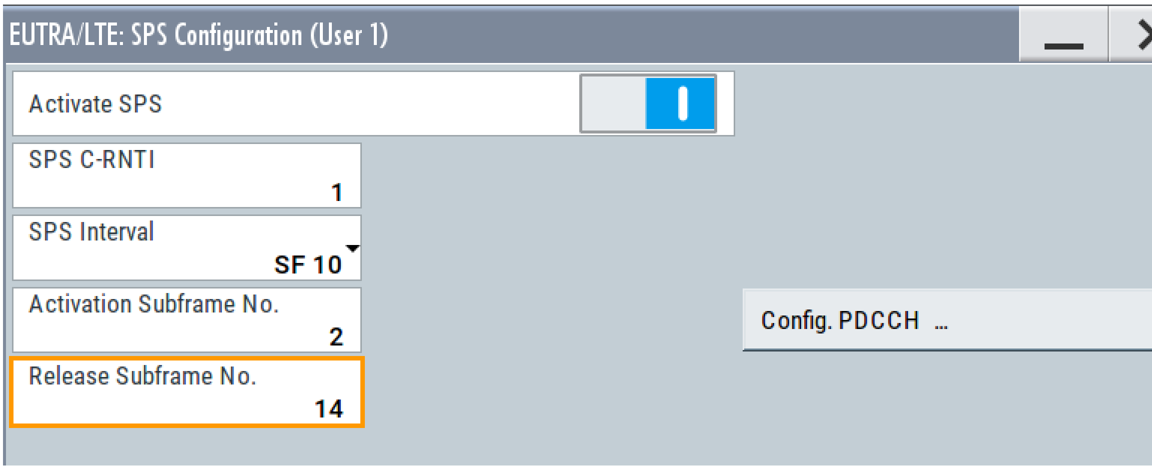
- Configuration of the SPS pattern is defined by:
  - SPS Interval
  - SPS C-RNTI
  - Activate SPS
- Activation of the SPS is defined by:
  - Activation Subframe No
  - Config PDCCH > "PDCCH Activation Subframe# > DCI Table > User > User x SPS > DCI Format" and
    "Content Act. > DCI Format Configuration > Special fields"
- Transmission
  Observe the scheduling in the OFDMA time plan
- Release of the SPS is defined by:
  - Release Subframe No
  - "Config PDCCH > PDCCH Release Subframe# > DCI Table > User > User x SPS > Content Rel > DCI Format Configuration > Special fields"

How to configure an SPS for User 1 and visualize the scheduling

The following is a simple example that demonstrates the necessary configuration steps and lists only the related settings. Setting beyond the scope of this example are not discussed.

To enable a semi-persistent scheduling

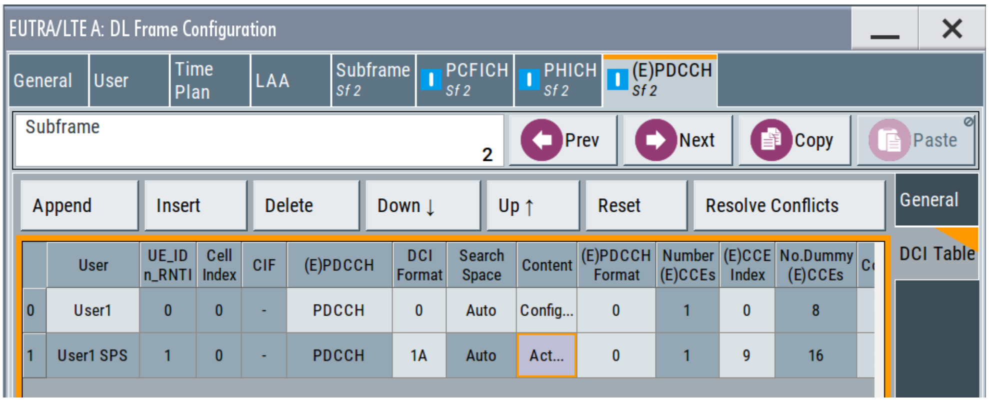
1. Select "EUTRA/LTE > Filter/Clipping/ARB > ARB Sequence Length = 3 Frames".
2. Select "EUTRA/LTE > General DL Settings > PDSCH Scheduling > Auto/DCI".
3. Select "EUTRA/LTE > Frame Configuration" and enable "Number of Configurable Subframes = 30".
4. Select "Frame Configuration > User".
   Enable "User 1 > SPS > Config".
5. In the "SPS Configuration" dialog, enable "SPS Interval = SF 10", "Activation Subframe No = 2" and "Release Subframe No = 14".



The User 1 is scheduled to start transmission in the subframe#2 and release it in subframe#14. The SPS interval is 10 subframes. If the DCIs are configured correctly, the User 1 transmits in subframe#2 and subframe#12.

6. In the "SPS Configuration" dialog, select "Config. PDCCH".

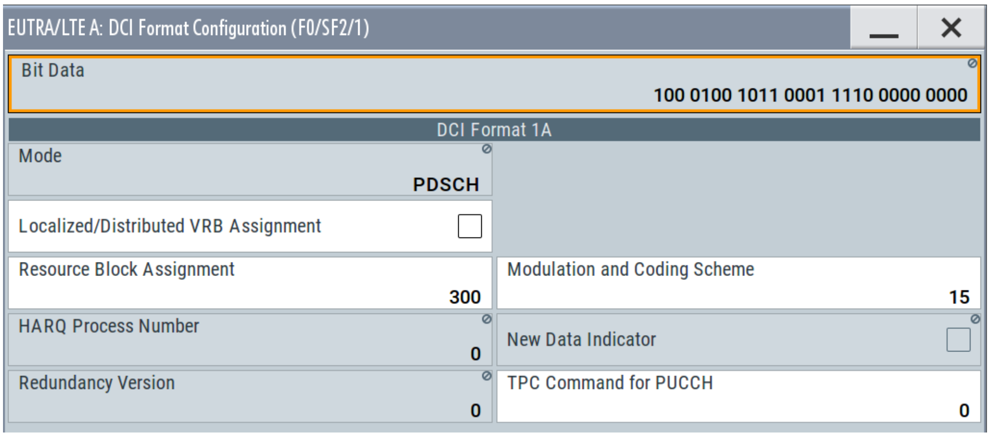
   The "Frame Configuration" dialog opens and the "DCI Table" displays the PDCCH settings of subframe#2.



The second PDCCH item in the DCI table confirms that the User 1 is semi-persistent scheduled ("User > User 1 SPS") and subframe#2 is the activation subframe of this SPS ("User 1 SPS > Content > Act.").

7. In the "DCI Table", select "User 1 SPS > Content > Act."

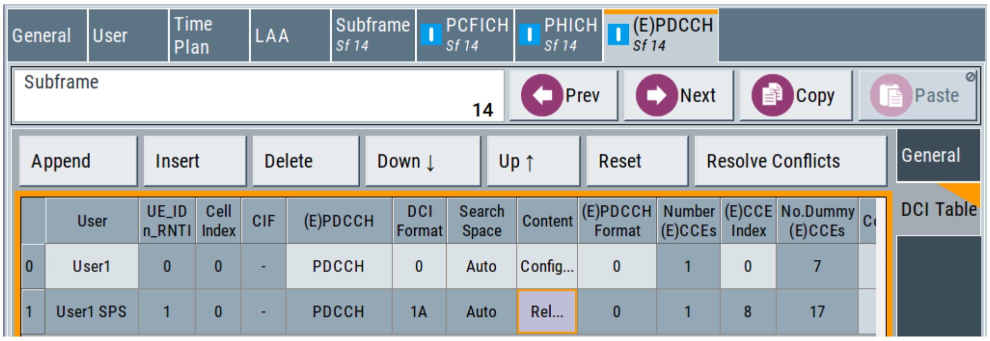
   The "DCI Configuration" dialog for DCI Format 1A opens. As defined in TS 36.213, some fields are predefined.



8. Adjust the DCI fields, for example set "Resource Block Assignment = 300" and "Modulation and Coding Scheme = 15".

   Note: In any SPS activation subframe, the maximum value allowed for the Modulation and Coding Scheme is 15; this corresponds to `0111` in binary form and is according to the requirements defined in TS 36.213.
   See also Table 4-5.

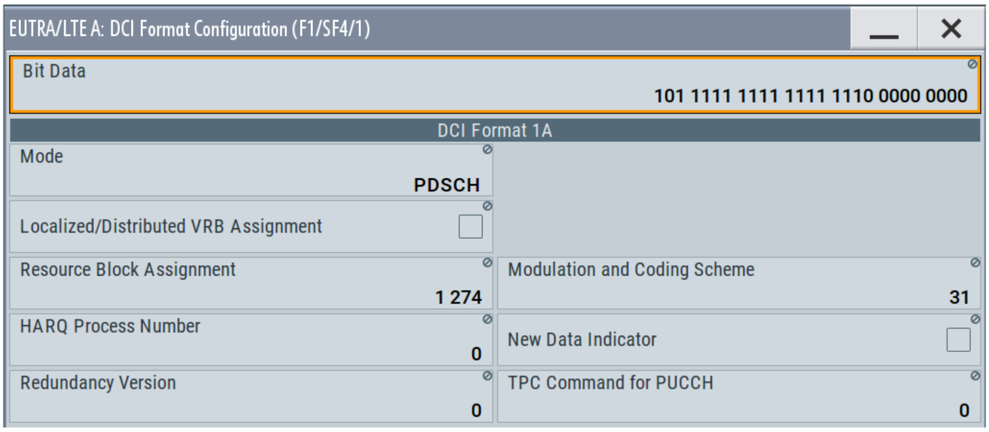
9. In the "Frame Configuration > PDCCH" dialog, select "Subframe = 14". Observe the "DCI Table".



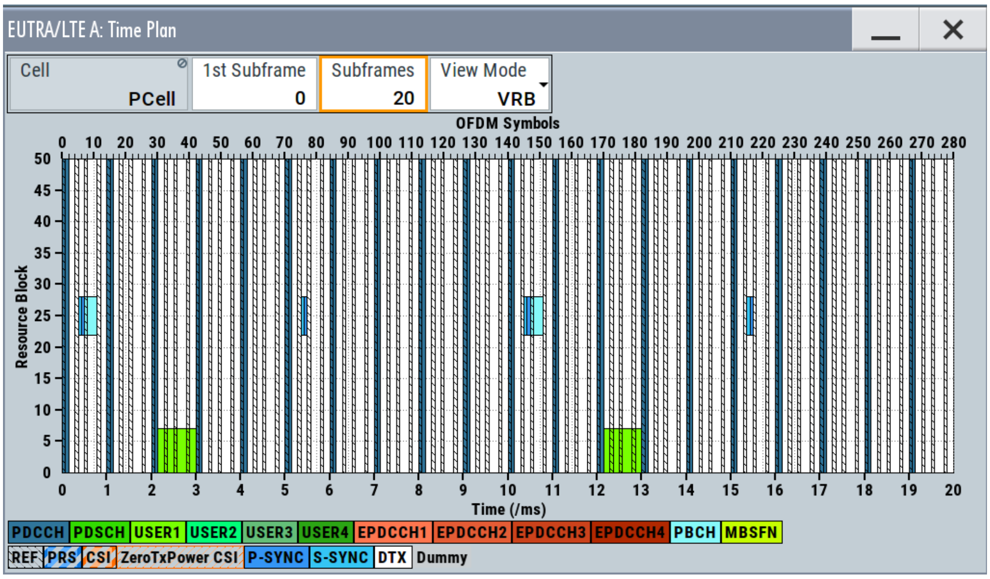
   The second PDCCH item in the DCI table confirms that the User 1 is semi-persistent scheduled ("User > User 1 SPS") and subframe#14 is the release subframe of this SPS ("User 1 SPS > Content > Rel.").

10. In the "DCI Table", select "User 1 SPS > Content > Rel."

    The "DCI Configuration" dialog for DCI Format 1A opens. The DCI fields are set as defined in TS 36.213; compare with the values in Table 4-5.



11. Open "Frame Configuration > OFDMA Timeplan" and enable:
    a) "No of Subframes = 20"
    b) "First Subframe = 0"



The time plan confirms User 1 transmission in subframe#2 and subframe#12.

12. Select "First Subframe = 10" to display the time plan of subframe#10 to subframe#20.

    There are no more subframes allocated to User 1; The SPS is released in subframe#14.

Activate SPS
Enables you to configure an SPS (semi-persistence scheduling) for the selected UE and triggers the instrument to generate the required DCIs.

Define the SPS pattern (SPS Interval) and select the exact subframe the SPS transmission starts and stops (Activation/Release Subframe No).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 878

SPS C-RNTI
Sets the SPS C-RNTI parameter.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:CRNTi on page 879

SPS Interval
Defines the SPS interval as number of subframes (SF).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SINTerval on page 879

Activation/Release Subframe No
Defines the start and end subframes of the semi-persistent scheduling (SPS).

The UE validates an activation/deactivation request for an SPS only if the DCI fields are set as required, see "Config PDCCH" on page 167.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SACTivation on page 879
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SRELease on page 879

Config PDCCH
Accesses the (E)PDCCH format variable dialog for configuring the required DCI settings in the activation subframe.

The UE validates an activation/deactivation request for an SPS only if the DCI fields are set according to Tables 9.2 in TS 36.213. The Table 4-5 is an example of the DCI format 1A fields (see also "DCI Format 1A" on page 201).

Table 4-5: PDCCH DCI format 1A fields for SPS activation and release/deactivation validation

Bit field	SPS activation value	SPS release value
"HARQ Process Number"	0	0
"Modulation and Coding Scheme"	0 .. 15	31
"Redundancy Version"	0	0
"Resource Block Assignment"	-	Set to all "1"

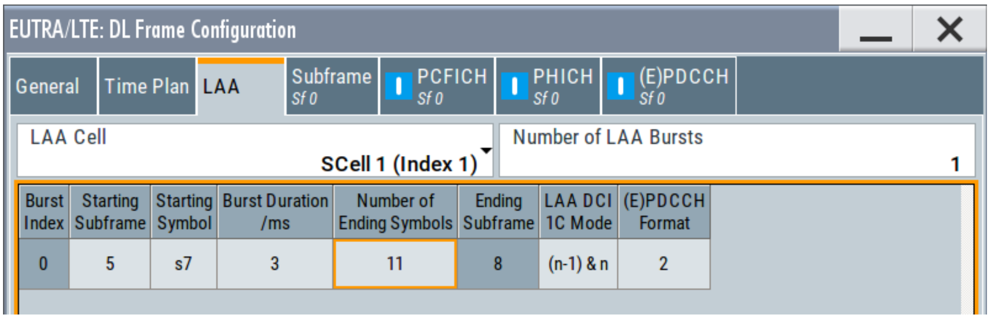
4.3.8 LAA settings

Option: R&S SMW-K119

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Scheduling PDSCH Scheduling" > **"Auto/DCI or Auto Sequence"**.
3. Enable at least on LAA SCell, for example select "General DL Settings > CA > SCell#1 > Duplexing" > **"LAA"**.
4. To configure the discovery reference signals:
   a) Select "General DL Settings > Signals > DRS"
   b) For example set, "SCell#1 > State = On", "Periodicity = 40", "Duration = 1", "Offset = 1" and "Pattern = 0".

   The DMTC occasion has a periodicity of 40 s. The DRS is 1 ms long and allocated in the subframe#1 of the DMTC occasion, because "Pattern = 0" but "Offset = 1".
   For more information, see "Discovery reference signal (DRS)" on page 58.
   See also Chapter 4.2.7.5, "Discovery reference signals (DRS) settings", on page 123.
5. Select "General > DL Frame Configuration" > **"LAA"**.
6. Select "LAA Cell = SCell 1 (Index 1)", i.e. one of the SCell configured as LAA cells in the DL carrier aggregation "CA" dialog.
7. Enable at least one LAA burst, e.g. set "Number of LAA Burst = 1".
8. Configure the LAA burst in terms of start and end subframe, burst duration and DCI mode.



9. Observe the LAA SCell allocation on the "Time Plan".

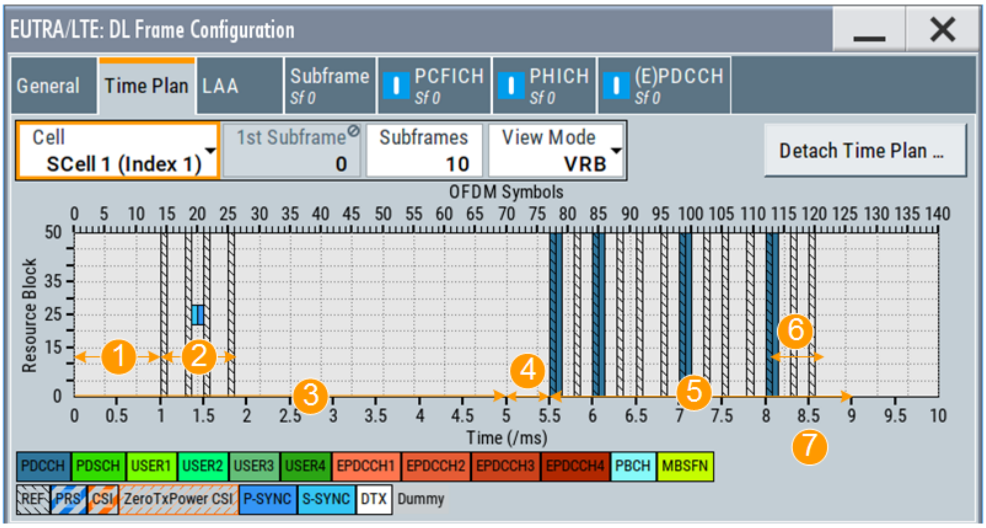


Figure 4-12: LAA burst: understanding the displayed information

1 = "DRS Offset = 1"
2 = "DRS Duration = 1 ms"
3 = LAA burst "Starting Subrame = 5", i.e. LAA burst start at subframe#5 of each frame
4 = "Starting Symbol = s7", i.e. the LAA partial subframe starts at the boundary of the second symbol within the LAA starting subframe
5 = "Burst Duration = 3 ms", where the starting LAA subframe is a partial subframe and the last (ending) subframe contains 11 ending OFDM symbols
6 = "Number of Ending Symbols = 11" (not all symbols are used)
7 = "Ending Subframe = Starting Subframe + Burst Duration = 8"
Subframes = 10

10. To configure the DCI format 1C:
    a) Select "General > DL Frame Configuration > LAA > LAA DCI 1C Mode = e.g. (n-1)&n"
    b) Select "(E)PDCCH > User = CC-RNTI"
    c) For "DCI Format > 1C", select "Content > Config".
    d) Set the field "Subframe Configuration for LAA".
11. Adjust the "ARB Sequence Length" according to "How to set the ARB sequence length for signals composed of DRSs with different periodicity" on page 124.

    For background details, see Chapter 2.2.8, "LTE Release 13/14 introduction", on page 55
    The remote commands required to define these settings are described in Chapter 11.14, "LAA and DRS", on page 771.

Settings:

LAA Cell

Selects the LAA SCell for that the LAA is configured.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LAA:CEINdex` on page 778

Number of LAA Bursts

You can configure up to 10 LAA bursts per LAA SCell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:NUMBursts` on page 779

Burst Index

Consecutive number indicating the LAA bursts.

Starting Subframe

Sets the first subframe of the LAA bust.

See:
- Figure 4-12
- Chapter 2.2.8.1, "Frame structure type 3 (LAA) and partial subframes", on page 56.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:STSFrame`
on page 779

Starting Symbol

Defines the time point the LAA burst started:
- "s0": LAA burst starts at the LTE subframe boundary (`subframeStartPositon`), i.e. at the **first slot** of a subframe
- "s7": LAA burst starts at the boundary of the **second slot** of a subframe (`secondSlotStartingPositon`

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:STSLot`
on page 779

Burst Duration (ms)

Sets the duration of the LAA burst.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:DURation`
on page 779

Number of Ending Symbols

Sets the number of OFDM symbols in the last subframe of the LAA burst.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:LSFSymbols on page 780

Ending Subframe
Indicates the number of the last subframe of the LAA burst. The value is calculated as follows:

Indicates the number of the last subframe of the LAA burst. The value is calculated as follows:

- For "Starting Symbol = s0"
  "Ending Subframe" = "Starting Subframe" + "Burst Duration" - 1
- For "Starting Symbol = s7"
  "Ending Subframe" = "Starting Subframe" + "Burst Duration"

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:ENSFrame? on page 780

LAA DCI 1C Mode
Defines how the DCI format 1C is sent.

Assuming n is the last subframe, DCI format 1C can be sent in the following ways:

- "(n-1)"
  DCI is present in the **next-to-last subframe** (n-1).
- "n"
  DCI is present in the **last subframe** n.
  If "Subframe Configuration for LAA < 14", no other physical channels are sent in subframe n
- "(n-1)&n"
  DCI present in both **n and n-1** subframes
  Both subframe have to use identical subframe configuration.
- "Manual"

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:C1Mode on page 780

(E)PDCCH Format
For "LAA DCI 1C Mode" different than "Manual", sets the (E)PDCCH format and defines how many (E)CCEs are used for the transmission of the (E)PDCCH.

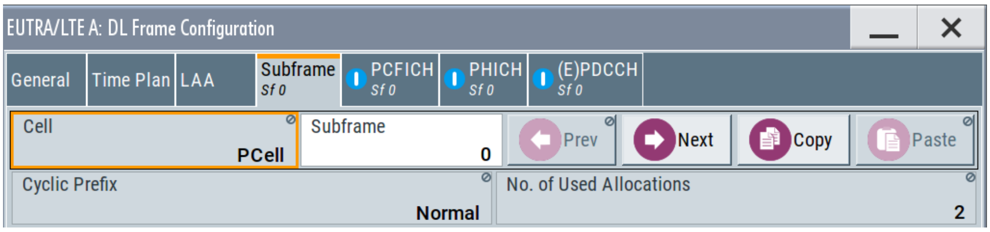
See also "(E)PDCCH Format (Variable)" on page 197.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:EPDCch on page 781

4.3.9 Subframe configuration settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Scheduling > Manual".
3. Select "General > Frame Configuration".
4. To access the common subframe configuration settings, select one of the following:
   - "Frame Configuration > Subframe"
   - "Frame Configuration > PCFICH"
   - "Frame Configuration > PHICH"
   - "Frame Configuration > PDCCH"



Provided are the following common settings:

Cell

With enabled "General DL Settings > CA > Activate Carrier Aggregation > On" state, indicates to which cell (i.e. component carrier) the settings apply.

Remote command:
n.a

Subframe Selection

Sets the subframe to be configured in the frame configuration table.

Remote command:
n.a

Cyclic Prefix

Configuration of the cyclic prefix per subframe is only enabled, if the parameter Cyclic Prefix is set to User Defined.

The number of the OFDM symbols per subframe is set automatically.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:CYCPrefix` on page 737

No. Of Used Allocations
Sets the number of scheduled allocations in the selected subframe.

The number of available allocations depends on the allocation's content type for a sub-frame and the general channel bandwidth setting.

The default value depends on the existence of a PBCH channel in a subframe. In this case, the default value is set to 2, otherwise to 1. The second or the first allocation is reserved for the PDCCH, regardless whether this allocation is enabled or not.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALCount` on page 738

Copy/Paste
Copies/pastes the settings of the selected subframe. P-SYNC/S-SYNC/PBCH settings are not considered.

For more detailed information, see Chapter B.1, "Copy/paste subframe", on page 1104.

Remote command:
n.a.

Next/Prev
Navigates through the subframes.

Remote command:
n.a.

4.3.10 DL resource allocation table

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General Settings > Scheduling > Manual".
3. In the "General" tab, select "Frame Configuration > Subframe".

	CW	Modu-lation	Enhanced Settings	VRB Gap	No. RB	No. Sym.	Offset RB	Offset Sym.	Auto	Phys. Bits	Data Source	DList / Pattern	ρ A /dB	Content Type	State	Con-flict
0	1/1	QPSK	Config...	-	6	4	22	7(1/0)	☐	480	MIB	-	0.000	PBCH	On	
1	1/1	QPSK		-	50	2	0	0(0/0)	☐	1520	PDCCH	-	0.000	PDCCH	On	
2.1	1/2	QPSK	Config...	-	10	12	0	2(0/2)	☑	5120	PN11	-	5.000	PDSCH	On	
2.2	2/2	64QAM	Config...	-	10	12	0	2(0/2)	☑	15360		-			On	
3.1	1/2	QPSK	Config...	-	5	12	10	2(0/2)	☑	1160	User1	-	0.000	PDSCH	On	
3.2	2/2	QPSK	Config...	-	5	12	10	2(0/2)	☑	1160		-			On	
4.1	1/2	QPSK	Config...	-	25	12	15	2(0/2)	☑	9152	User2	-	0.000	PDSCH	On	
4.2	2/2	256QAM	Config...	-	25	12	15	2(0/2)	☑	36608		-			On	

The resource allocation table comprises the settings necessary to configure the individual allocation parameters for a subframe.

Allocation number

Displays the consecutive number of the allocation.

Remote command:
n.a.

Codeword

Determines whether one or two codewords use the same physical resource, and whether codeword 1/2 or 1/2 is configured with this allocation table entry

In case the data source for an allocation is set to User, changing this parameter sets also the parameter "Codeword" of all allocations, belonging to the same User in the subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CODWords`
on page 738

Modulation

Selects the modulation scheme for the allocation.

In case the data source for an allocation is set to User, changing this parameter sets also the parameter "Modulation" of all allocations, belonging to the same User in the subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:MODulation` on page 738

Enhanced Settings

Opens the "Enhanced Settings" dialog for configuration of precoding and channel coding (see Chapter 4.4, "Enhanced PBCH, PDSCH and PMCH settings", on page 211).

Remote command:
n.a.

VRB Gap
Enables the utilization of virtual resource blocks (VRB) of distributed type and determines whether the first or the second gap is applied. That is, it determines the distribution and the mapping of the VRB pairs to the physical resource blocks (PRB) pairs.

The VRB-to-PRB mapping and the calculation of the VRB gap values are performed according to TS 36.211. The specification defines two types of VRBs, a localized distribution with a direct mapping and distributed VRBs for better frequency diversity. The distribution of the VRBs is performed in such a way, that consecutive VRBs are not mapped to frequency-consecutive PRBs. The VRBs are spread over the frequencies instead. Each single VRB pair is split into two parts and a frequency gap between these two VRB parts is introduced. That is, a frequency hopping on a slot basis is applied. For wider channel bandwidths (more than 50 RBs), a second VRB gap with smaller size may be applied.

Tip: Use the "DL Time Plan" to visualize the PDSCH mapping.

The information whether localized or distributed VBRs are applied is carried by the PDCCH. The DCI Formats 1A/1B/1D provide the special 1-bit flag "Localized/Distributed VBR Assignment" for this purpose. The selection whether the first or the second gap is applied, is determined by the additional bit "Gap Value".

Note: In case a "General DL Settings > Scheduling > PDSCH Scheduling > Auto/DCI" mode is used, the "VRB Gap" value is read-only and is set according to the configuration of the corresponding DCI format.

Example:

"DL Channel Bandwidth = 10 MHz" (50 RBs)

Three subframes are configured:

- Subframe#0
  - PDSCH allocation#2 (User2): "VRB Gap = 0"
  - PDSCH allocation#3 (User4): "VRB Gap = 0"

	CW	Mod.	Enh. Sett.	VRB Gap	No. RB	No. Sym.	Offs RB	Offs Sym.	Auto	Phys. Bits	Data Source	DList / Pattern	ρA /dB	Content Type	State	Conf
0	1/1	QPSK	Config...	-	6	4	22	7(1/0)	☐	480	MIB	-	0.000	PBCH	On	
1	1/1	QPSK		-	50	2	0	0(0/0)	☐	1920	PDCCH	-	0.000	PDCCH	On	
2	1/1	QPSK	Config...	-	1	12	0	2(0/2)	☑	276	User2	-	0.000	PDSCH	On	
3	1/1	QPSK	Config...	-	1	12	1	2(0/2)	☑	276	User4	-	0.000	PDSCH	On	

- Subframe#1
  - PDSCH allocation#2 (User2): "VRB Gap = 1"
  - PDSCH allocation#3 (User4): "VRB Gap = 1"
  - Both allocations use distributed VRBs; the first VRB gap is applied.

  According to TS 36.211, the first VRB gap for 10 MHz channel bandwidth is **27 RBs**
- Subframe#2

– PDSCH allocation#2 (User2): "VRB Gap = 1"
– PDSCH allocation#3 (User4): "VRB Gap = 2"
– Both allocations use distributed VRBs. The first VRB gap is applied for PDSCH allocation#2 (User2) and the second VRB gap for the allocation#3 (User4) .

According to TS 36.211, the second VRB gap for 10 MHz channel bandwidth is **9 RBs**

Use the "DL Time Plan" to visualize the PDSCH mapping.

"0"	A **localized distribution** is applied, i.e. the PDSCH mapping is performed on a direct VRB-to-PRB mapping.
"1"	Enables a **distributed** resource block allocation. The first VRB gap is used.
"2"	Enabled for "Channel Bandwidths" greater than 50 RBs. The mapping is based on the second (smaller) VRB gap.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:GAP` on page 739

No. RB (Resource Blocks)

Defines the bandwidth of selected allocation in terms of resource blocks per slot.

In case two codewords are configured, the defined bandwidth of the allocation with the second codeword is determinate by the selected bandwidth of the first one.

"Auto" indicates automatically calculated value depending on other settings, like the "Content type".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBCount` on page 739

No. Sym.

Sets the size of the selected allocation in OFDM symbols.

For FDD mode and content type PDSCH, this value is set automatically in a way that the allocation always fills the complete subframe with consideration of the symbol offset.

Example:

For Cyclic Prefix with normal length (14 OFDMA Symbols) and Symbol Offset = 2 the resulting "No. Of Symbols" is 12.

In case two codewords are configured, the size of the allocation with the second codeword is determinate by the size of the first one.

While configuring a special subframe for TDD mode, the maximum size of the PDSCH allocation is determined by the selected TDD frame structure settings and depends on the selected Cyclic Prefix.

The following table shows the cross-reference between the special subframe configuration and the maximum number of OFDM symbols available for PUSCH (DwPTS) in a special subframe for normal and extended CP.

Configuration of Special Sub-frame	DwPTS (Normal CP)	DwPTS (Extended CP)
0	3	3
1	9	8
2	10	9
3	11	10
4	12	3
5	3	8
6	9	9
7	10	5
8	11	-
9	6	-

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMCount` on page 740

Offset RB
Sets the start resource block of the selected allocation.

The value is:
- **Read only:** if "Auto Offset Calculation > On"
- In case two codewords are configured, the start resource block of the allocation with the second codeword is determinate by the selected start resource block of the first one.
- **"Auto"**: if automatically calculated depending on other settings, like the "Content type".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBOFfset` on page 740

Offset Sym.
Sets the start OFDM symbol of the selected allocation.

Note: If the "Auto Offset Calculation" mode is activated, this value is read only.

For extended cyclic prefix, the maximum symbol offset is 13.

Note: According to TS 36.211, up to first three OFDM symbols of a subframe are reserved for control information (PDCCH). Therefore, for PDSCH allocations the maximum value is 3, regardless of the cyclic prefix length.

In case two codewords are configured, the start OFDM symbol of the allocation with the second codeword is determinate by the selected start OFDM symbol of the first one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMoffset on page 740

Auto
Sets whether automatic offset calculation is used or not.

Note: If the "Auto Offset Calculation" mode is activated, the resource block offset and the start symbol offset are set automatically and cannot be changed.

By setting new allocations or changing the number of RBs of an existing allocation, the Auto mode tries to distribute the allocations with activated Auto mode in an optimal manner to the available resource blocks by adjusting the parameters "Offset RB". The resulting "No. of Bits" of a certain allocation can vary, due to overlapping control channels.

If it is not possible to distribute the changed configuration to the available resources blocks, a conflict is displayed.

Note: "Auto Offset Calculation" mode is only available for PDSCH. For PDCCH, this parameter is always off.

In case two codewords are configured, the state of the "Auto Offset Calculation" mode of the second codeword is set to the state of the first one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:AOC on page 741

Phys. Bits
Displays the size of the selected allocation in bits and considering the subcarriers that are used for other signals or channels with higher priority.

See Chapter A, "Conflict handling", on page 1099.

"Auto" indicates automatically calculated value depending on other settings, like the "Content type".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PHYSbits? on page 741

Data Source
Selects the data source for the selected allocation.

For PBCH allocation with enabled parameter MIB (including SFN), the "Data Source = MIB" is used.

If MBSFN is used, the data source of the allocations in the MBSFN subframes is set to MCCH or MTCH depending on the MBSFN configuration.

Use the User configuration settings dialog to configure the data sources for "User x".

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"

An internally generated sequence according to a bit pattern.
Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DATA` on page 741
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DSELect` on page 742
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PATTern` on page 742

Rho A

Sets the power P_{PDSCH} (ρ A) respectively P_{PBCH} for the selected allocation.

The power of the PDCCH allocation P_{PDCCH} is read-only. The value is set in the "Enhanced Channel Configuration" dialog of the corresponding subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:POWer` on page 743

Content Type

Indicates the type of the selected allocation.

Note: There can be only one PBCH in subframe 0.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONType?` on page 743

State

Sets the allocation to active or inactive state.

In case two codewords are configured, the state of the allocation with the second codeword is determinate by the state of the first one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:STATe` on page 744

Conflict
Indicates a conflict between allocations.

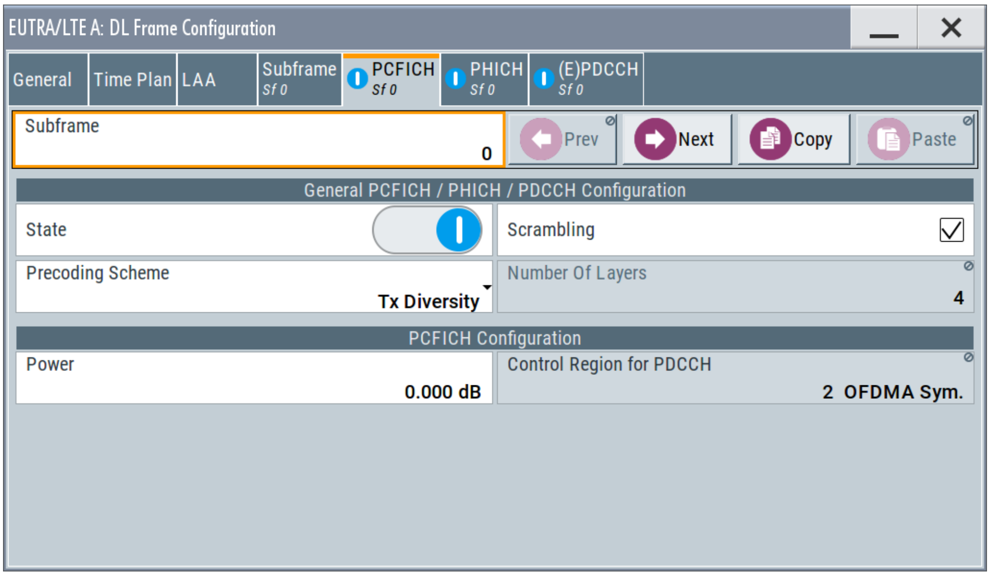
For more information, see Chapter A, "Conflict handling", on page 1099.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONFlict on page 744

4.3.11 PCFICH settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > PCFICH".



This dialog comprises the settings required for configuring PCFICH.

Settings:

General PCFICH/PHICH/PDCCH Configuration
Comprises the settings common to all DL enhanced channels.

State ← General PCFICH/PHICH/PDCCH Configuration
Enables/disables the PDCCH, PCFICH and PHICH allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:STATe` on page 792

Precoding Scheme ← General PCFICH/PHICH/PDCCH Configuration
Selects the precoding scheme for PDCCH, PCFICH and PHICH.

"None" Disables precoding.

"Tx Diversity" Precoding for transmit diversity is performed according to TS 36.211 and the selected parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:SCHeme`
on page 793

Number of Layers (Enhanced Channels) ← General PCFICH/PHICH/PDCCH Configuration
(Enabled for Precoding Scheme set to Tx Diversity)

Displays the number of layers for PDCCH, PCFICH and PHICH. This value is fixed to 1 for PDCCH, PCFICH and PHICH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:NOLayers?`
on page 793

Scrambling State ← General PCFICH/PHICH/PDCCH Configuration
Enables/disables the scrambling of all DL enhanced channels.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:SCRambling:STATe`
on page 793

PCFICH Configuration
Comprises the PCFICH settings:

PCFICH Power ← PCFICH Configuration
Sets the power of the PCFICH (P_{PCFICH}).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:POWer`
on page 794

Control Region for PDCCH (PCell) ← PCFICH Configuration
Sets the size of the control region, i.e. the number of OFDM Symbols that the region spans (see Table 4-6).

Table 4-6: Number of OFDM symbols in the control region for PDCCH

Channel Bandwidth	PHICH Duration	Duplex. Mode	OFDM Symbols in	The control region
			Normal Subframe	Special Subframe
No RB > 10	Normal	FDD	1, 2 ,3	-
	Normal	TDD	1, 2, 3	1, 2
	Extended	FDD	3	-
	Extended	TDD	3	2
No RB <=10	Normal	FDD	2, 3, 4	-
	Normal	TDD	2, 3, 4	2
	Extended	FDD	3, 4	-
	Extended	TDD	3, 4	2

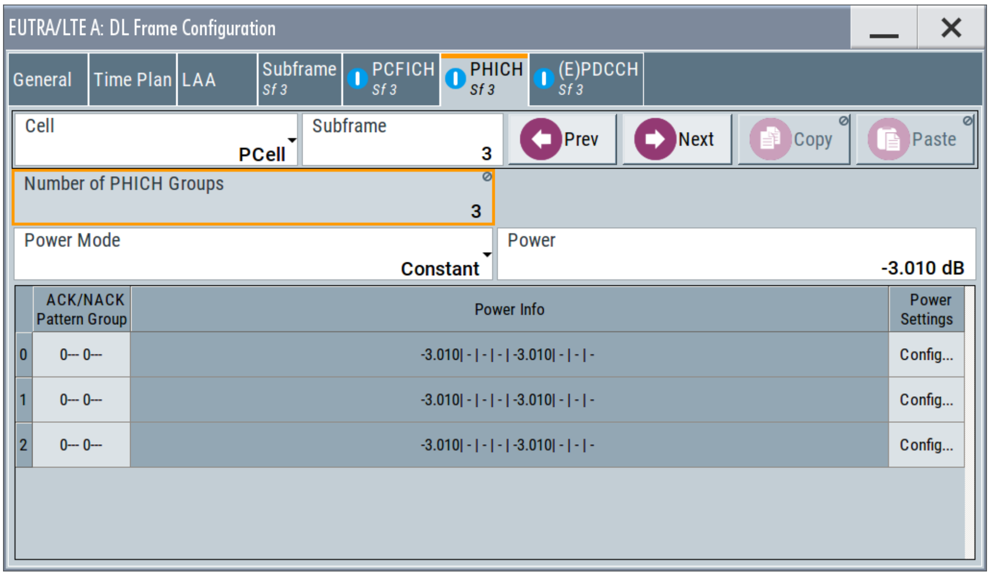
The size of the control region can vary per subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:CREGion
on page 794

4.3.12 PHICH settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > PHICH".



This dialog comprises the settings required for configuring PHICH.

Provided are the following settings:

Cell

With enabled "General DL Settings > CA > Activate Carrier Aggregation > On" state, indicates to which cell (i.e. component carrier) the settings apply.

Remote command:
n.a

Number of PHICH Groups

Displays the number of available PHICH groups, depending on the value of the parameter PHICH N_g.

If "PHICH N_g > Custom", this parameter is enabled for configuration.

- For normal CP, one PHICH group consists of 8 ACK/NACK messages from several users.
- For extended CP, one PHICH group carries 4 ACK/NACK messages from several users.

Each PHICH group uses 3 resource element groups (REGs); hence the total number of REGs used for PHICH is 3 times the number of PHICH groups.

The number of the available OFDM symbols for the allocation of this total number of REGs depends on the selection made for the parameter PHICH Duration (normal or extended).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:NOGRoups` on page 795

Power Mode

Determines whether all PHICHs in a PHICH group are sent with the same power or enables the adjustment of each P_{PHICH} individually.

The parameter Power Info displays the power values of the configured PHICHs.

"Constant"	The power of a PHICH (P_{PHICH}) in a PHICH group is set with the parameter Power.
"Individual"	The power of the individual PHICHs is set in the PHICH Power Config dialog.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:PMODe` on page 794

PHICH Power

Sets the power of one PHICH (P_{PHICH}) in a PHICH group, i.e. the total power of one PHICH group is the sum of the power of the transmitted PHICHs within this group.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:POWer` on page 795

PHICHs Table

Comprises the settings of the PHICHs.

ACK/NACK Pattern Group x ← PHICHs Table

Sets the ACK/NACK pattern for the corresponding PHICH group, where:

- "1" indicates an ACK
- "0" indicates a NACK
- "-" indicates DTX
  DTX means that the corresponding PHICH is not transmitted, i.e. the orthogonal sequence is not used.

The number of ACK/NACK messages carried by a PHICH group depends on the Cyclic Prefix. Hence, a pattern group consists of 8 or 4 values for normal and extended CP respectively.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:CELL<ch0>:ANPattern<gr0>` on page 795

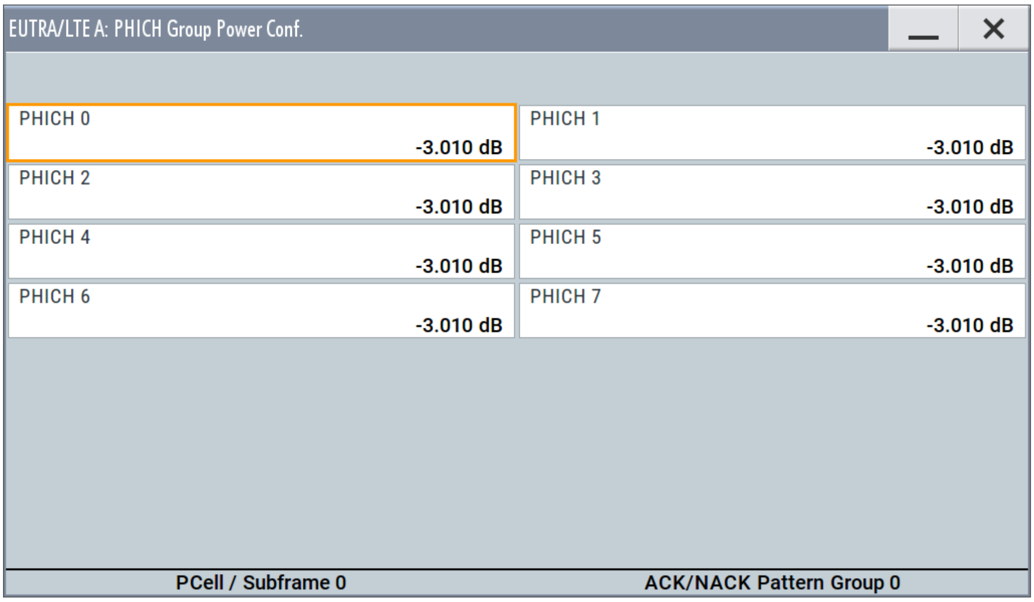
Power Info ← PHICHs Table

Displays the power values of the configured PHICHs.

Remote command:
n.a.

Power Settings Config. ← PHICHs Table

Opens the "PHICH Power Config". dialog to configure the power of the PHICHs individual.



"ACK/NACK Pattern Group"
Displays the ACK/NACK pattern group the values are adjusted for.

"PHICH x" Sets the power of the individual PHICHs.

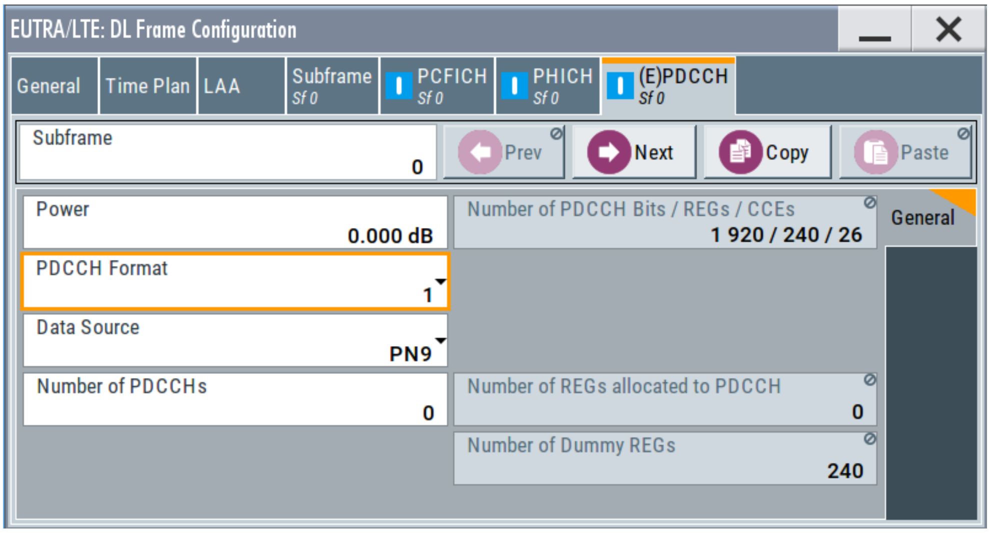
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:GROup<gr0>:ITEM<user0>:POW` on page 796

4.3.13 (E)PDCCH settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > (E)PDCCH".

3. Select "PDCCH Format = 1".



This dialog comprises the settings required for configuring PDCCH.

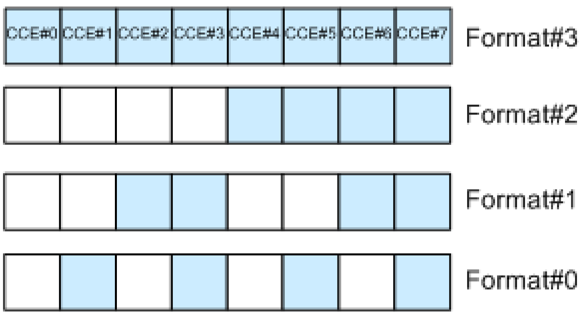
Settings:

PDCCH Format

Sets the PDCCH format.

The PDCCH format determines how many CCEs (control channel elements) are used for the transmission of the PDCCH, i.e. determines how many PDCCHs (#PDCCH) can be transmitted.

The following figure shows the distribution of the PDCCH over the CCEs for the different formats.



"Variable" Select this mode to enable full flexibility by the configuration of the downlink control information (DCI) format and content (see Chapter 4.3.14, "(E)PDCCH format variable", on page 189).

"-1" Proprietary format for legacy support.

This format corresponds to the transmission of one PDCCH on all available REGs, i.e.
- Number of available REGs = #REGs allocated PDCCH,
- #PDCCH = 1,
- #DummyREGs = 0.

"0" One PDCCH is transmitted on one CCE, i.e. #REG=1.

"1" One PDCCH is transmitted on two CCEs, i.e. #REG=18.

"2" One PDCCH is transmitted on four CCEs, i.e. #REG=36.

"3" One PDCCH is transmitted on eight CCEs, i.e. #REG=72.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:FORMat on page 798

Power

Sets the power of the PDCCH (P_{PDCCH}).

The value set with this parameter is also displayed in the allocation table for the corresponding allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:POWer on page 796

Number of PDCCH Bits / REGs / CCEs

Displays the number of bits / REGs / CCEs allocated for PDCCH.

"Number of PDCCH Bits"
Indicates the number of bits available for PDCCH.

The number of bits available for PDCCH allocation depends on the selected:
- Channel Bandwidth
- Global MIMO Configuration
  Number of PHICH Groups
- PHICH Duration
- Control Region for PDCCH (PCell)

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:BITS on page 797

"Number of PDCCH REGs"

Indicates the number of the REGs that are available for the PDCCH allocation.
The number of REGs available for PDCCH allocation depends on the "Number of PDCCH Bits" ($\#Bits_{PDCCH}$) and is calculated as follows:
$\#REGs\ available_{PDCCH} = \#Bits_{PDCCH} / 8$

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:BITS on page 797

"Number of PDCCH CCEs"

Indicates the number of the control channel elements (CCEs) that are available for the PDCCH allocation.
The PDCCH is mapped to the REGs not used for PHICH and PCFICH and transmitted on one or several CCEs, where a CCE corresponds to 9 REGs, i.e. the number of the available CCEs is calculated as follows:
$\#CCEs\ available_{PDCCH}$ = "Number of PDCCH REGs"/ 9

Note: If Activate Carrier Aggregation > "On", the parameter "Number of available CCEs" displays information about the PCell.
Information related to the SCells is displayed by the corresponding parameter No. Dummy (E)CCEs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVCCes on page 797

Number of PDCCHs
(for "PDCCH Format" different than "Variable")

Sets the number of PDCCHs to be transmitted.

The maximum number PDCCH that can be transmitted on the available REGs for PDCCH depends on the number of REGs (#REG) reserved for the transmission of one PDCCH, i.e. depends on the selected PDCCH Format and is calculated as follows:

#PDCCH = Number of PDCCH REGs / #REG.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:NOPDcchs on page 798

Number of REGs allocated to PDCCH
(for "PDCCH Format" different than "Variable")

Defines the number of REGs that are allocated for PDCCH transmission ($\#REGs\ allocated_{PDCCH}$) and is calculated as follows:

$\#REGs\ allocated_{PDCCH}$ = #PDCCH * #REG

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:ALRegs on page 799

Number of Dummy REGs
(for "PDCCH Format" different than "Variable")

Displays the number of REGs that are available for the PDCCH allocation but are not allocated and is calculated as follows:

#DummyREGs = Number of PDCCH REGs - #REGs allocated PDCCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DREGs` on page 799

Data Source
(for "PDCCH Format" different than "Variable")

Selects the data source for PDCCH.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

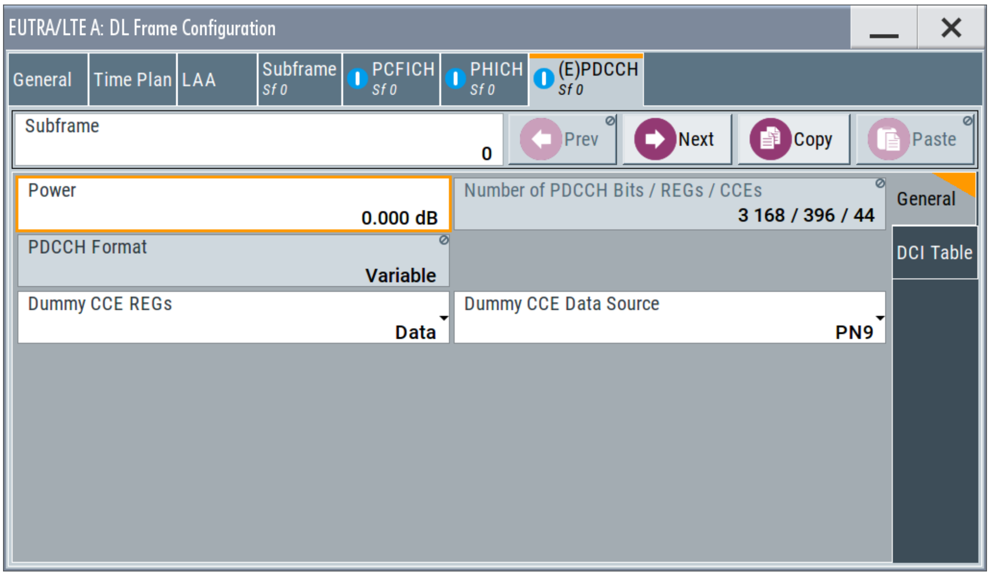
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DATA` on page 799
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:PATTern`
on page 800
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:PATTern`
on page 800

4.3.14 (E)PDCCH format variable

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > (E)PDCCH".

3. Select PDCCH Format > "Variable".



Use these parameters and the DCI table to configure the multiple scheduling messages (DCIs) with the corresponding (E)PDCCHs.

Dummy CCE REGs

Sets the behavior of the dummy REGs, i.e. determines whether dummy data or DTX is transmitted.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:TRSource`

on page 800

Dummy CCE Data Source
Selects the data source for the dummy CCE.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DATA on page 801
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:PATTern on page 801
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DSELect on page 801

Standard configuration functions
Standard configuration functions:

"Append" Adds a row at the end of the table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:APPend on page 802

"Insert" Insert a new row before the current one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SITem on page 802
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:INSert on page 802

"Delete" Deletes the selected row.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DELete on page 802

"Down/Up" Moves the selected row down or up.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DOWN on page 803
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UP on page 803

Reset

Resets the table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:RESet on page 804

Resolve Conflicts

The "Resolve Conf." is a built-in algorithm that reassigns automatically the CCE values depending on the configured "Search Space"; previously configured CCE values are not maintained. If the conflict cannot be resolved automatically, the values are left unchanged.

For more information on how to solve DCI conflicts, see Chapter A.3, "DCI conflict handling", on page 1101.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SOLVe? on page 804
To query the number of current conflicts:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:CONFlicts? on page 803

DCI Table

Access:
- Select "General > Link Direction > Downlink (OFDMA)".
- Select "Frame Configuration > (E)PDCCH".
- Select PDCCH Format > "Variable".
- Select "DCI Table".

The "DCI Table" comprises the settings concerning the (E)PDCCH content.

Number of Used (E)PDCCH Items ← DCI Table

Displays the number of the (E)PDCCH items, i.e. the number of rows in the DCI table.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UITems` on page 804

User ← DCI Table

Selects the user the DCI is dedicated to. The available DCI Format depend on the value of this parameter.

Note: If Activate Carrier Aggregation > "On", the Cell Index determines the component carrier the corresponding user is mapped to.
To enable one particular user in more than one component carrier, append several table rows and enable the same "User" in the different component carriers.

"User x" Selects one of the four users configured in the User configuration settings dialog.
The DCIs of an inactive user ("Configure User" > State > "Off") are not configurable and not considered by the calculation of "No. Dummy CCEs".

"P-RNTI/S-RNTI/RA-RNTI"
A group of users is selected.

"User x eIMTA"
Option: R&S SMW-K113
Indicates that the user supports eIMTA. Use the DCI format 1C settings to define the UL/DL configuration numbers.
See "DCI Format 1C for eIMTA" on page 205.

"CC-RNTI" Option: R&S SMW-K119
Sets that the DCI format 1C uses CRC scrambled with the CC-RNTI.
Use the DCI format 1C settings to define the LAA subframe configuration.
See "DCI Format 1C for LAA" on page 206.

"User x SPS" Indicates an activated semi-persistent scheduling (SPS) for the corresponding user.

"None" Allows free definition of all settings

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:USER on page 808

UE_ID/n_RNTI ← DCI Table

Displays the UE_ID or the n_RNTI for the selected PDCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:UEID on page 805

Cell Index ← DCI Table

Sets the component carrier on that the corresponding DCI is transmitted.

This parameter refers to the "DL Carrier Aggregation Configuration" > Cell Index. The "Cell Index" of the PCell (primary cell) is always set to 0.

Example:

If the following settings are enabled in the "DL Carrier Aggregation Configuration" dialog, the value range of the parameter "Cell Index" is 0, 1, 3, 5 and 7.

Component carrier	Cell index
PCell	0
SCell#1	1
SCell#2	3
SCell#3	7
SCell#4	5

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CELL on page 806

Carrier Indicator Field (CIF) ← DCI Table

(Requires R&S SMW-K85)

This field is enabled if:
- Activate Carrier Aggregation > "On" and
- For each User with "Configure User" > Activate CA.

The CIF is present in **each** DCI Format and identifies the component carrier that carries the PDSCH or PUSCH for the particular PDCCH in the cross-carrier approach (see Figure 2-27).

According to the LTE specification, cross-carrier scheduling is enabled by higher-level signaling. To simulate a cross-carrier scheduling in this implementation, enable the "DL carrier aggregation configuration>CIF Present" per each component carrier/cell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField` on page 810

(E)PDCCH ← DCI Table
Indicates if the DCI is carried by a PDCCH or by an EPDCCH set.

You can assign an EPDCCH set in the following cases:
- If the EPDCCH transmission and the particular set are activated for the selected user.
  See Chapter 4.3.5, "EPDCCH configuration settings", on page 156.
- EPDCCH is not allocated in a TDD special subframe in one of the situations listed in Table 4-7.

Table 4-7: Combinations of cyclic prefix and TDD special subframe configurations

"Cyclic Prefix"	TDD Special Subframe Config
Normal / Extended	0
Normal	5
Extended	4, 7, 8, 9

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:PDCChtype` on page 807

DCI Format ← DCI Table
Sets the DCI format for the selected PDCCH.

The downlink control information (DCI) is a message used to control the physical layer resource allocation in both the UL and DL direction. It carries scheduling information as well as uplink power control commands.

The DCI is mapped on the PDCCH and depending on the DCI message size and usage are categorized into four different formats that are further subdivided (see Table 4-8).

Table 4-8: Overview DCI formats

DCI format	Purpose
DCI Format 0	PUSCH allocation information
DCI Format 1 DCI Format 1A DCI Format 1B DCI Format 1C DCI Format 1D	PDSCH information with one codeword

DCI format	Purpose
DCI Format 2/2A/2B/2C/2D	PDSCH information for MIMO configuration (two codewords)
DCI Format 3/3A	Uplink power control information

The fields of each DCI format are configurable parameters that can be adjusted in the corresponding dialog box. Select Content Config/ Content Act./Rel. to access this dialog box for the selected "DCI Format".

Not all DCI formats are always enabled for selection.

The following table gives an overview of the cross-reference between the available DCI formats and the value of the parameter User.

User	DCI format
P-RNTI/SI-RNTI/RA-RNTI	1A, 1C
User x	1, 1A, 1B, 1D, 2, 2A, 2B, 2C, 2D
None	All formats

See also TS 36.212, chapter 5.3.3.1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIFmt` on page 805

Search Space ← DCI Table
Defines the search space for the selected DCI, i.e. determines the valid CCE indexes.

The search space determines the set of CCEs a UE monitors. The UE can decode only the control information on a PDCCH that is transmitted over CCEs within the search space this UE monitors.

Note: The 3GPP specification defines two kinds of search spaces, the common and the UE-specific search space.
Avoid the use of the "Auto" and "Off" values; these values are provided for backwards compatibility reasons only.

"Off" No search space is determined.
All CCEs are monitored.

"Auto" Provided for backward compatibility only.
An internal mapping to the common and UE-specific search space is applied depending on the value of the parameter "User":
- For "User x", "Auto" corresponds to "UE-spec"
- In all other cases, "Auto" corresponds to "Common"

"Common" The DCI is mapped to the common search space.
A common search space is used when all or a group of UEs is addressed. The combination "User 1" and common search space is enabled in PCell only.

"UE-spec" Non-common DCIs are mapped to the UE-specific search space. Each UE has multiple UE-specific search space, determined as a function of the UE_ID and the subframe. A UE-specific search space applies for the User set to "User x".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:SESPace on page 808

Content Config/ Content Act./Rel. ← DCI Table
Opens the DCI format configuration dialog to configure the DCI fields of the selected DCI Format.

In the activation and release subframes of users that are semi-persistent scheduled (User > "User x SPS"), the function "Act./Rel." accesses the DCI format configuration dialog to configure the special fields for the SPS validation.

Remote command:
n.a.

(E)PDCCH Format (Variable) ← DCI Table
Sets the (E)PDCCH format.

The (E)PDCCH format determines how many (E)CCEs are used for the transmission of the (E)PDCCH.

Table 4-9: Supported PDCCH formats [TS 36.211]

PDCCH format	Number of CCEs	Number of REGs	Number of PDCCH bits
0	1	9	72
1	2	18	144
2	4	36	288
3	8	72	576

Table 4-10: EPDCCH formats and number of ECCEs for one EPDCCH N^{EPDCCH}_{ECCE} [TS 36.211]

EPDCCH format	Case A	Case B
0	2	1
1	4	2
2	8	4
3	16	8
4	- / 32*	- / 16*

*) EPDCCH format 4 is supported if distributed transmission is used (see Transmission Type).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:PFMT on page 806

Number (E)CCEs ← DCI Table
Defines the number of control channel elements used for the transmission of the (E)PDCCH.

The value depends on the selected (E)PDCCH format.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:NCCes?` on page 806

(E)CCE Index ← DCI Table
Sets the (E)CCE start index.

The available ECCEs depend on the selected (E)PDCCH format.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CINDex` on page 807

No. Dummy (E)CCEs ← DCI Table
Defines the number of dummy (E)CCEs that are appended to the corresponding PDCCH.

Note: If Activate Carrier Aggregation > "On", the "Number of Dummy CCEs" is calculated per component carrier and depends on the selected Bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:NDCCes?` on page 807

Conflict (DCI) ← DCI Table
Indicates a conflict between two DCI formats.

For more information on how to solve DCI conflicts, see Chapter A.3, "DCI conflict handling", on page 1101.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CONFlict?` on page 809
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:CONFlicts?` on page 803

4.3.15 DCI format configuration

For information on the provided settings, see also TS 36.212, chapter 5.3.3.1.

Carrier Indicator Field (CIF)
(Requires R&S SMW-K85)

This field is enabled if:

- Activate Carrier Aggregation > "On" and
- For each User with "Configure User" > Activate CA.

The CIF is present in **each** DCI Format and identifies the component carrier that carries the PDSCH or PUSCH for the particular PDCCH in the cross-carrier approach (see Figure 2-27).

According to the LTE specification, cross-carrier scheduling is enabled by higher-level signaling. To simulate a cross-carrier scheduling in this implementation, enable the "DL carrier aggregation configuration>CIF Present" per each component carrier/cell.

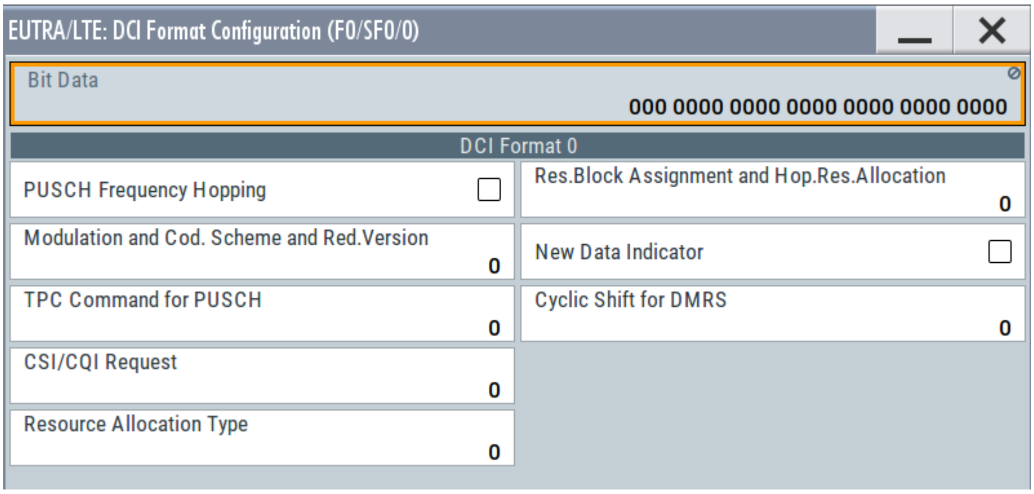
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810

Bit Data
Displays the resulting bit data as selected with the DCI format parameters.

Mapping of the information bits is according to TS 36.212.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:BITData? on page 810

DCI Format 0
The DCI format 0 is used for scheduling uplink transmission on PUSCH and transmits the information listed in the following table.



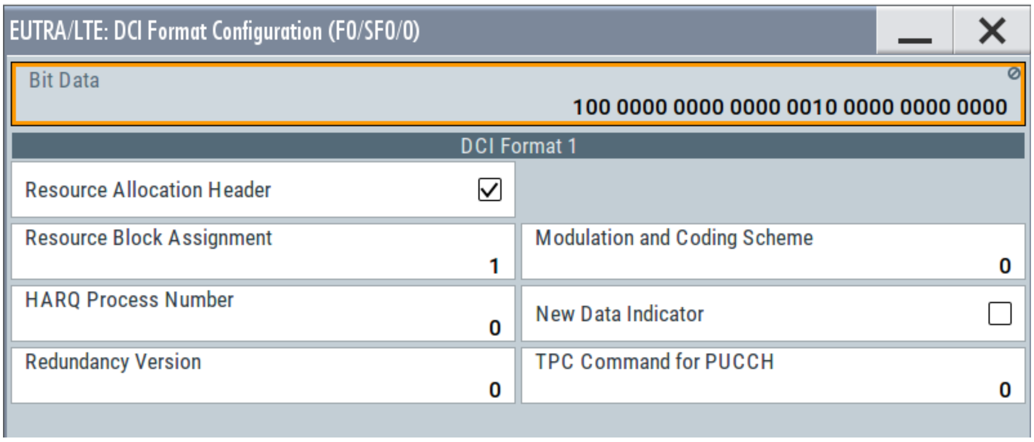
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 4.3.7, "SPS configuration settings", on page 162.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810	See "Carrier Indicator Field (CIF)" on page 194
"PUSCH Frequency Hopping"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PFHopping on page 816	
"Resource Block Assignment and Hopping Resource Allocation"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAHR on page 817	
"Modulation and Coding Scheme and Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 814	
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 815	
"TPC Command for PUSCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 821	
"Cyclic Shift for DMRS"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CSDMrs on page 812	
"UL Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:ULINdex on page 822	TDD mode and TDD frame structure settings 0
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 812	TDD mode and "UL/DL Configuration = 1 to 6"
"CSI/CQI Request"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CSIRequest on page 812	"Search Space" other than "Common" and "User > Tx Mode = TM10"
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SRSRequest on page 818	"User Configuration" > Aperiodic SRS State > "On"
"Resource Allocation Type"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAType on page 818	

DCI Format 1

The DCI format 1 carries information for scheduling transmission of one codeword on PDSCH. The different fields of this format are summarized in the following table.



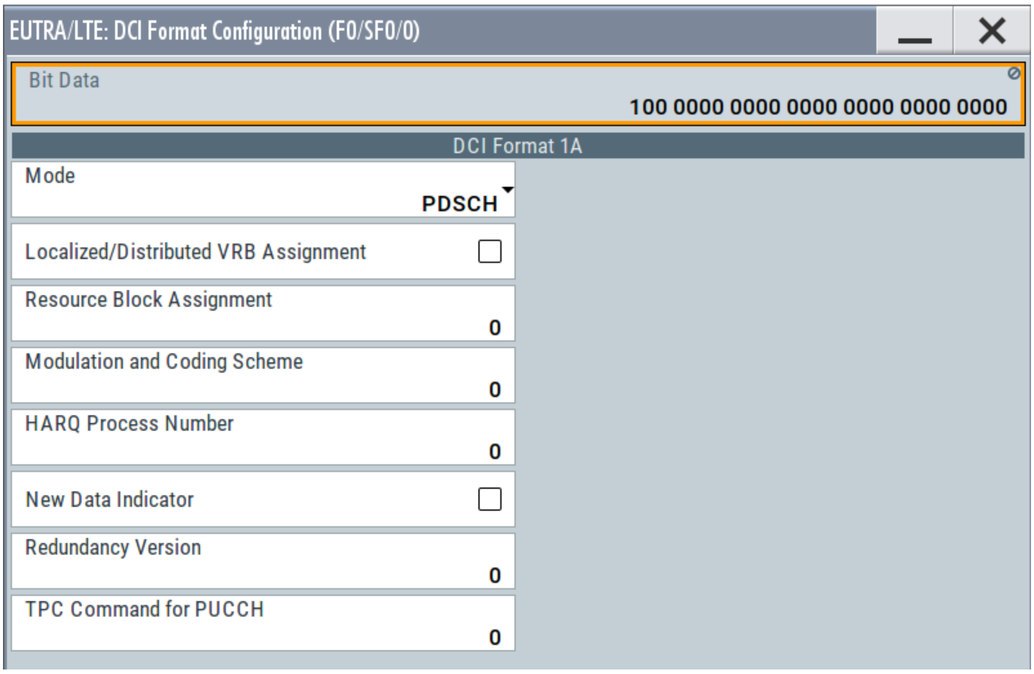
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 4.3.7, "SPS configuration settings", on page 162.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810	See "Carrier Indicator Field (CIF)" on page 194
"Resource Allocation Header"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAH on page 817	"Channel Bandwidth > 10RBs"
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 818	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 814	
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 813	
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 815	
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 818	
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 821	
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 812	TDD mode

DCI Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

The contents of DCI Format 1A are listed in the following table; the available fields depend whether a PDSCH or PRACH is transmitted.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 4.3.7, "SPS configuration settings", on page 162.

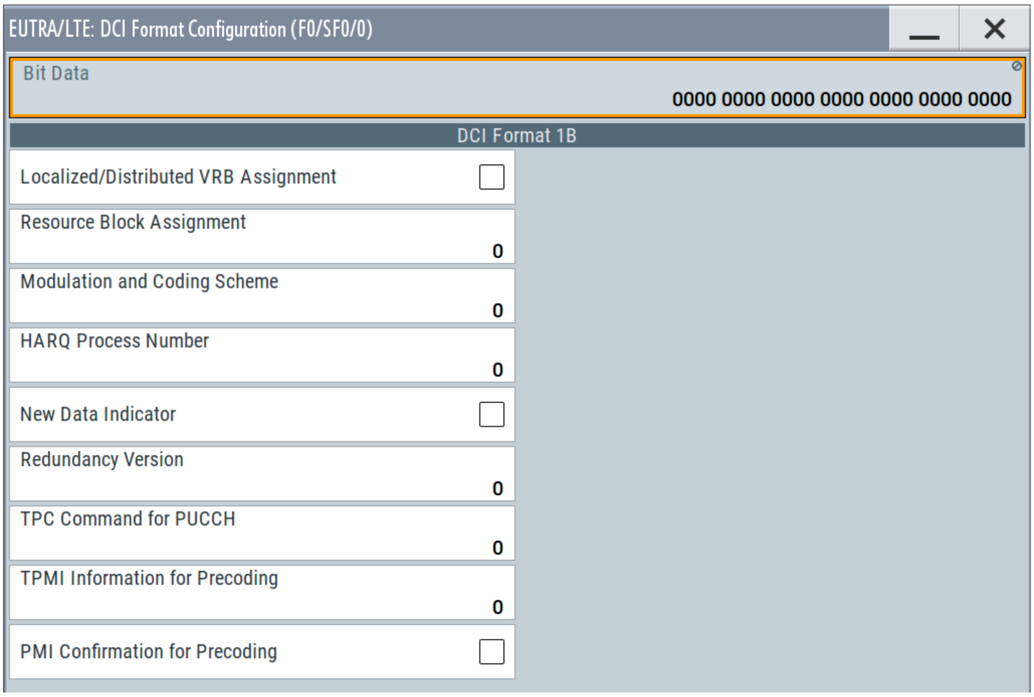
Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810	See "Carrier Indicator Field (CIF)" on page 194
"Mode"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:F1AMode on page 810	
"Localized/Distributed VRB Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:VRBA on page 823	
"GAP Value"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 813	"Channel Bandwidth >= 50RBs", "Distributed VBR Assignment" and "User = User x"
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 818	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 814	PDSCH Mode

Control Information Field	SCPI command	Dependencies
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 813	PDSCH Mode
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 815	PDSCH Mode
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 818	PDSCH Mode
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 821	PDSCH Mode
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 812	PDSCH Mode TDD mode
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SRSRequest on page 818	"User Configuration > User x > Aperiodic SRS > On"
"Preamble Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:PRINdex on page 811	PRACH Mode
"PRACH Mask Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:MINDex on page 811	PRACH Mode

DCI Format 1B

DCI format 1B is used for the compact scheduling of one PDSCH codeword with precoding information, i.e. when MIMO operation is involved.

The precoding information consists of 2 or 4 bits for 2 and 4 antennas respectively.



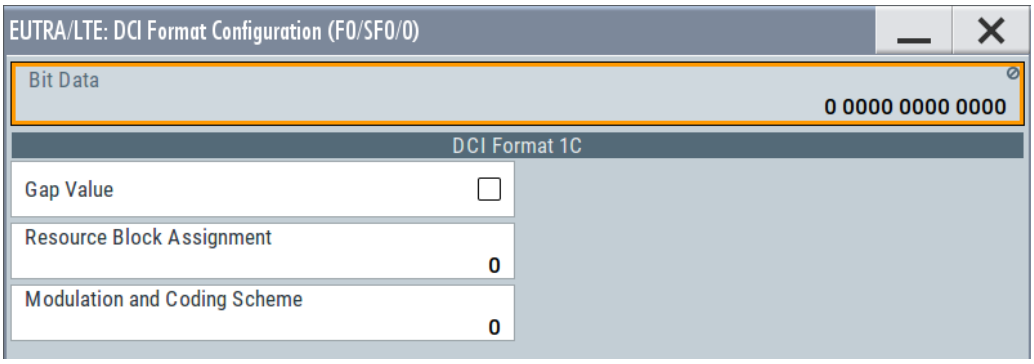
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

The DCI Format 1B transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810	See "Carrier Indicator Field (CIF)" on page 194
"Localized/Distributed VRB Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:VRBA on page 823	
"GAP Value"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 813	"Channel Bandwidth >= 50RBs", "Distributed VBR Assignment" and "User = User x"
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 818	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 814	
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 813	
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 815	
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 818	
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 821	
"Downlink Assignment Index"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 812	TDD mode
"TPMI Information for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPMI on page 821	
"PMI Confirmation for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PMI on page 816	

DCI Format 1C

DCI format 1C is used for compact scheduling of one PDSCH codeword.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

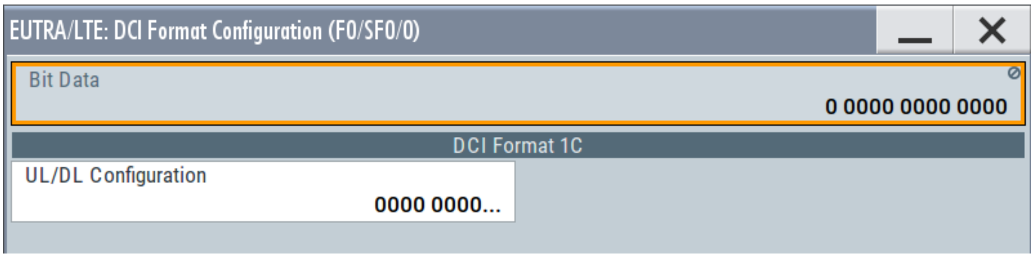
The DCI Format 1C transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
GAP Value	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 813	[Channel Bandwidth >= 50 RBs]
Resource Block Assignment	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 818	
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 814	

DCI Format 1C for eIMTA

Option: R&S SMW-K113

To enable this parameter, select "DCI Table" > User > "User x eIMTA".



If eIMTA is used, the DCI format 1C carries information about the UL/DL configuration numbers. Each UL/DL configuration number consists of 3 bits and indicates one of the configurations listed in Figure 2-5.

The UL/DL configuration is defined as a bit pattern. The bit pattern length is selected so that the payload size of the DCI is equal to the payload size of the DCI format 1C, when it used for compact scheduling. If the configured pattern is shorter than the required, the remaining bits are filled with zeros.

DCI format 1C for eIMTA is supported in the common search space (Search Space) and in the PCell.

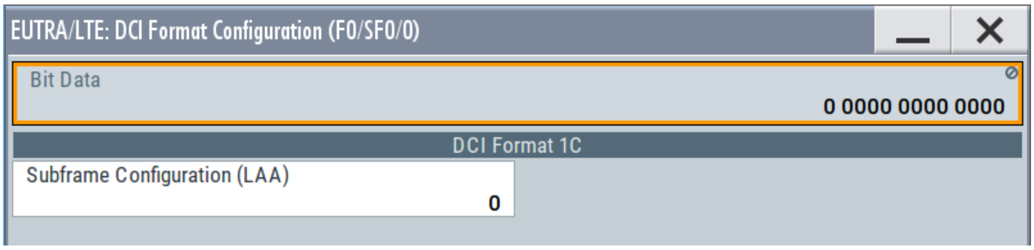
The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:ULDLconf on page 822

DCI Format 1C for LAA

Option: R&S SMW-K119

To enable this parameter, select "DCI Table" > User > "CC-RNTI".



If LAA is used, the DCI format 1C carries information about the LAA subframe configuration.

Table 4-11: Subframe configuration for LAA in current and next subframe [36.211]

Value of "Subframe configuration for LAA" field in current subframe	Configuration of occupied OFDM symbols (current subframe, next subframe)
0000	(-,14)
0001	(-,12)
0010	(-,11)
0011	(-,10)
0100	(-,9)
0101	(-,6)
0110	(-,3)
0111	(14,*)
1000	(12,-)
1001	(11,-)
1010	(10,-)
1011	(9,-)
1100	(6,-)
1101	(3,-)
1110	reserved
1111	reserved

Where:

- (-, Y) means UE may assume the first Y symbols are occupied in next subframe and other symbols in the next subframe are not occupied.

- (X,-) means UE may assume the first X symbols are occupied in current subframe and other symbols in the current subframe are not occupied.
- (X,*) means UE may assume the first X symbols are occupied in current subframe, and at least the first OFDM symbol of the next subframe is not occupied.

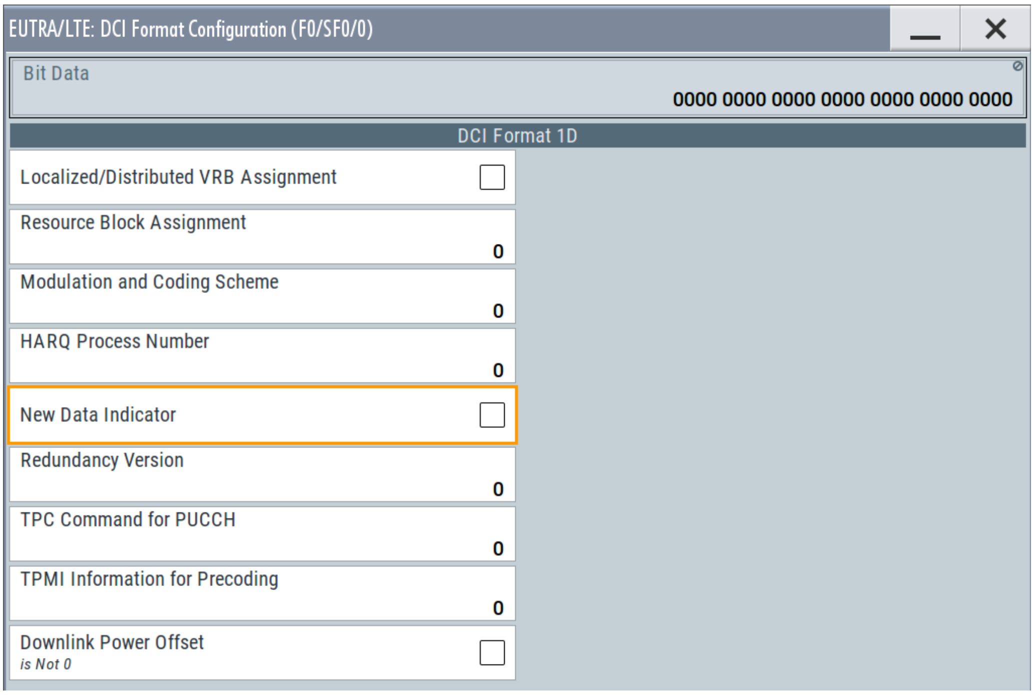
DCI format 1C for LAA is supported in the common search space (Search Space) and in the SCell.

The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:LAASubframe on page 781

DCI Format 1D

DCI format 1D is used for the compact scheduling of one PDSCH codeword with pre-coding and power offset information.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

The DCI Format 1D transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
"Carrier Indicator Field (CIF)"	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810	See "Carrier Indicator Field (CIF)" on page 194
Localized/Distributed	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:VRBA on page 823	

Control Information Field	SCPI command	Dependencies
Resource Block Assignment	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 818	
GAP Value	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP on page 813	"Channel Bandwidth >= 50RBs", "Distributed VBR Assignment" and "User = User x"
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:MCSR on page 814	
HARQ Process Number	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 813	
New Data Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:NDI on page 815	
Redundancy Version	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RV on page 818	
TPC Command for PUCCH	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 821	
Downlink Assignment Index	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 812	TDD mode
TPMI Information for Precoding	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPMI on page 821	
Downlink Power Offset	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DPOFfset on page 813	

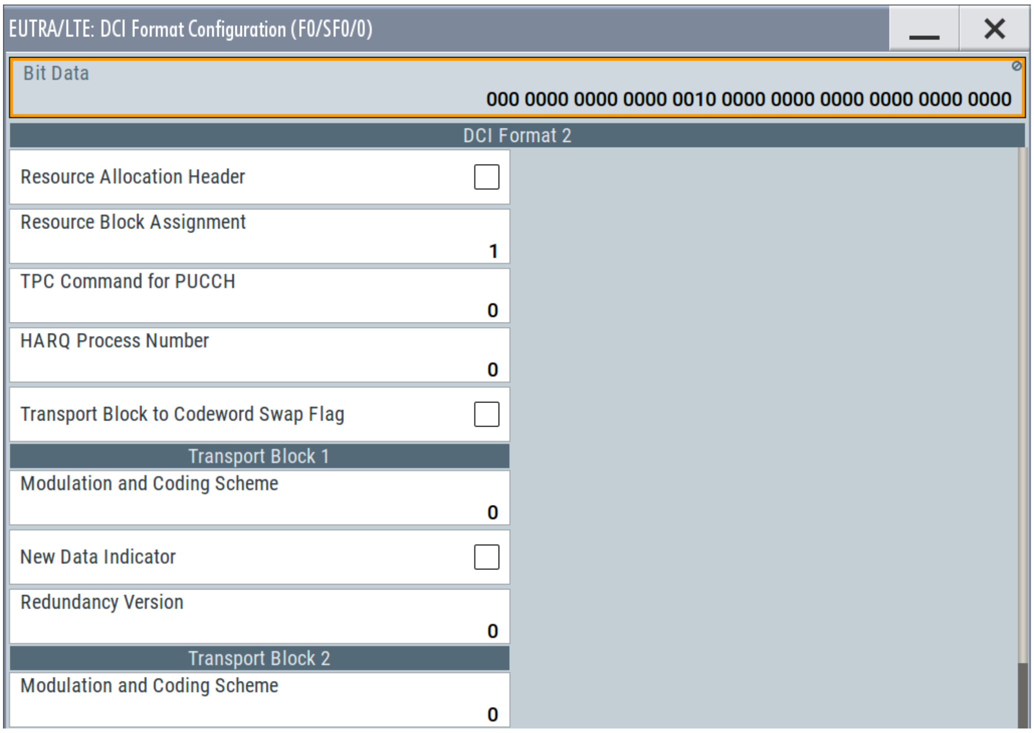
DCI Format 2/2A/2B/2C/2D

The DCI formats are used in the following cases:

- DCI format 2: for PDSCH scheduling in a spatial multiplexing configuration
- DCI format 2A: for PDSCH scheduling in a spatial multiplexing configuration, but without PMI feedback.
- DCI format 2B: in 2-, 4-Tx antenna configurations.
- DCI format 2C: in a multi-layer transmissions (Tx Mode 9).
- DCI format 2D: in a multi-layer transmissions (Tx Mode 10), using CoMP.

Since MIMO operation requires two codewords, the modulation and coding scheme, new data indicator and the redundancy version are signaled separately for each of the codewords. The spatial multiplexing also requires a transmission of precoding information.

The transport block to codeword mapping is performed according to the 3GPP specification: transport block 1 (TB1) is mapped to codeword 1/2 (CW1) and TB2 to codeword 2/2 (CW2). The "Transport Block to Codeword Swap Flag" determines the mapping in case both transport blocks are enabled. If this swap flag is enabled, the TB1 is mapped to CW2 and vice versa.



The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

If the DCI format is used for validation of the semi-persistent scheduling (SPS) activation or release, some special DCI fields are predefined according to Tables 9.2 in TS 36.213. See also Chapter 4.3.7, "SPS configuration settings", on page 162.

The DCI format 2D is required for downlink transmission using TM10 as the DCI format 2C is used for the TM9. The DCI format 2D is also similar to the format 2C but it carries additionally QCL (quasi-co-location) and rate matching information. The "PDSCH RE Mapping and QCL Indicator" is a two bit field that indicates one of four sets of parameters sets, as specified in the TS 36.211.

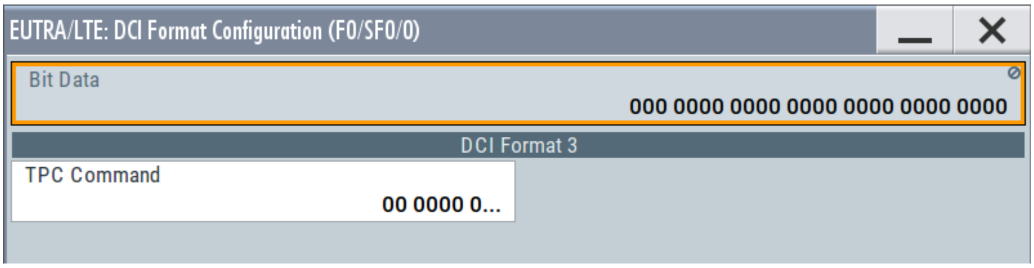
The DCI Format 2/2A/2B/2C/2D transmits the information listed in the following table.

Control Information Field	SCPI command	Dependencies
Carrier Indicator Field (CIF)	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:CIField on page 810	See "Carrier Indicator Field (CIF)" on page 194
Resource Allocation Header	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RAH on page 817	"Channel Bandwidth > 10 RBs"
Resource Block Assignment	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:RBA on page 818	
TPC Command for PUCCH	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCC on page 821	
Downlink Assignment Index	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DLAindex on page 812	TDD mode

Control Information Field	SCPI command	Dependencies
HARQ Process Number	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN on page 813	
Ant. Port(s), Layers, SCID	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:APLayer on page 809	DCI Format 2C/2D
Transport Block to Codeword Swap Flag	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SWAPflag on page 819	DCI Format 2/2A
Scrambling Identity	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SID on page 820	DCI Format 2B
Precoding Information	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRECinfo on page 816	DCI Format 2/2A
SRS Request	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SRSRequest on page 818	DCI Format 2B and TDD mode
	"Transport Block 1"	
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:MCS on page 819	
New Data Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:NDI on page 819	
Redundancy Version	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:RV on page 820	
	"Transport Block 2"	
Modulation and Coding Scheme	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:MCS on page 819	
New Data Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:NDI on page 819	
Redundancy Version	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:RV on page 820	
PDSCH RE Mapping and QCL (quasi-co-location) Indicator	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PDRE on page 815	DCI Format 2D
HARQ-ACK Resource Offset	[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HACK on page 814	If EPDCCH is used

DCI Format 3/3A

The DCI Format 3/3A is used for the transmission of TPC Commands for PUCCH and PUSCH with 2-bit and a single bit power adjustment respectively.



The "TPC Command" is set as a bit pattern.

The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification and the resulting Bit Data is displayed.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TPCinstr` on page 821

4.4 Enhanced PBCH, PDSCH and PMCH settings

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > Subframe > No of Used Allocations = 3".
3. Select "Allocation Table > Allocation#3 > Content Type".
4. Select one of the following "Content Type":
   a) "PBCH"
   b) "PDSCH"
   c) "PMCH"
5. Select "Enhanced Settings > Config..."

   In the "Enhanced Settings" dialog, you can define the precoding and the channel coding settings for the DL channels PBCH and PDSCH. The settings are configurable on a subframe basis.

Consider the following interdependencies:

- The "Precoding" settings are available for the first codeword and applied for both codewords.
- The available "Precoding" settings depend on:
  – The global MIMO configuration
  – The content of the allocation
  – The selected codeword
- For all allocations, where the "Data Source > User x":
  – The following parameters are read-only: "Scrambling State", "UE ID" and "Channel Coding State".

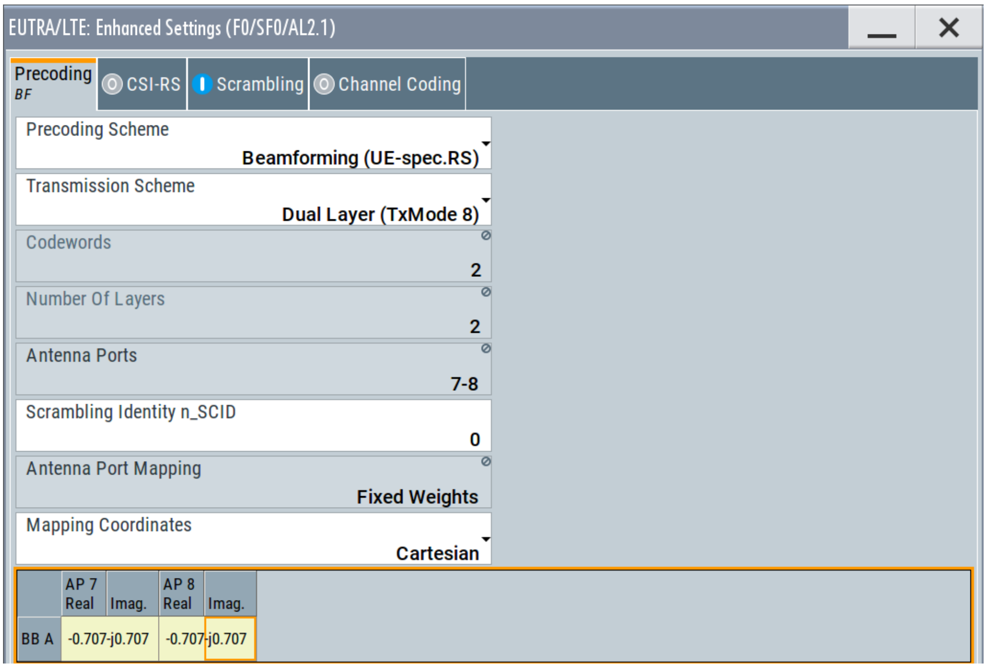
To configure these parameters, open the User configuration settings dialog for the corresponding user.

– You can access the "Enhanced Settings" of one particular "User 1..4" form any allocations belonging to this user.

4.4.1 Precoding settings

Access:

1. Select "General DL Configuration > Antenna Ports"
2. Select "Global MIMO Configuration > 2 TxAntennas"
3. Select "General > Frame Configuration > Subframe > No of Used Allocations = 3".
4. Select "Allocation Table > Allocation#3 > Content Type".
5. Select "Content Type > PDSCH"
6. Select "Enhanced Settings > Config..."



Consider the following interdependencies:

- The "Precoding" settings are available for the first codeword and applied for both codewords.
- The available "Precoding" settings depend on:
  – The global MIMO configuration
  – The content of the allocation
  – The selected codeword

Precoding Scheme

Selects the precoding scheme.

Note: The available precoding schemes depend on Content Type and the MIMO Configuration.

"None" Disables precoding.

"Spatial Multiplexing/Tx Diversity"
Precoding for spatial multiplexing or transmit diversity is performed according to TS 36.211 and the selected parameters.

"Beamforming (UE-spec.RS)"
Sets the PDSCH to transmission mode selected with the parameter Transmission Scheme.

"Antenna Port 4"
Option: R&S SMW-K84
Default precoding scheme for the PMCH transmitted in MBFSN subframes.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:SCHeme` on page 788

Transmission Scheme

Option: R&S SMW-K84/K85/K112

Determines the transmission scheme (see also Table 2-6).

"Transmission Scheme"	Available for Global MIMO Configuration	Description
"Single Layer (TxMode 7)"	SISO+BF 2Tx/4Tx-Antennas	Option: R&S SMW-K84 Sets the PDSCH to transmission mode 7, as described in TS 36.213, i.e. UE-specific RS (DM-RS) are added to the PDSCH. This special mode is defined for transmission using antenna port 5. **Tip:** To enable the instrument to generate a **transmission using antenna port 5** signal, select "Global MIMO Configuration > SISO + BF" Antenna port 5 transmission is also known as transmission corresponding to the UE-specific reference signal. It is defined in the TS 36.101, chapter 8.3.
"Dual layer (TxMode 8)"	SISO+BF 2Tx/4Tx-Antennas	Option: R&S SMW-K84 Sets the PDSCH to transmission mode 8, as described in TS 36.213, i.e. UE-specific RS are added to the PDSCH. In this mode, antenna ports 7 and 8 are used. By default, the antenna ports 7 and 8 are mapped on the first two basebands but this configuration can be changed. **Tip:** To enable the instrument to generate a transmission using antenna port 7 and 8, set the parameter "Global MIMO Configuration" to "SISO + BF", "2 Tx-antennas" or "4 Tx-antennas".
"Multi-layer (TxMode 9)"	SISO+BF 2Tx/4Tx-Antennas	Option: R&S SMW-K85 Sets the PDSCH to transmission mode 9. Depending on the used layers, antenna ports 7 to 14 are used.
"Multi-layer, CoMP (TxMode 10)"	SISO+BF 2Tx/4Tx-Antennas	Option: R&S SMW-K112 Sets the PDSCH to transmission mode 10, used for multi-layer transmissions combined with CoMP (coordinated multi-point operation). Depending on the used layers, antenna ports 7 to 14 are used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:TRSCheme on page 789

Codeword

Displays the number of the codeword and the total number of codewords used for the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CODWords
on page 738

Number of Layers

Sets/displays the number of layers for the selected allocation.

The number of available layers depends on selected Content Type and Precoding Scheme

The combination of number of codewords and number of layers determines the layer mapping for the selected precoding scheme, see also "Codewords and spatial layers" on page 43.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:NOLayers on page 787

Scrambling Identity n_SCID
Sets the scrambling identity according to TS 36.211.

This value is used for initialization of the sequence used for generation of the UE-specific reference signals.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:SCID on page 788

Antenna Ports
Option: R&S SMW-K84

Displays and configures the antenna ports for the selected Transmission Scheme.

See also "Mapping table" on page 225.

If one of the multi-layer modes is configured to use one codeword (i.e. one layer), the mapping of the layer to the antenna ports (7 to 9) is configurable.

Tip: Use this setting to configure a dual-layer multi-user MIMO (MU-MIMO) scenario.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:AP on page 785

Antenna Port Mapping
Option: R&S SMW-K84/K85

Sets the way that the logical antenna ports are mapped to the physical TX antennas, see Chapter 4.5, "DL antenna port mapping settings", on page 222.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:APM on page 785

Use Alternative Codebooks
Option: R&S SMW-K113)

This parameter applies the enhanced 4 Tx codebook and is enabled if the following applies:
- Transmission Scheme > "Tx Mode 8/Tx Mode 9/Tx Mode 10" (dual- or multi-layer transmission) and
- Global MIMO Configuration = "4 TxAntennas"

The enhanced 4 Tx codebook is part of the further downlink MIMO enhancements feature proposed in LTE-A Rel. 12; see "Further DL MIMO enhancements (enhanced 4Tx codebook)" on page 55.

"Off" Applied is the normal codebook, as specified in TS 36.211.

"On" Applied is the enhanced 4Tx codebook, as specified in TS 36.213.
Tip: Toggle the parameter "Use Alternative Codebooks" and observe the effect on the values in the Mapping table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:CBUA` on page 786

Codebook Index/Codebook Index 2
Enabled if:
- Precoding Scheme > "TX Diversity or Spatial Multiplexing"
- "Codeword = 1/2"
- "Antenna Port Mapping > Codebook"
- "User Specific Antenna Port Mapping" > Constant Codebook Index > "Off"
If "Constant Codebook Index > On", the "Codebook Index/Codebook Index 2" is set automatically to the values set in the "User Specific Antenna Port Mapping" dialog.

Sets the codebook index for the selected allocation and selects the predefined precoder matrix.

The number of available codebook indices depends on the number of antenna ports with mapped user-specific reference symbols, the number of layers and number of Tx antennas per component carrier.

Figure 2-23 shows the range of the codebook index for downlink spatial multiplexing for LTE Rel. 8/9. The LTE Rel. 10 (R&S SMW-K85) defines up to eight layers and uses the same principles.

The combination of codebook index and the selected Number of Layers determines the pre-coding matrix used for precoding.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CBINdex[<dir>]` on page 786

Cyclic Delay Diversity
(Enabled for Precoding Scheme set to TX Diversity or Spatial Multiplexing and codeword 1/2 only)

Sets the CDD for the selected allocation.

The combination of cyclic delay diversity and the selected Number of Layers determines the precoding parameters for spatial multiplexing.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CDD` on page 787

Mapping Coordinates
Switches between the "Cartesian" and "Cylindrical" coordinates representation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:DAFormat on page 787

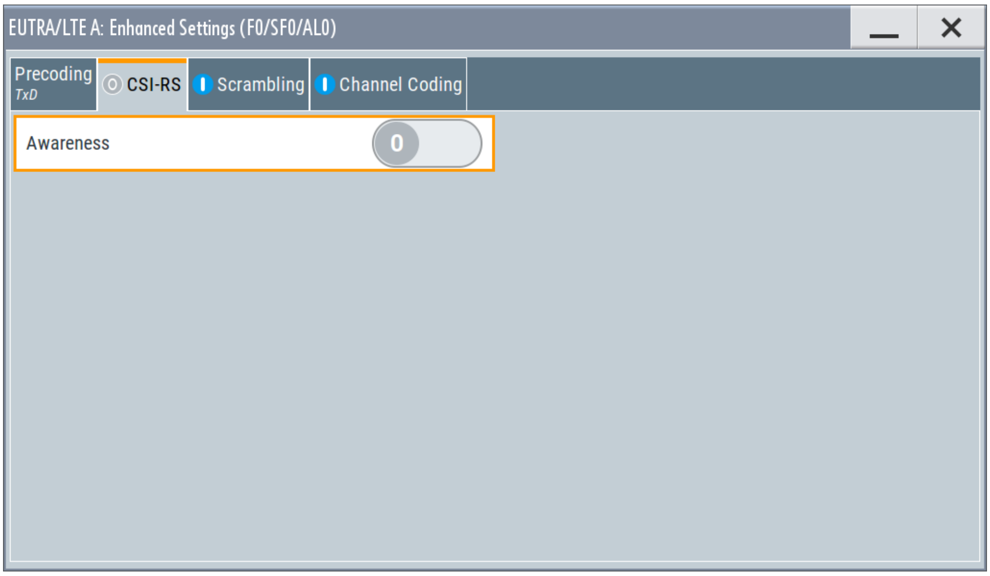
Mapping Table
Option: R&S SMW-K84

Defines the mapping of the antenna ports (AP) to the physical antennas, see "Mapping table" on page 228.

4.4.2 CSI-RS settings

Access:

► Select "Enhanced Settings > CSI-RS".



In this dialog, the CSI awareness can be enabled/disabled.

CSI Awareness
Determines the way the PDSCH is processed.

"On" During the channel coding, the resource elements configured for the CSI-RS transmission are explicitly avoided and the PDSCH is mapped only on the available physical bits.

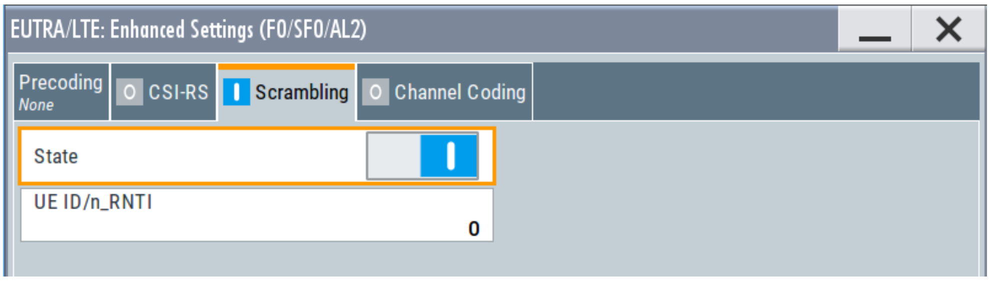
"Off" The channel coding is performed as if the CSI-RS is not transmitted. The PDSCH mapping is not modified to avoid the resource elements on that the CSI-RS can be transmitted.
The modulation symbols necessary for the transmission of the CSI-RS are subsequently substituted by the CSI-RS information; the CSI-RS are transmitted instead of the PDSCH symbols.
This process leads to increased bit error rate, but an UE receiving this PDSCH can still decode the information correctly.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CAW on page 783

4.4.3 Scrambling settings

Access:

► Select "Enhanced Settings > Scrambling".



This dialog comprises the settings needed for configuring the scrambling:

State Scrambling (DL)

Enables/disables the bit-level scrambling.

If a "User x" is selected as Data Source in the allocation table for the corresponding allocation, the "State Scrambling" is read only. Its value is displayed as set in the User configuration settings dialog for the corresponding user.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SCRambling:STATe on page 789

UE ID/n_RNTI (PDSCH)

Sets the user equipment identifier (n_RNTI) of the user to which the PDSCH transmission is intended. The UE ID is used to calculate the scrambling sequence.

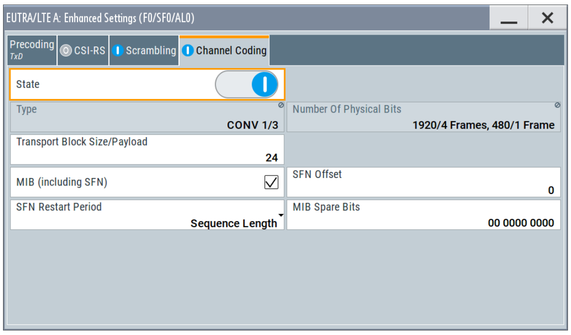
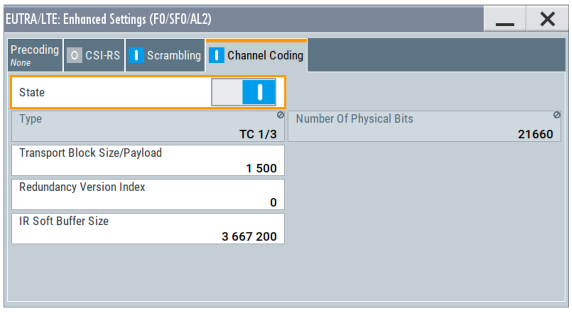
If a "User x" is selected as Data Source in the allocation table for the corresponding allocation, the "UE ID" is read only. Its value is displayed as set in the User configuration settings dialog for the corresponding user.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SCRambling:UEID on page 789

4.4.4 Channel coding settings

Access:

► Select "Enhanced Settings > Channel Coding".

PBCH channel coding settings	PDSCH channel coding settings
	

This dialog comprises the settings needed for configuring the channel coding. The settings vary according to the selected "Content Type"

State Channel Coding (DL)

Enables/disables channel coding for the selected allocation and codeword.

For any allocation with Data Source > "User x", the "Channel Coding State" is read only. The value is set in the User configuration settings dialog for the corresponding user.

A PBCH can be generated in one of the following modes:

- Without channel coding, i.e. this parameter is disabled.
  Dummy data or user-defined data lists are used.
- Channel coding with arbitrary transport block content
  Channel coding is activated and parameter MIB (including SFN) is disabled.
- Channel coding with real data (MIB) including SFN
  Channel coding and MIB are activated.

For the PBCH allocation with activated channel coding, one block of data (transport block size TBS of 24) is coded jointly and then spread over four frames. Set the ARB sequence length to a value that is a multiple of four.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:STATe on page 784

Type Channel Coding (DL)
Displays the used channel coding scheme and channel coding rate.

PBCH uses always tail biting convolution coding with code rate 1/3; PDSCH uses always turbo code with code rate 1/3.

Remote command:
n.a.

Number of Physical Bits (DL)
Displays the size of the selected allocation in bits and considering the subcarriers that are used for other signals or channels with higher priority (see Chapter A, "Conflict handling", on page 1099).

For Data Source > "User x", the value of the parameter "Number of Physical Bits" is the sum of the "Physical Bits" of all allocations of the same user in the selected subframe.

The size of the PBCH allocation is fixed to 1920/4 Frames, 480/1 Frame.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PHYSbits? on page 741
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:USER<ch>:PHYSbits? on page 744

MIB (including SFN)
(for PBCH only)

Enables transmission of real MIB (master information block) data, calculated according to the values of the following "General DL Settings" parameters:
- Channel Bandwidth
- PHICH Duration
- PHICH N_g

The SFN (system frame number) is included as well.

If this parameter is enabled, the "Transport Block Size" is fixed to 24 and the Data Source for the PBCH allocation is set to "MIB".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB on page 782

SFN Offset
(for PBCH only)

By default, the counting of the SFN (system frame number) starts with 0. Use this parameter to set a different start SFN value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SOFFset on page 782

SFN Restart Period
Option: R&S SMW-K84

Determines the time span after which the SFN (system frame number) restarts.

"Sequence Length"
The SFN restart period is equal to the ARB sequence length.

"3GPP (1024 Frames)"
The PBCH including SFN is calculated independently from the other channels. The SFN restarts after 1024 frames and the generation process is fully 3GPP compliant, but the calculation can take long time.
Tip: Use the "3GPP (1024 Frames)" mode only if 3GPP compliant SFN period is required.
This mode is disabled if a baseband generates more than one carrier.
Depending on the configured "System Configuration > Mode > Advanced", this parameter is not available in all baseband blocks.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SRPeriod` on page 782

MIB Spare Bits
Sets the 10 spare bits in the PBCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MSPare` on page 783

Transport Block Size/Payload (DL)
Defines the size of the transport block/payload in bits.

- One transport block is generated and spread over all allocations. If "Data Source = User x", the parameters "Transport Block Size", "Redundancy Version Index" and "IR Soft Buffer Size" are related to all allocations of the same user in the subframe.
- In case a spatial multiplexing with two codewords is configured, individual transport blocks for the two code blocks are generated.
- For PBCH allocations with enabled parameter MIB (including SFN), the transport block size is fixed to 24.
  Set the transport block size to 24 if a generation compliant to the 3GPP specifications is required.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:TBSize` on page 784

Redundancy Version Index (PDSCH)
Sets the redundancy version index.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:RVINdex` on page 784

IR Soft Buffer Size (PDSCH)
Sets the size of the IR soft buffer for the selected transport block (N_IR from TS 36.212).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:ISBSize on page 783

4.5 DL antenna port mapping settings

The 3GPP standard defines the different antenna ports for transmission in different transmission modes (TM, also "TxMode") and for the transmission of different reference signals. See Table 2-6 and Chapter 2.2.1.5, "Downlink reference signal structure and cell search", on page 27.

The settings necessary to configure the reference signals and to enable the transmission modes are distributed among different dialogs, depending on their type (cell-specific, user-specific, etc.). The related antenna port mapping settings are distributed in these dialogs, too.

To set the cell-specific antenna port mapping settings

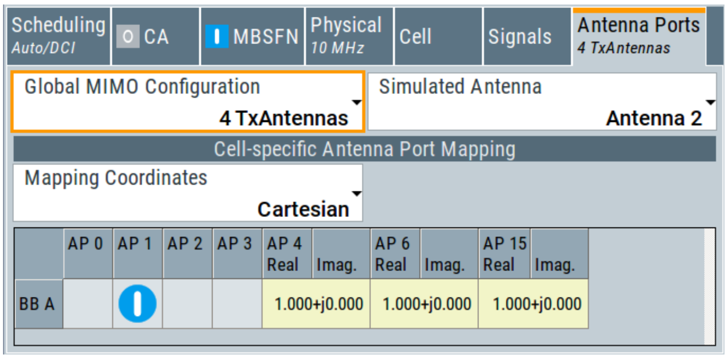
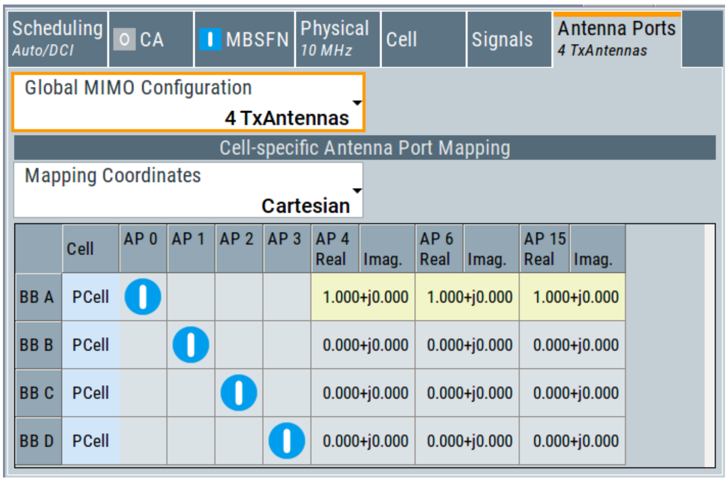
1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General DL Settings > Antenna Ports".

The provided settings depend on the selected "System Configuration > Fading and Baseband Configuration > Mode" and the enabled LxMxN MIMO scenario, i.e. the number of enabled "Entities", "Basebands" and "Streams".

For details, see R&S SMW User Manual.

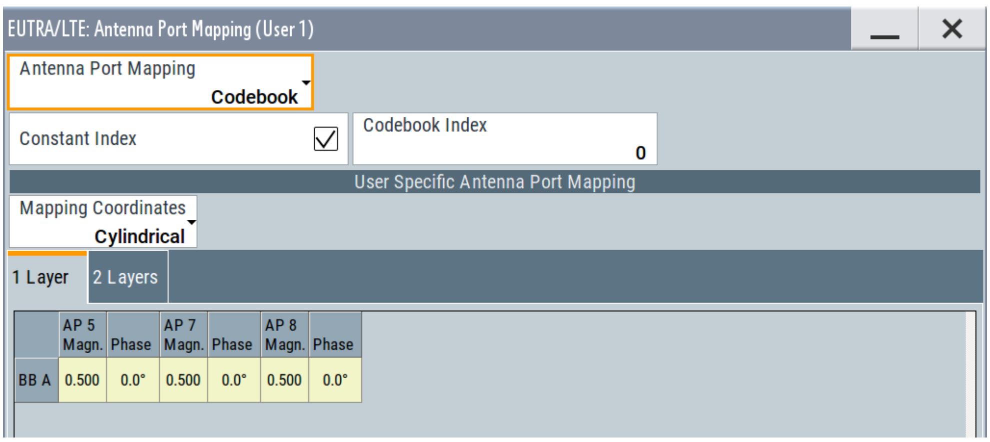
See Table 4-4. Compare the displayed settings for the same 4x4 MIMO configuration.

Table 4-12: Antenna ports settings depending on the enabled MxN MIMO configuration and System Configuration > Fading/Baseband Configuration > BB Source Config mode

<table>
<tr><th>Mode</th><th>"System Configuration > Fading/Baseband Configuration > 1x4x4"</th></tr>
<tr><td>"Separate"</td><td>
</td></tr>
<tr><td>"Coupled"</td><td>
</td></tr>
</table>

To set the user-specific antenna port settings

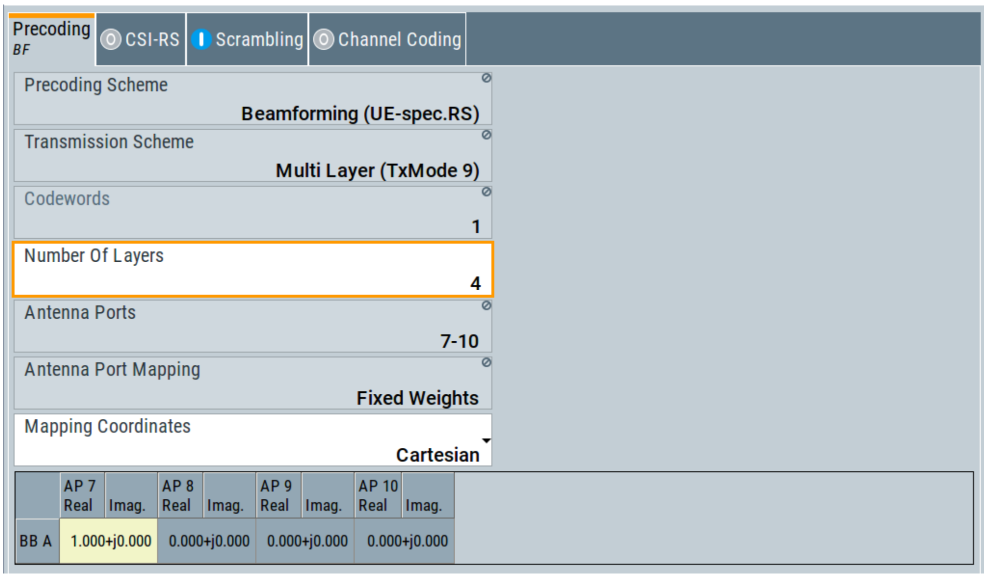
► Select "Frame Configuration > General > User > Antenna Mapping > Config".



The available antenna ports and layers depend on the number of antennas and the transmission mode the UE is working in ("Frame Configuration > General > User > Tx Mode")

To configure the PDSCH belonging to a particular user

1. Select "Frame Configuration > General > User > User 1 > Tx Mode > e.g. Mode 9".
2. Select "Frame Configuration > Subframe > Subframe Selection#0 > No. of Used Allocation = 3".
3. Select "Frame Configuration > Subframe > Allocation Table > All#2 > Data Source > UE1".
4. Select "Frame Configuration > Subframe > Allocation Table > All#2 > Enh. PDSCH Settings > Precoding".



Refer to Chapter 4.4.1, "Precoding settings", on page 212 for description of the provided settings.

The dialogs shown in "To set the cell-specific antenna port mapping settings" on page 222, "To set the user-specific antenna port settings" on page 223 and "To configure the PDSCH belonging to a particular user" on page 224 comprise the settings necessary to configure the mapping of the logical antenna ports to the physical TX antennas (Basebands). The number of physical antennas is set with the parameter "General DL Settings" > Global MIMO Configuration.

The dialogs consist of two parts, a mapping table and a selection about the way the antenna mapping is performed. The yellow matrix elements in the mapping table indicate the default antenna port to physical antenna (TX antenna/baseband) mapping.

Mapping methods

The antenna mapping can be performed according to one of the following three methods:

- "Codebook"
  The used precoding weights are according to the TS 36.211, table 6.3.4.2.3-1 resp. 6.3.4.2.3-2. The selected element is defined by the selected codebook index and the number of layers.

- "Random codebook"
  The precoding weights are selected randomly from the tables defined for the codebook method.
- "Fixed weight"
  A fixed precoding weight can be defined which is used for all allocations of the according “User” throughout the frame.

Depending on the selected mapping method, the mapping table is invisible ("Random codebook"), read-only ("Codebook") or full configurable ("Fixed weight").

Mapping table

The mapping table is a matrix with number of rows equal to the number of physical Tx antennas and number of columns equal of the number of antenna ports (AP). The available antenna ports depend on the current configuration.

- Antenna Ports AP0, AP1, AP2 and AP3 are always mapped to the four Tx antennas "BB A", "BB B", "BB C" and "BB D".
- Antenna Port AP4 is reserved for the MBSFN RS ("General DL Settings > MBSFN > State > Mixed") and per default mapped to "BB A".
- Antenna Port AP5 is reserved for the UE-specific RS (DM-RS) in TM7, AP7/AP8 are reserved for TM8
  ("Frame Configuration > General > User Configuration > Antenna Mapping > Config")
- Antenna Port AP6 is reserved for the PRS ("General DL Settings > PRS > State > On") and per default mapped to "BB A".
- Antenna Ports AP9 to AP14 are used by TM9
  ("Frame Configuration > General > User > Antenna Mapping > Config")
- Antenna Ports AP15 to AP22 are reserved for CSI-RS (up to LTE Rel. 13)
  Option: R&S SMW-K85
  ("General DL Settings > Signals > CSI-RS" > CSI-RS State > "On" and Number of AP per CSI-RS Configuration)
  The number of antenna ports corresponds to the maximum "Number of CSI-RS Antenna Ports", selected for any active cell with active CSI-RS or active DRS carrying CSI-RS.
- Option: R&S SMW-K112
  Antenna Ports AP107 to AP110 are reserved for EPDCCH
  ("Frame Configuration > General > User": "Tx Modex > TM10",
  EPDCCH > Config > "Activate EPDCCH > On" and "Antenna Mapping > Config")
- Option: R&S SMW-K115
  Antenna Ports AP7 or AP8 are used for the transmission of eMTC PDSCH
  Antenna Ports AP107 to AP110 are reserved for MPDCCH
  Antenna Ports AP2000 and AP2001 are reserved for the NB-IoT reference signal NRS

Cell-Specific Antenna Port Mapping
Option: R&S SMW-K84/K85

Comprises the settings for defining the mapping of the logical antenna ports to the available physical TX antennas (Baseband).

Mapping Coordinates ← Cell-Specific Antenna Port Mapping
Switches representation between the "Cartesian (Real/Imag)" and "Cylindrical (Magn./ Phase)" coordinates.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:MAPCoordinates` on page 712

Mapping table ← Cell-Specific Antenna Port Mapping
Defines the mapping of the antenna ports (AP) to the physical antennas, see "Mapping table" on page 225.

The column "Cell" defines which baseband generates which cell, in the following cases:

- Carrier aggregation is activated
  ("EUTRA/LTE > General DL Settings > CA > Activate Carrier Aggregation > On")
- Coupled baseband sources are used
  ("System Configuration > Fading/Baseband Configuration > BB Source Config > Coupled Sources")

The default mapping is selected to fit the current configuration but it can be changed afterwards.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB<st0>` on page 713
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:REAL` on page 713
`[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:IMAGinary` on page 714

User-Specific Antenna Port Mapping
Comprises the settings for defining the mapping of the logical APs to the available physical TX antennas.

Antenna Port Mapping ← User-Specific Antenna Port Mapping
Defines the antenna port mapping method, see Mapping Methods.

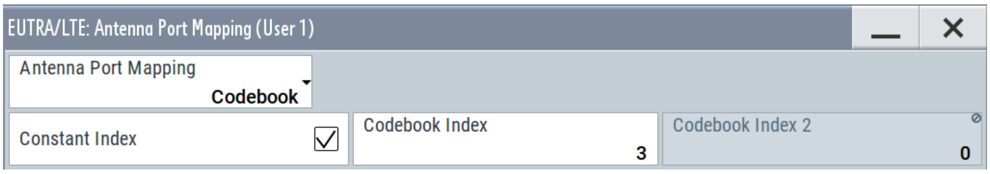
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MODE` on page 865

Constant Codebook Index ← User-Specific Antenna Port Mapping
For "Antenna Port Mapping > Codebook", defines whether the codebook index is set globally or per subframe.

Example:

Configure the settings as described in "To configure the PDSCH belonging to a particular user" on page 224.

- In the "User Specific Antenna Port Mapping" dialog:
  - Set "Antenna Port Mapping > Codebook"
  - Set **"Constant Codebook Index > On"**
  - Set the "Codebook Index/Codebook Index 2" values.



- Open the "Frame Configuration > Subframe > Allocation Table > All#2 > Enh. PDSCH Settings > Precoding" dialog.
  Observe the "Codebook Index/Codebook Index 2" values.
  The values are set automatically to the values set in the "Antenna Port Mapping" dialog.
- In the "User Specific Antenna Port Mapping" dialog, set **"Constant Codebook Index > Off"**.
- In the "Frame Configuration > Subframe > Allocation Table > All#2 > Enh. PDSCH Settings > Precoding" dialog, set the "Codebook Index/Codebook Index 2" values.

"On" Set the codebook index with the parameters Codebook Index/Codebook Index 2.
The values are constant and are used in all subframes for any PUSCH transmission of the particular user ("PUSCH Data Source > User x").

"Off" Set the codebook index with the parameters "Enhanced PDSCH Settings" > Codebook Index/Codebook Index 2
The values are set on a per subframe basis.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBCI on page 863

Codebook Index/Codebook Index 2 ← User-Specific Antenna Port Mapping
For "Antenna Port Mapping > Codebook" and "Constant Codebook Index > On", sets the codebook index for codebook mapping method.

The codebook index values are constant are used in all subframes for any PUSCH transmission of the particular user.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBINdex[<dir>] on page 864

Use Alternative Codebooks ← User-Specific Antenna Port Mapping
Option: R&S SMW-K113

This parameter applies the enhanced four Tx codebook and is enabled if the following applies:

- Transmission Scheme > "Tx Mode 8/Tx Mode 9/Tx Mode 10" (dual- or multi-layer transmission) and
- Global MIMO Configuration = "4 TxAntennas"

The enhanced 4 Tx codebook is part of the further downlink MIMO enhancements feature proposed in LTE Rel. 12; see "Further DL MIMO enhancements (enhanced 4Tx codebook)" on page 55.

"Off" Applied is the normal codebook, as specified in TS 36.211.

"On" Applied is the enhanced 4Tx codebook, as specified in TS 36.213.
Tip: Toggle the parameter and observe the effect on the values in the Mapping table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBUA` on page 864

Cell ← User-Specific Antenna Port Mapping
Indicates the cell to that the antenna port mapping is related, if a carrier aggregation is enabled (Activate Carrier Aggregation = On and Activate CA = On).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CELL` on page 863

Mapping Coordinates ← User-Specific Antenna Port Mapping
Switches between the "Cartesian (Real/Imag)" and "Cylindrical (Magn./Phase)" coordinates representation.

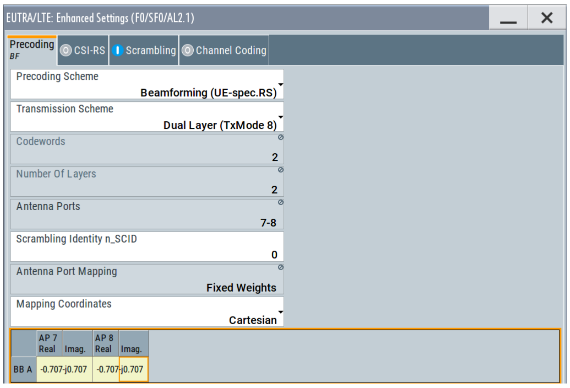
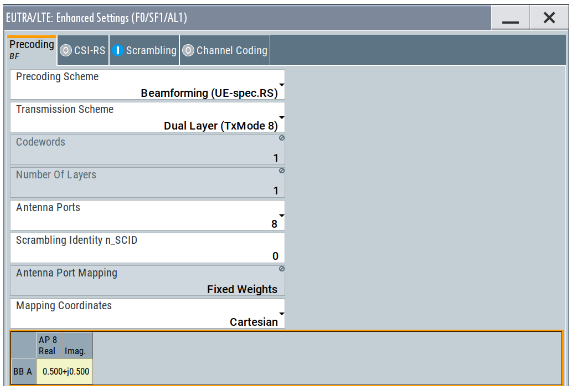
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MAPCoordinates` on page 864

Mapping table ← User-Specific Antenna Port Mapping
Defines the mapping of the antenna ports (AP) to the physical antennas, see also "Mapping table" on page 225.

You can set the precoding matrix per layer and not only of the most upper one that corresponds to the selected number of layers, but also for the layers underneath. The number of used layers is always lower or equal to the number of Tx antennas. Different layers can be assigned per subframe, therefore it is possible that the antenna port mapping changes on a per subframe basis.

Example:

- Enable 1x4x4 MIMO configuration
  This MIMO configuration used 4 Tx antenna.
  Hence, the number of layers is Layer# ≤4.
- Select "DL Frame Configuration > General > User 1 > Antenna Mapping Config"
  For both layers, configure the values in the "Mapping table".
  Use different mapping, for example:
  – For Layer#1 and PCell set "AP7 Real = AP 7 Imag = AP 8 Real =AP 8 Imag" = **0.5**
  – For Layer#2 and PCell set "AP7 Real = AP 7 Imag = AP 8 Real =AP 8 Imag" = **-0.707**
- Select "DL Frame Configuration > Subframe" and enable one additional allocation for subframe#0 and subframe#1
  In both subframes, set "Data Source = User 1".
- In subframe#0, select **"CW = 1/2"**.
  Select "Enhanced Settings > Config" and observe the values in the mapping table.
- In subframe#1, open the "Enhanced Setting", too.

Antenna port mapping in subframe#0	Antenna port mapping in subframe#1
 The precoding uses 2 codewords and 2 layers. The antenna mapping resembles the antenna mapping configuration of User 1 and Layer#2	 The precoding uses 1 codeword and 1 layer. The antenna mapping resembles the antenna mapping configuration of User 1 and Layer#1

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:REAL` on page 865
`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:IMAGinary` on page 865

4.6 General UL settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "General UL Settings"

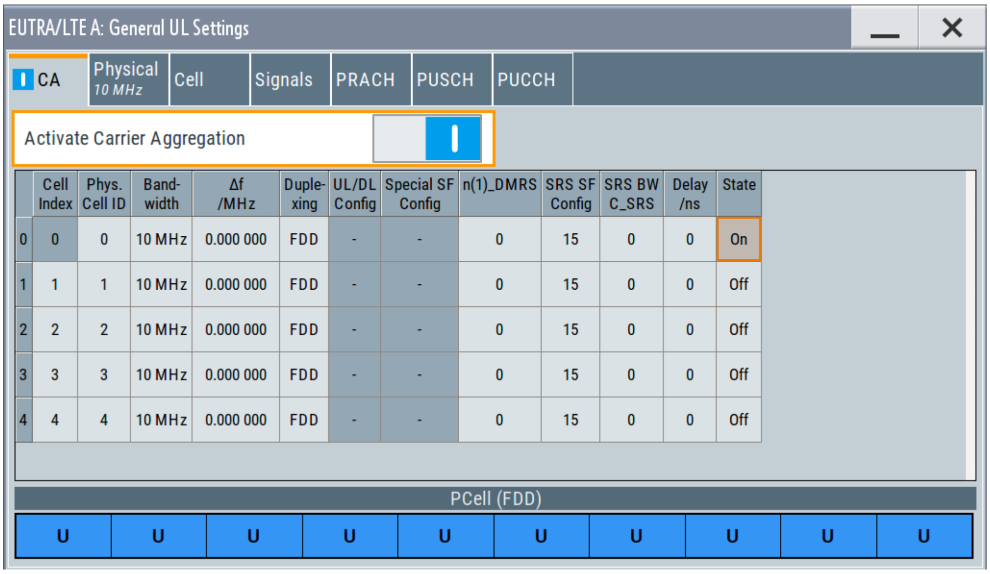
   This dialog allows configuring the EUTRA/LTE system for transmission direction uplink.

4.6.1 UL carrier aggregation configuration

UL Carrier Aggregation is an LTE-A (LTE Rel. 11) feature.
It requires options R&S SMW-K55 and R&S SMW-K112.

Access:

1. Select "Baseband > EUTRA/LTE > General > Link Direction > Uplink (SC-FDMA)".
2. Select "General UL Settings > CA".



The available settings depend on the current "System Configuration" settings, in particular on the selected "BB Source Config".
The dialog provides the settings for the configuration of one primary cell (PCell) and up to four secondary cells (SCell). The most important SCell settings are grouped in the "Carrier Aggregation" dialog.

The cell-specific parameters, like the PUCCH and PUSCH configuration, the DMRS and SRS transmission and the antenna port mapping are configurable in the User equipment configuration dialog of the corresponding UE.

4.6.1.1 About UL carrier aggregation

This section lists implementation-related information.

The following apply, if UL Carrier Aggregation is enabled:

- Combination of FDD and TDD is not possible.
- Component carriers are configured independent from each other. Their settings are calculated automatically from the PCell settings and form the parameters in the "UL Carrier Aggregation Configuration" dialog.
- Simultaneous support of LTE and LTE-A UEs is provided
- UE settings are configurable; they are however the same for each cell

Difference between carrier aggregation with coupled BB sources and with separated BB sources

- If "BB Source Config > Separated" is used, carrier aggregation is not activated automatically.
  One Primary Cell and up to four SCells can be *manually activated* per baseband.
  Component carriers are separated by applying a frequency offset ("Δf").
  It is not possible to apply independent fading on the component carriers generated by the same "Baseband" block.
- If "BB Source Config > Coupled" is used, *carrier aggregation is activated automatically*.
  One Primary Cell and up to four SCells can be configured. The signals of several component carriers can be routed to the same output connector (e.g. RF). Apply a frequency offset to separate the streams ("I/Q Stream Mapper > Frequency Offset").
  Component carriers can be faded independently.

Supported LTE-A bandwidth

The LTE specification defines a maximum Channel Bandwidth of 20MHz and aggregation of up to five component carriers to achieve 100MHz bandwidth.

The maximum bandwidth of the generated LTE-A signal depends on the installed options. Using the maximum sampling rate, the R&S SMW equipped with the options R&S SMW-B10/K522 can internally generate signals with up to 160 MHz RF bandwidth. With the options R&S SMW-B9/K527, the maximum bandwidth is up to 2 GHz.

For more information, see data sheet.

4.6.1.2 How to enable UL carrier aggregation

In the following, a general example is provided. Only the related settings are discussed.

To enable carrier aggregation and cross-carrier scheduling in coupled mode

The R&S SMW generates the required signal in system configuration with *coupled* baseband sources.

1. Select "System Config > Fading and Baseband Configuration > Mode > Advanced"
2. Enable a suitable LxMxN configuration, for example:
   a) For an LTE-A carrier aggregation scenario without MIMO, enable a 2x1x1 configuration.
   (That is "Entities = 2", "Basebands = 1", "Streams = 1")
   b) For an LTE-A carrier aggregation scenario with 2x2 MIMO each component carrier, enable a 2x2x2 configuration
   (That is "Entities = 2", "Basebands = 2", "Streams = 2")
3. Select "BB Source Config > Coupled Sources".
   Confirm with "Apply".
4. Select "Baseband > EUTRA/LTE".
5. Select "General UL Settings > CA".

   The "Activate Carrier Aggregation > On" parameter confirms that carrier aggregation is enabled automatically. Activated are two component carriers with 10 MHz bandwidth each.
   The number of active component carriers depends on the selected "System Configuration".
6. Change the settings of the second component carrier.
   For example, as shown on Figure 4-13.

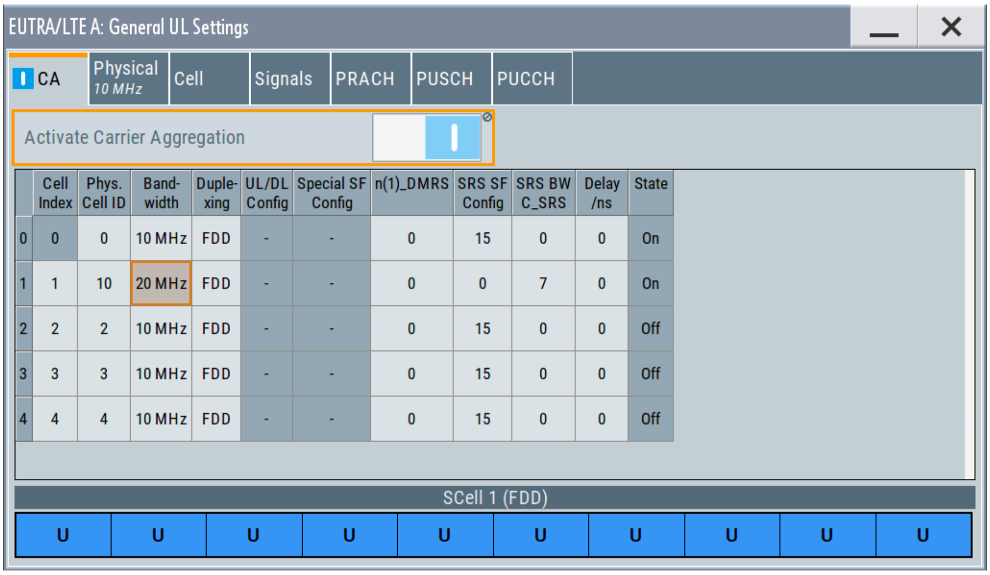
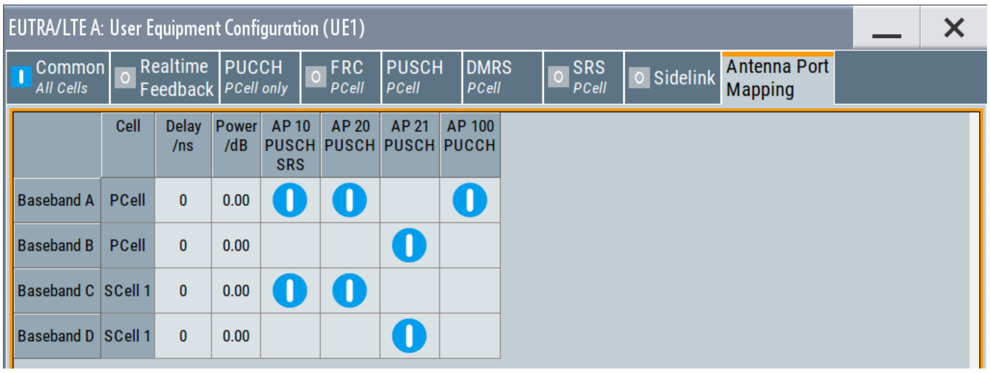


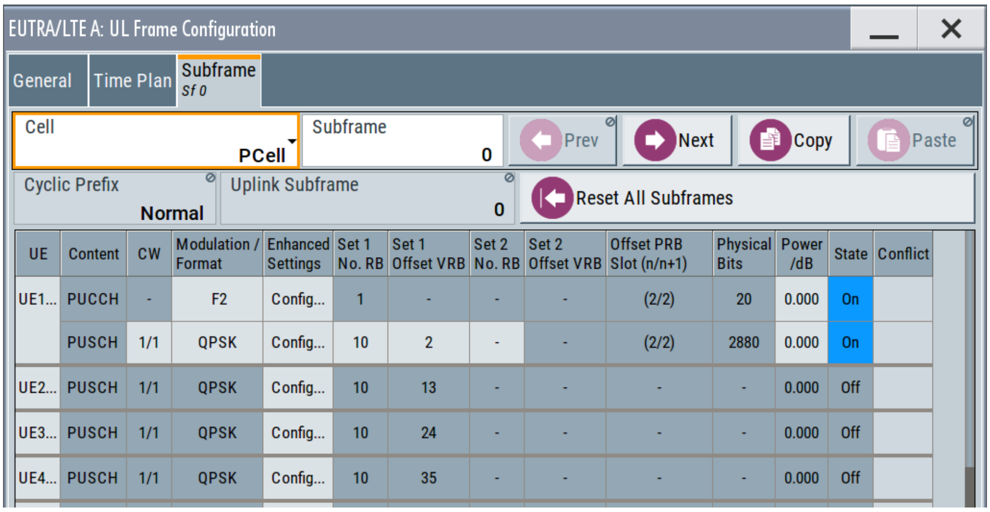
Figure 4-13: General UL Settings > Carrier Aggregation dialog in System Config > Fading/Base-band Configuration > BB Source Config > Coupled Sources

7. Select "UL Frame Configuration > General > UE#1 > Antenna Port Mapping" to verify the configuration.



8. Select "UL Frame Configuration > Subframe".

   The settings of the primary cell (PCell) and the currently activated SCells can be configured individually.

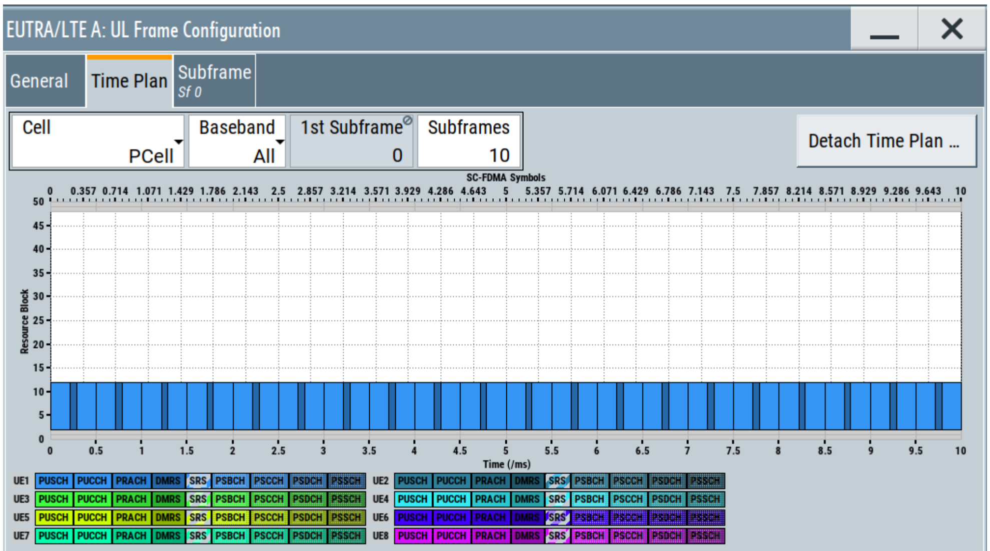


Secondary cells are identified by their "Cell Index". In this example (see Figure 4-13), there is one SCell that uses "Cell Index = 5".

Note: There is no PUCCH transmission on the SCells.

9. Select "UL Frame Configuration > Time Plan" to observe the configuration. Toggle between the time plan of the PCell and the SCell.

   The time plan confirms that the component carriers use different bandwidths and the PUCCH is transmitted only on the PCell.

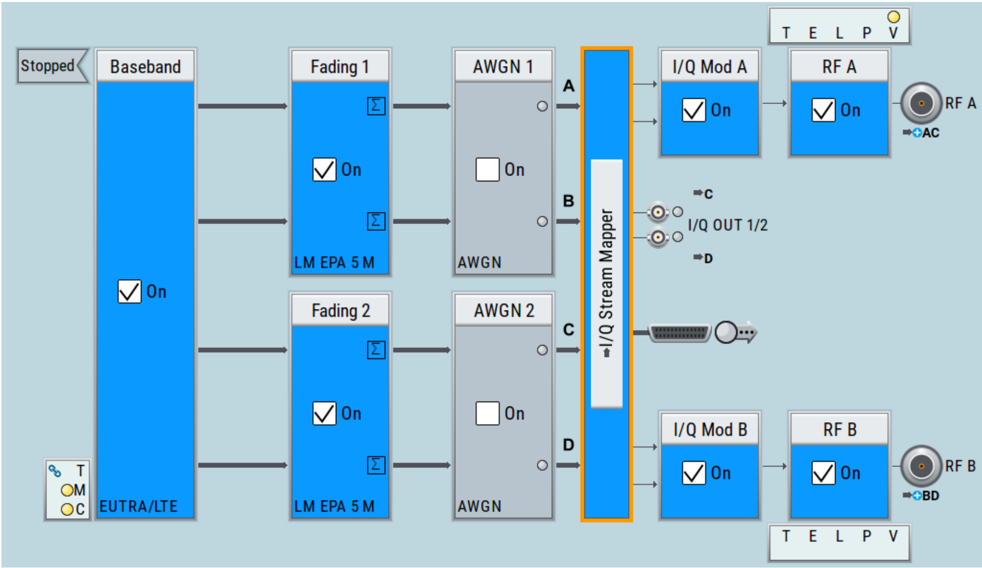


   Further displayed information depends on the current configuration, e.g. activated SRS transmission, etc.

10. Select "EUTRA/LTE State > ON".

11. If necessary, use the Fading simulator to configure the propagation conditions.
    For example, for both entities, select "Fading > Fading Settings".
    Select "Standard > LTE-MIMO > EPA 5Hz Medium".
    Select "State > On".

12. Adjust the RF frequency of both RF outputs.
13. Activate the RF outputs.



4.6.1.3 Carrier aggregation settings

The cell-specific parameters, like the PUCCH and PUSCH configuration, the DMRS and SRS transmission and the antenna port mapping, are configurable in the User equipment configuration dialog.

Settings

Activate Carrier Aggregation

Enables/disables the generation of several component carriers.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:CA:STATe` on page 841

Component Carrier Table
The table provides the settings of the component carriers.

The first row displays the settings of the PCell as configured in the General UL settings dialog.

The following four rows provide the configurable settings of the up to four SCells.

Cell Index ← Component Carrier Table
Sets the cell index of the corresponding SCell.

The cell index of the PCell is always 0.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:INDex on page 841

Physical Cell ID ← Component Carrier Table
Sets the physical Cell ID of the corresponding component carrier.

The value of the parameter "General UL Settings" > Cell ID is set automatically to the physical cell ID of the PCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:ID on page 842

Bandwidth ← Component Carrier Table
Sets the bandwidth of the corresponding component carrier.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:BW on page 842

delta f / MHz ← Component Carrier Table
(enabled in "System Configuration > BB Source Config > Separate Sources" configuration)

Sets the frequency offset between the central frequency of corresponding SCell and the frequency of the PCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DFReq on page 842

Duplexing ← Component Carrier Table
Selects the duplexing mode of the PCell. The duplexing mode of the SCells is set accordingly.

Combination of FDD and TDD requires option R&S SMW-K113.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DUPLexing on page 842

TDD UL/DL Configuration ← Component Carrier Table
Sets the uplink-downlink configuration number. That is, defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

The individual carriers can use different "UL/DL Configuration". The frame configuration of the selected carries and the used duplexing are also displayed. Alternatively, use the SC-FDMA time plan to visualize them.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:UDConf on page 843

TDD Special Subframe Config ← Component Carrier Table
Sets the special subframe configuration number.

Together with the parameter Cyclic Prefix, this parameter defines the lengths of the DwPTS, the guard period GP and the UpPTS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SPSConf on page 843

n(1)_DMRS ← Component Carrier Table
Sets the part of the demodulation reference signal (DMRS) index used by the calculation of the DMRS sequence, transmitted by the PCell/SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DMRS on page 843

SRS Subframe Configuration ← Component Carrier Table
Sets the cell-specific parameter SRS subframe configuration of the PCell/SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SUConfiguration on page 843

SRS Bandwidth Configuration C_SRS ← Component Carrier Table
Sets the cell-specific parameter SRS Bandwidth Configuration (C_{SRS}) of the PCell/SCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:CSRS on page 844

Delay / ns ← Component Carrier Table
Sets the time delay of the SCell relative to the PCell.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:TDELay on page 844

State ← Component Carrier Table
Activates/deactivates the component carrier.

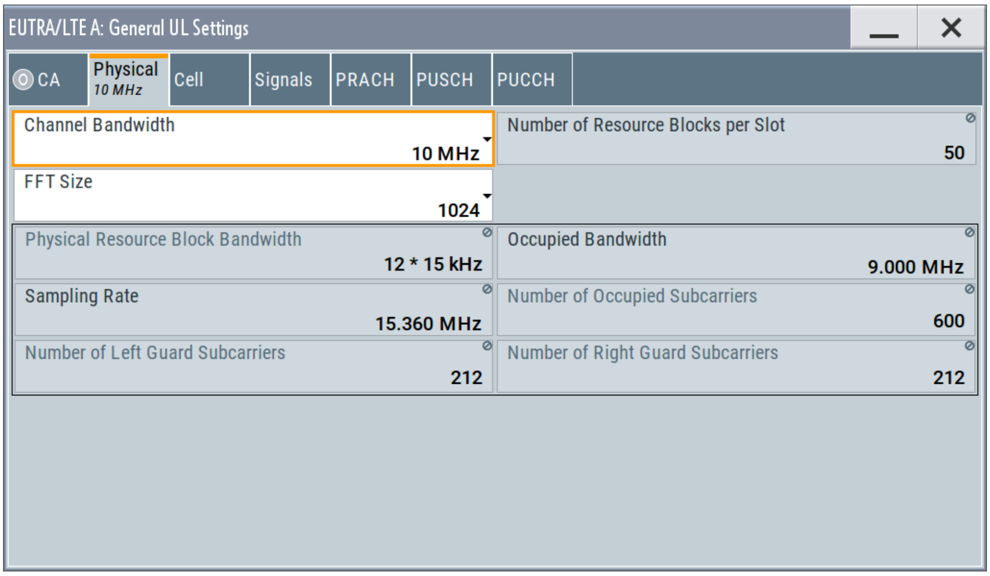
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:STATe on page 844

4.6.2 Physical settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "General UL Settings > Physical"



This dialog comprises the physical settings for uplink.

Settings:

Channel Bandwidth

Sets the channel bandwidth of the EUTRA/LTE system.

The 3GPP specification defines bandwidth agonistic layer 1 where the channel bandwidth is determined by specifying the desired number of resource blocks. However, the current EUTRA standardization focuses on six bandwidths.

- "1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"
  Select a predefined channel bandwidth.
  The parameter "Number of Resource Blocks Per Slot" is internally calculated for the selected "Channel Bandwidth" and "Physical Resource Block Bandwidth".
  The sampling rate, occupied bandwidth and FFT size are therefore determined by the parameter "Number of Resource Blocks Per Slot". If necessary, adjust the "FFT Size".
  See also Table 2-1 for an overview of the cross-reference between the parameters.

If "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected, the "1.4 MHz" bandwidth is supported by LTE and eMTC; the NB-IoT-specific settings are not available for configuration.

- "200 kHz"
  Option: R&S SMW-K115
  This channel bandwidth is **dedicated to NB-IoT**. It is available, if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.
  If channel bandwidth of 200 kHz is used, the LTE or eMTC-specific settings are not available for configuration. Available is only one NB-IoT carrier which works in standalone mode (Mode = "Standalone").
- "User"
  Option: R&S SMW-K55
  Provided for backward compatibility with previous version of this software, this parameter allows you to select a user-defined bandwidth as number of resource blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:BW on page 724

Number of Resource Blocks Per Slot
Indicates the number of used resource blocks for the selected "Channel Bandwidth".

"Channel Bandwidth"	"Number of Resource Blocks Per Slot (UL)"
"1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz"	Read-only value, set automatically as function of the "Channel Bandwidth" and "Physical Resource Block Bandwidth"
"User"	"Channel Bandwidth" depends on the "Number of Resource Blocks Per Slot" and "Physical Resource Blocks Bandwidth"

The sampling rate and the occupied bandwidth are determined by the parameter "Number of Resource Blocks Per Slot". If necessary, adjust the value of FFT Size.

See also Table 2-1.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:NORB on page 725

FFT Size
Sets the FFT (Fast Fourier Transformation) size. The available values depend on the selected "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:FFT on page 725

Number of eMTC Narrowbands
Option: R&S SMW-K115

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates the number of eMTC narrowbands N_{NB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 366.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NNBands?` on page 1035

Number of eMTC Widebands
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" and Wideband Config > "On" is selected.

It indicates the number of eMTC widebands N_{WB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Widebands" = Number of eMTC Narrowbands / 4

For more information, see "Widebands" on page 367.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NWBands?` on page 1035

Wideband Config
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

If enabled, the available channel bandwidth is split into eMTC widebands, where the resulting number of widebands is indicated by the parameter "Number of eMTC Wide-bands" on page 240.

For more information, see "Widebands" on page 367.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:EMTC:WBCFg` on page 1036

Physical Resource Block Bandwidth
Displays the bandwidth of one physical resource block.

Note: In this release, this value is fixed to 12 x 15 kHz.

Remote command:
n.a.

Occupied Bandwidth
Displays the occupied bandwidth, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:OCCBandwidth?` on page 726

Sampling Rate
Displays the sampling rate, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:SRATe? on page 725

Number Of Occupied Subcarriers
Displays the number of occupied subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:OCCSubcarriers? on page 726

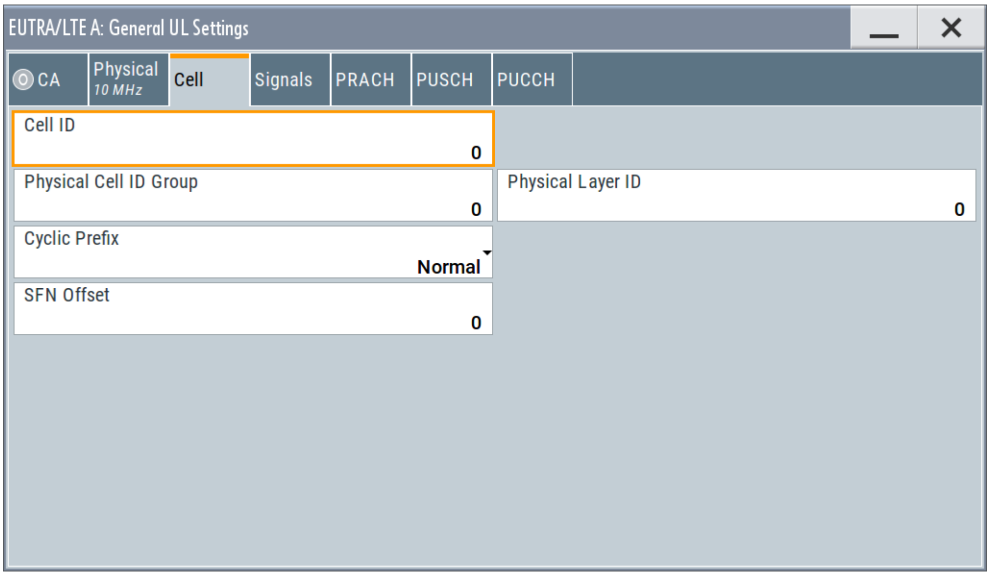
Number of Left/Right Guard Subcarriers
Displays the number of left/right guard subcarriers, calculated from the parameter "Number of Resource Blocks Per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:LGS? on page 726
[:SOURce<hw>]:BB:EUTRa:UL:RGS? on page 727

4.6.3 Cell-specific settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "General UL Settings > Cell"



This dialog comprises the settings needed for configuring the physical layer cell ID settings, the UL Reference Signal settings, the PUSCH, PUCCH and PRACH structures are selected, as well as cell-specific SRS parameters.

Provided are the following settings:

Cell ID

Sets the cell identity.

There are 504 unique physical layer cell identities (cell ID), grouped into 168 unique physical cell identity groups that contain three unique identities each. The cell ID is calculated as following:

Cell ID = 3*Physical Cell ID Group + Physical Layer ID

There is a cross-reference between the values of these three parameters and changing of one of them results in adjustment in the values of the others.

The cell ID determinates:
- The reference signal grouping hopping pattern
- The reference signal sequence hopping
- The PUSCH demodulation reference signal pseudo-random sequence
- The cyclic shifts and scrambling sequences for all PUCCH formats
- The pseudo-random sequence used for scrambling
- The pseudo-random sequence used for type 2 PUSCH frequency hopping.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CID` on page 727

Physical Cell ID Group

Sets the ID of the physical cell identity group.

To configure these identities, set the parameter Physical Layer ID.

The physical layer cell identities determine the sequence shift pattern used for PUCCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CIDGroup` on page 727

Physical Layer ID

Sets the identity of the physical layer within the selected physical cell identity group, set with parameter Physical Cell ID Group.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:PLID` on page 728

Cyclic Prefix

Sets the cyclic prefix length for all subframes.

The number of the SC-FDMA symbols is set automatically.

"Normal" Normal cyclic prefix, i.e. the UL slot contains 7 SC-FDMA symbols.

"Extended" Extended cyclic prefix, i.e. the UL slot contains 6 SC-FDMA symbols. The extended cyclic prefix is defined in order to cover large cell scenarios with higher delay spread and MBMS transmission.
NB-IoT allocations cannot be activated.

"User Defined" If Mode = LTE, the cyclic prefix length can vary over the subframes. Set the cyclic prefix length per subframe with the parameter "UL Frame Configuration" > "Cyclic Prefix.".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:CPC on page 728

SFN Offset
By default, the counting of the SFN (System Frame Number) starts with 0. Use this parameter to set a different start SFN value, e.g. to skip a defined number of frames.

Example: Visualizing the SFN offset in the SC-FDMA time plan

Perform the following:
- Select "EUTRA/LTE > General > Standard > LTE"
- Select "EUTRA/LTE > General > Filter/Clipping/ARB ...".
- Select "ARB > Sequence Length = 100 Frames".
- Select "General > Link Direction > Uplink (SC-FDMA)".
- Select "General > General Settings > Cell > SFN Offset = 1".
- Select "General > Frame Configuration > No. of PUCCH Config = No. PUSCH Config. = 40".
- Select "Frame Configuration > Subframe#0 > PUSCH > No. of RB = 50".
- Select "Frame Configuration > Time Plan" and set "Subframes = 20".

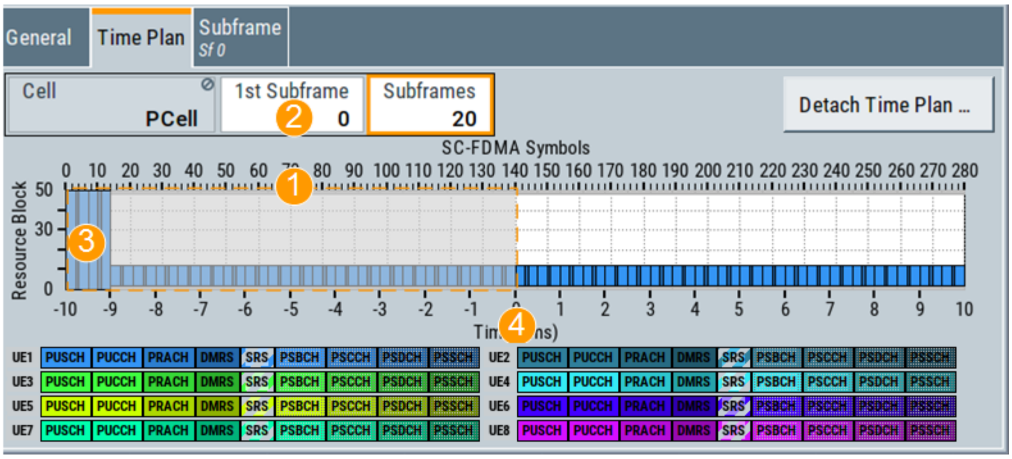


Figure 4-14: Visualization of an enabled SFN offset in the time plan

1 = SFN offset = 1 Frame = 10 Subframes
2 = First (most left) displayed subframe is Subframe#0; 20 subframes = 2 frames are displayed
3 = PUCCH with "No. of RB = 50" as configured in the Subframe#0
4 = First 1 frame is skipped; generation starts with the second frame

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:SOFFset on page 728

UL/DL Cyclic Prefix
In "Duplexing > TDD", determines the cyclic prefix for the appropriate opposite direction.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:DLCPc on page 728
[:SOURce<hw>]:BB:EUTRa:DL:ULCPc on page 720

eMTC Parameters
Comprises cell-specific parameters, dedicated to eMTC.

Retuning Symbols ← eMTC Parameters
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It sets the number of symbols used for the transmission between the eMTC narrowbands or widebands.

For details, see "Guard period for narrowband and wideband retunning" on page 365.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:RSYMbol on page 1036

Valid Subframes ← eMTC Parameters
Option: R&S SMW-K115

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates that a subframe (SF) is used for eMTC transmission. If an SF is set to invalid, the eMTC transmission is postponed during this SF.

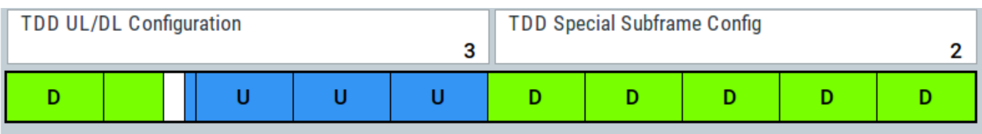
The selected subframes influence the scheduling of the eMTC transmissions (see Start Subframe).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:VALid:SUBFrame<dir> on page 1036

4.6.4 TDD frame structure settings

Access:

► Select "EUTRA/LTE > Duplexing > TDD".



The TDD frame is configured by adjusting the UL/DL configuration and the special subframe configuration (see also Chapter 2.2.1.1, "OFDMA parameterization", on page 21).

TDD UL/DL Configuration

Sets the UL/DL configuration number and defines which subframe is used for downlink respectively uplink, and where the special subframes are located.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDD:UDConf on page 710

TDD Special Subframe Config

Sets the special subframe configuration number and together with the parameter "Cyclic Prefix" defines the lengths of the DwPTS, the guard period (GP) and the UpPTS.

The DwPTS length selected with this parameter determines the maximum number of the OFDM symbols available for PDSCH in the special subframe.

The UpPTS length selected with this parameter determines the maximum number of the SC-FDMA symbols available for SRS in the special subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf on page 709

Number of UpPTS Symbols

Option: R&S SMW-K119 (if "Mode = LTE")

Option: R&S SMW-K143 (if "Mode = eMTC/NB-IoT")

For TDD Special Subframe Config = 10, sets the number of UpPTS symbols.

In all other configurations, the number of UpPTS symbols is set automatically depending on:

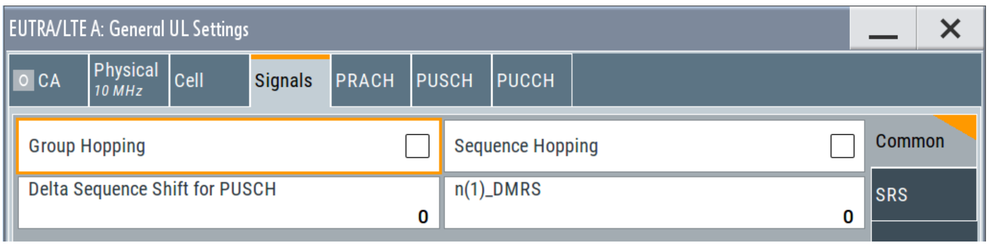
- "TDD UL/DL Configuration" on page 108
- "TDD Special Subframe Config" on page 108.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TDD:UPTS on page 710

4.6.5 Signals settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "General Settings > Signals"

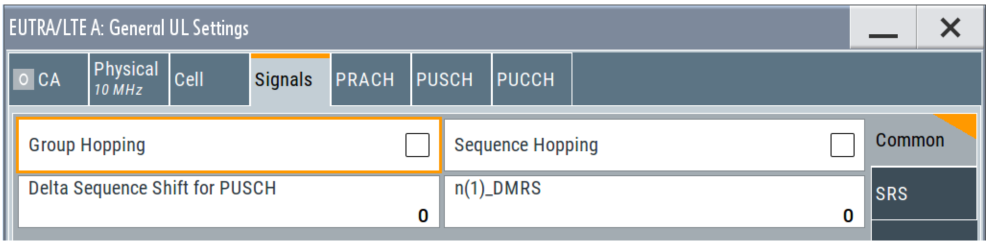


This dialog comprises the settings needed for configuring the uplink reference signals and the SRS structure.

4.6.5.1 UL reference signals

Access:

1. Select "LTE > Link Direction > Uplink".
2. Select "General Settings > Signals > Common".



Settings:

Group Hopping

Enables/disables group hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

17 different hopping patterns and 30 different sequence shift patterns are used for group hopping.

PUSCH and PUCCH use **the same group hopping pattern** that is calculated if the "Group Hopping" is enabled. The group hopping pattern is generated by a pseudo-random sequence generator. The sequence shift patterns are derived as follows:

- PUCCH
  From the physical layer cell ID set as a combination of the parameters Physical Cell ID Group and Physical Layer ID.
- PUSCH
  By the parameter Delta Sequence Shift for PUSCH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:GRPHopping` on page 729

Sequence Hopping

Enables/disables sequence hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

If sequence hopping and Group Hopping are be activated simultaneously, only group hopping is applied as defined in TS 36.211.

The sequence hopping is generated by a pseudo-random sequence generator.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SEQHopping` on page 729

Delta Sequence Shift for PUSCH
Sets the delta sequence shift for PUSCH needed for the calculation of the group hopping pattern.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DSSHift on page 729

n(1)_DMRS
Sets the part of the demodulation reference signal (DMRS) index which is broadcasted and therefore valid for the whole cell. This index applies when multiple shifts within a cell are used. It is used for the calculation of the DMRS sequence.

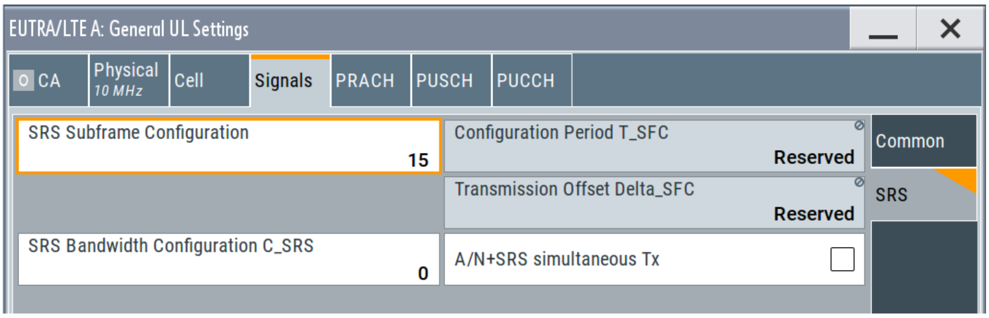
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DMRS on page 730

4.6.5.2 Cell-specific SRS settings

The cell-specific parameters in this section determine the structure of the sounding reference signal (SRS) according to the TS 36.211.

Access:

1. Select "LTE > Link Direction > Uplink".
2. Select "General Settings > Signals > SRS"



To configure the UE-specific parameters, necessary for the complete definition of the SRS structure and SRS mapping, use the settings in the "UEx > User Equipment > SRS" dialog.
See Chapter 4.8.6, "Sounding reference signal (SRS)", on page 280.

To enable an aperiodic SRS transmission, use the parameters:
- "DL Frame Configuration > Configure User" > Aperiodic SRS State.
- "SRS Request" flag in the DCI formats "DL Frame Configuration > PDCCH > DCI Format > Config", for example DCI Format 1A.
- SRS set parameters in the "User Equipment" > Sounding reference signal (SRS) dialog.

Settings:

SRS Subframe Configuration
Sets the cell-specific parameter SRS subframe configuration.

This parameter can also influence the shortening of PUCCH/PUSCH transmissions, regardless whether the UEs are configured to send an SRS in the subframe or not.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:SUConfiguration` on page 731

Configuration Period T_SFC
Displays the value for the cell-specific parameter configuration period T_{SFC} in subframes, depending on the selected "SRS Subframe Configuration" and the "Duplexing" mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:TSFC?` on page 731

Transmission Offset Delta_SFC
Displays the value for the cell-specific parameter transmission offset $Delta_{SFC}$ in subframes, depending on the selected "SRS Subframe Configuration" and the "Duplexing" mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:DSFC?` on page 731

SRS Bandwidth Configuration C_SRS
Sets the cell-specific parameter SRS bandwidth configuration (C_{SRS}).

The SRS bandwidth configuration C_{SRS}, the SRS Bandwidth B_SRS and the "Channel Bandwidth" determine the length of the sounding reference signal sequence, calculated according to TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS` on page 730

A/N + SRS simultaneous Tx
Enables/disables simultaneous transmission of SRS (sounding reference signal) and ACK/NACK messages, i.e. transmission of SRS and PUCCH in the same subframe.

Simultaneous transmission of SRS and PUCCH is allowed only for PUCCH formats 1, 1a, 1b and 3, since CQI reports are never simultaneously transmitted with SRS.

If this parameter is disabled, the SRS is not transmitted in the corresponding subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:ANSTx` on page 730

SRS MaxUpPTS
In TDD duplexing mode, enables the cell-specific parameter `srsMaxUpPts`.

If enabled, an SRS is transmitted in the frequency area of the UpPTS field that does not overlap with the frequency resources reserved for a possible PRACH preamble format 4 transmission.

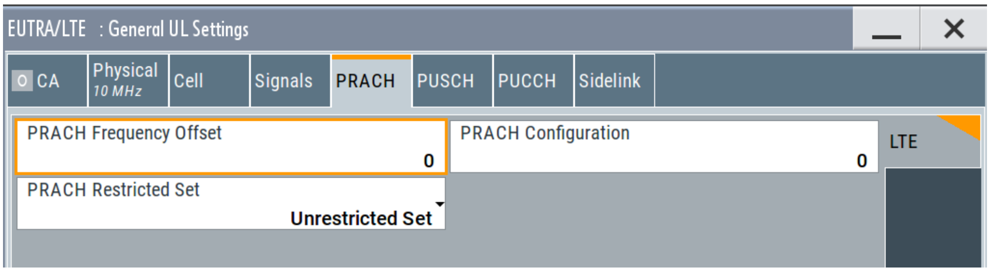
This is done by reconfiguring the number of SRS resource blocks in the special subframes, which would otherwise be determined by C_SRS and B_SRS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:MUPTs on page 730

4.6.6 PRACH settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "General UL Settings > PRACH".



This dialog comprises the cell-specific parameters that determine the PRACH configuration according to the TS 36.211.

The UE-specific parameters, necessary for the complete definition of the PRACH, are configurable in the User Equipment Configuration dialog of the corresponding UE.

PRACH Frequency Offset

For preamble formats 0 to 3, sets the prach-FrequencyOffset $n^{RA}_{PRBoffset}$ as defined in the TS 36.211, i.e. determines the first physical resource block available for PRACH expressed as a physical resource block number that fulfills the equation:

$0 <= n^{RA}_{PRBoffset} <=$ Number of Resource Blocks Per Slot - 6

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:FOFFset on page 732

PRACH Configuration

Sets the PRACH configuration index as defined in the TS 36.211. PRACH configuration defines the time and frequency resources in which random access preamble transmission is allowed.

The PRACH allocation occupies a bandwidth of 6 RBs.

The PRACH distribution (subframe, length, offset) depends on several other parameters:

- Selected "Cyclic Prefix"
- Selected PRACH Frequency Offset
- Selected frame format, i.e. on the selected "Duplexing Mode" mode
- Selected Frequency Resource Index (for TDD mode).

Not all combinations of channel bandwidth, PRACH configuration and PRACH frequency offset are allowed.

The table below gives an overview on the dependency of the value range of the parameter "PRACH Configuration" and other parameters.

Duplexing Mode	TDD Special Subframe Config	(Global) Cyclic Prefix	PRACH Configuration
FDD	-	Normal/Extended	0 to 63
TDD	0 to 3	Normal/Extended	0 to 47
	4	Normal	0 to 47
	4	Extended	0 to 57
	5 to 8	Normal/Extended	0 to 57

The Preamble Format is automatically derived form the "PRACH Configuration".

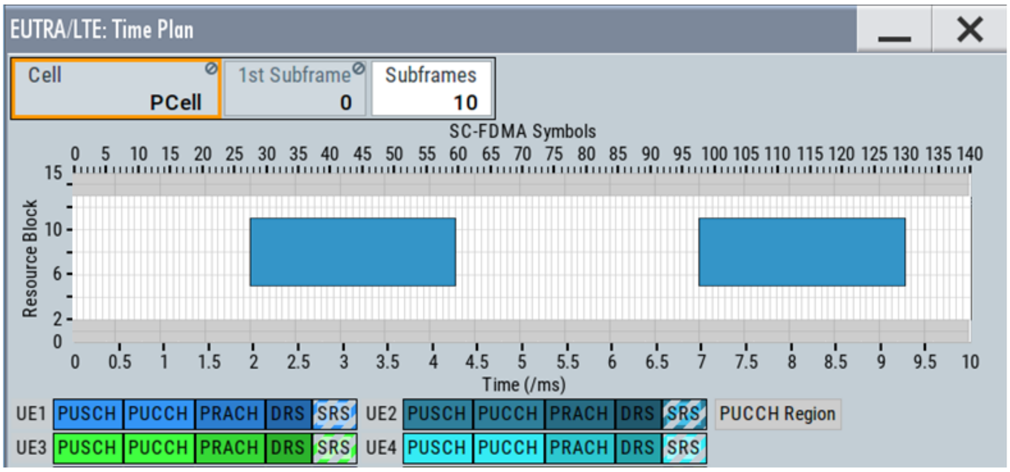
Use the SC-FDMA Time plan to display the PRACH distribution.

Example:

PRACH example configuration:

- "Duplexing Mode = FDD"
- "General UL Settings > Cell > Cyclic Prefix = Normal"
- "General UL Settings > Physical > Channel Bandwidth = 3 MHz"
- "General UL Settings > PRACH > PRACH Frequency Offset = 5"
- "PRACH Configuration = 55"
  (Preamble Format = 3)
- Adjusted the PRACH frequency offset

Observe the timeplan.



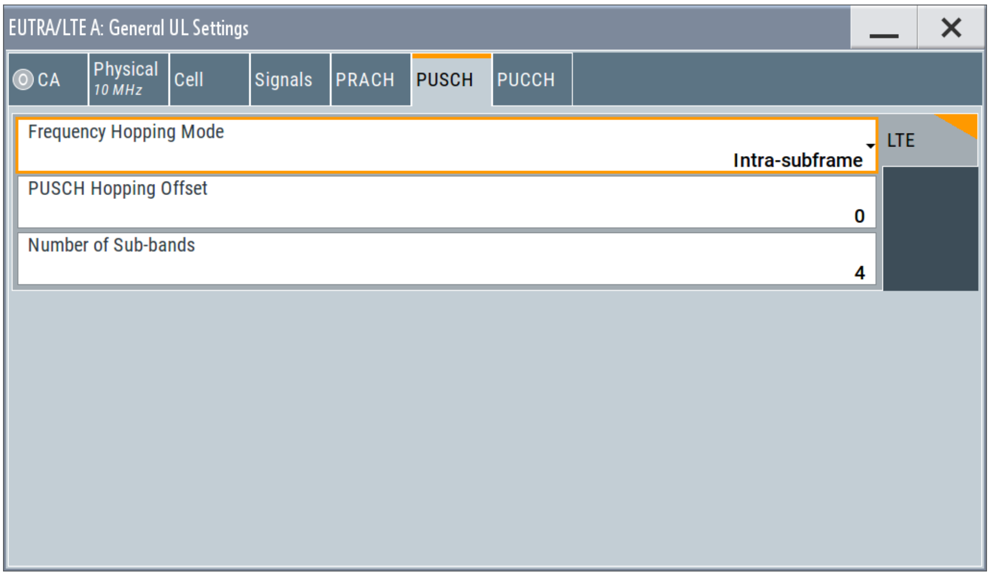
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:CONFiguration on page 732

PRACH Restricted Set
Selects whether a restricted preamble set ("Type A" or "Type B") or the unrestricted preamble set (normal mode) will be used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:RSET on page 732

4.6.7 PUSCH structure

1. To access this dialog, select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "General UL Settings > PUSCH".



Provided are the following settings:

Frequency Hopping Mode
Sets the frequency hopping mode for PUSCH.

Frequency hopping is applied according to TS 36.213.

"Inter-sub-frame" The PUSCH position in terms of used resource blocks is changed each subframe.

"Intra-sub-frame" Both intra- and inter-subframe hopping are performed.
The PUSCH position in terms of used resource blocks is changed each slot and each subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHMode on page 732

PUSCH Hopping Offset

Sets the PUSCH Hopping Offset N_{RB}^{HO}.

The PUSCH Hopping Offset determines the first physical resource block and the maximum number of physical resource blocks available for PUSCH transmission if PUSCH frequency hopping is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHOFfset on page 733

Number of Sub-bands

Sets the number of sub-bands (N_{sb}) into that the total range of physical resource blocks available for PUSCH transmission is divided. The frequency hopping is performed at sub-band level.

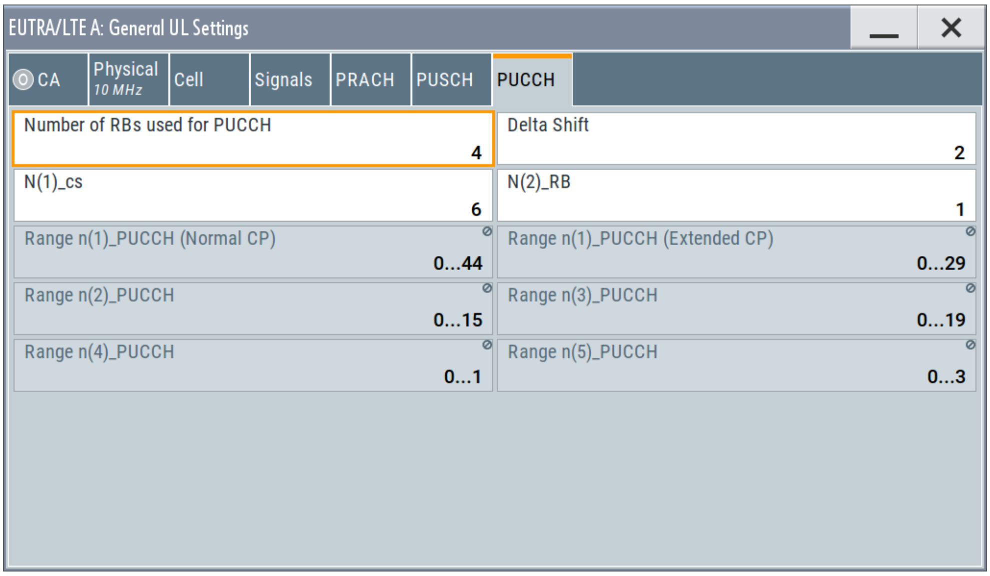
The size of one sub-band is determinate by the number of resource blocks available for PUSCH transmission, the "Number of Sub-bands" and the PUSCH hopping parameters.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NOSM on page 733

4.6.8 PUCCH structure

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "General UL Settings > PUCCH".



Settings:

Number of RBs used for PUCCH

Sets the PUCCH region in terms of reserved resource blocks, at the edges of the channel bandwidth (see Figure 2-18).

The PUCCH region is displayed on the time plan.

Example:

- "Physical > Channel Bandwidth = 3 MHz"
- "General UL Settings > PUCCH > Number of RBs used for PUCCH = 3"
- "UL Frame Configuration > PUCCH > Format = 2a" and "PUCCH State > On"

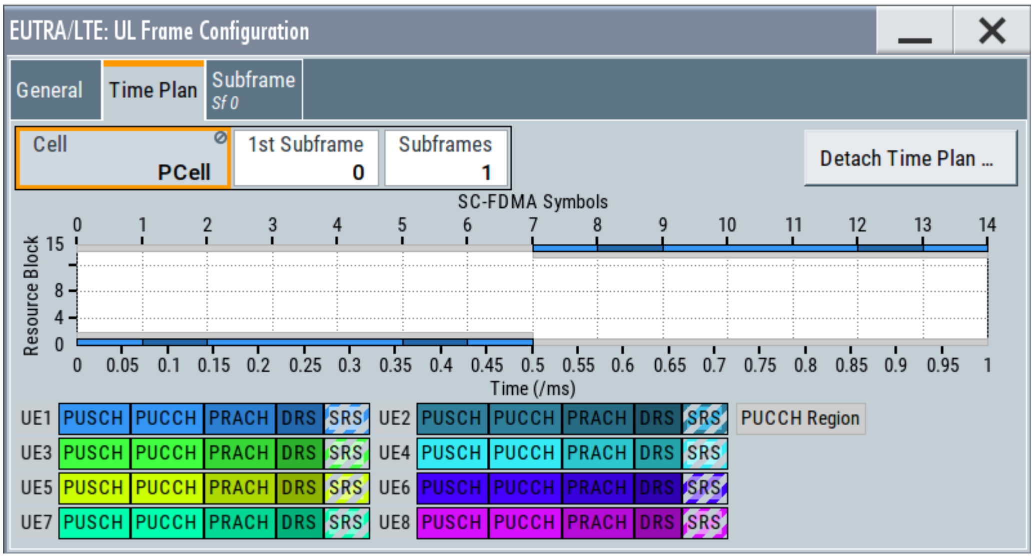


Figure 4-15: Example: Representation of subframe with PUCCH region with three reserved resource blocks on the time plan

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB` on page 733

Delta Shift

Sets the delta shift parameter, i.e. the cyclic shift difference between two adjacent PUCCH resource indices with the same orthogonal cover sequence (OC).

The delta shift determinates the number of available sequences in a resource block that can be used for PUCCH formats 1/1a/1b (see also Table 2-5).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:DESHift on page 734

N(1)_cs
Sets the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Only one resource block per slot can support a combination of the PUCCH formats 1/1a/1b and 2/2a/2b.

The number of cyclic shifts available for PUCCH format 2/2a/2b N(2)_cs in a block with combination of PUCCH formats is calculated as follows:

N(2)_cs = 12 - N(1)_cs -2

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1CS on page 734

N(2)_RB
Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

There can be only one resource block per slot that supports a combination of the PUCCH formats 1/1a/1b and 2/2a/2b. Hence, the number of RBs per slot available for PUCCH format 1/1a/1b is determinate by "N(2)_RB".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2RB on page 734

Range n(1)_PUCCH (Normal/Extended CP)
Displays the range of the possible PUCCH format 1/1a/1b transmissions from different UEs in one subframe and per cyclic prefix.

Insufficient ranges are displayed as '-'.

The parameter "Range n(1)_PUCCH (Normal CP)" determines the value range of the index "n_PUCCH" for PUCCH format 1/1a/1b.

See n_PUCCH

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1NMax? on page 735
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax? on page 735

Range n(2)_PUCCH
Displays the range of possible number of PUCCH format 2/2a/2b transmissions from different UEs in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2Max? on page 735

Range n(3)_PUCCH
Displays the range of possible number of PUCCH format 3 transmissions from different UEs in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N3Max? on page 736

Range n(4)_PUCCH/Range n(5)_PUCCH
Option: R&S SMW-K119

Displays the range of possible number of PUCCH format 4 and 5 transmissions from different UEs in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N4Max? on page 736
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N5Max? on page 736

4.7 UL frame configuration settings

Access:

1. Select "LTE General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration"

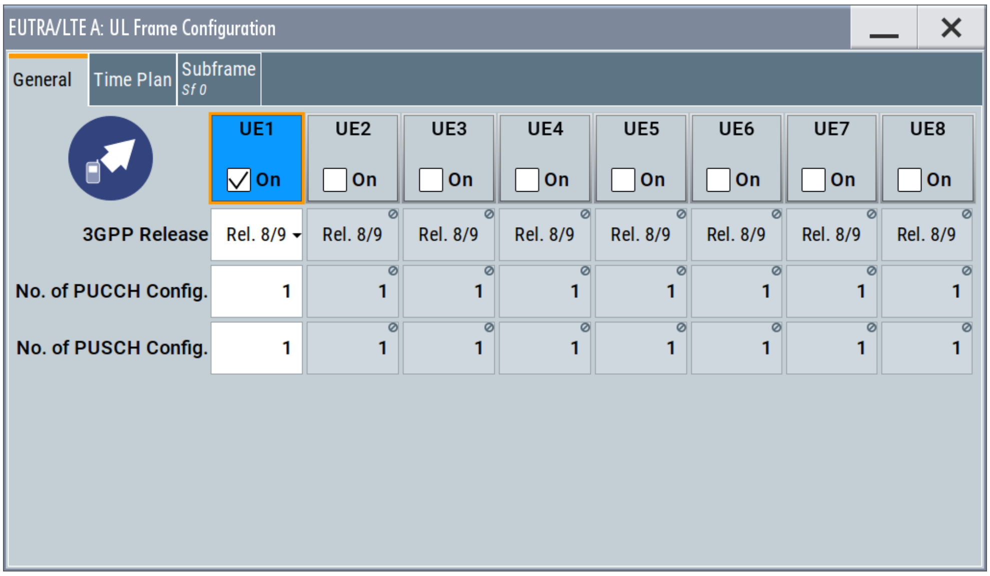
   This dialog allows you to configure the subframes and the SC-FDMA resource allocations.
   The dialog consists of the following sections:

4.7.1 General scheduling configuration settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "Frame Configuration > General"



This dialog provides access to the user equipment settings and settings concerning the UL scheduling, like configuring the subframes and adjusting the PUCCH/PUSCH scheduling.

Settings:

UEx

Accesses the User equipment configuration dialog for configuring the UE settings.

The check box activates or deactivates the selected UE. The 3GPP release the UE is compliant to is displayed.

Note: Disabling the UE deactivates its allocations: the reference signal, PUSCH/PUCCH allocations, and PRACH are not transmitted.

Remote command:
n.a.

3GPP Release

Sets the 3GPP release version supported by the UE.

Generally, each UE can work in one of the modes: LTE, LTE-A, eMTC or NB-IoT. The available values depend on the installed options and the value of the parameter Mode.

"Mode"	Description	Required options	"3GPP Release"
"LTE"	Standalone LTE	R&S SMW-K55 R&S SMW-K85	"Release 8/9" "LTE-Advanced"
"eMTC/NB-IoT"	Standalone IoT	R&S SMW-K115	"eMTC, NB-IoT"
"LTE/eMTC/NB-IoT"	Mixed LTE and IoT	R&S SMW-K55 and R&S SMW-K115	"Release 8/9, LTE-Advanced, eMTC, NB-IoT"

Several further settings are enabled only for LTE-A or IoT UEs.

In MIMO configurations, the "3GPP Release" is set automatically to LTE-Advanced.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease` on page 881

Number Of PUCCH/PUSCH Configurations/Number Of Configurable Subframes

- If "3GPP Release > eMTC/NB-IoT":
  PUSCH and PUCCH configurations are defined entirely in the "User Equipment Configuration" dialog.
- If "3GPP Release > LTE/LTE-A":
  Sets the number of configurable subframes in the up to four configurable frames, i.e. determines the scheduling cycle per UE.
  All uplink subframes are filled periodically with the configured subframes except for the Sounding Reference Signal. You can set the SRS individually for each UE in the User equipment configuration dialog.
  The maximum number of configurable subframes depends on the following:
  – Select duplexing mode (TDD or FDD)
  – Configured TDD frame structure settings
  – Whether a realtime feedback is enabled or not, see Chapter 5.6, "Real-time feedback configuration settings", on page 356
  – If TDD special subframe configuration 10 is used.

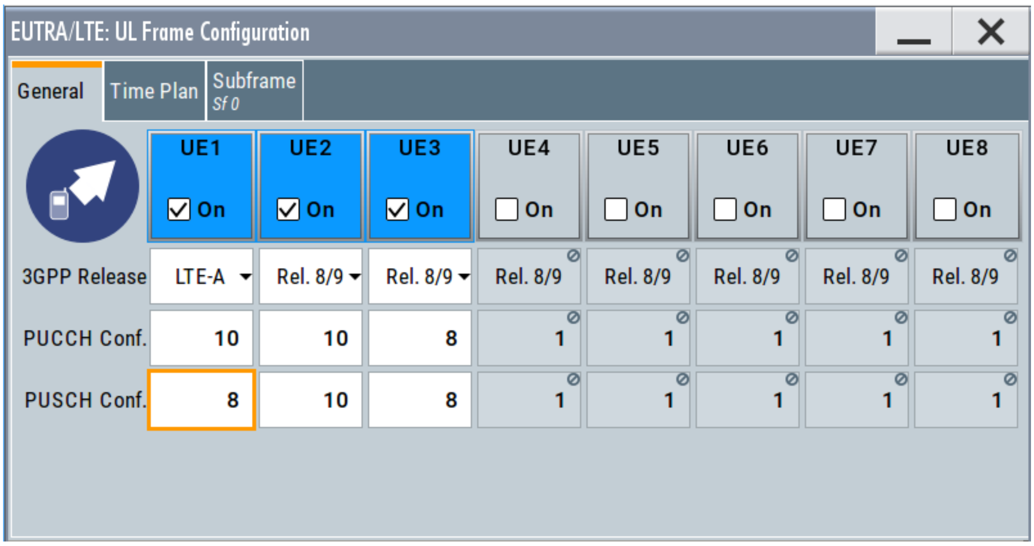
  For more detailed information about the maximum number of configurable subframes and for description of the dependencies between the parameters, see Chapter B.3, "Four configurable frames in uplink and downlink direction", on page 1105.
  – For "LTE" UEs, the "No Of Configurable Uplink Subframes" is the same for PUCCH and PUSCH.
  – For "LTE-A" UEs, the scheduling cycles are independent per PUSCH and PUCCH.
    The number of configurable subframes can be defined individually per PUCCH and per PUSCH. This enables the configuration of PUCCH and PUSCH with different repetition patterns.

Example: Independent cycles for PUSCH and PUCCH of the same LTE-Advanced UE

As described in the test case 8.2.4, TS 36.141, the PUCCH of the UE has to be transmitted once a frame and the PUSCH - once each eight subframes.

- Set "UE1" > User equipment configuration > 3GPP Release = LTE-Advanced.
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE1 > PUCCH" = 10
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE1 > PUSCH" = 8
- Configure the PUCCH and PUSCH allocations of UE1 as required.

Example: Independent cycles for PUSCH and PUCCH of the same LTE Rel. 8/9 UE



- Select "UE2" > UE ID/n_RNTI = UE ID_{UE2}.
- Set "UE3" > UE ID/n_RNTI = UE ID_{UE2}
- Configure the allocations of as required.
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE2 > PUCCH/PUSCH" = 10
- In the "UL Frame Configuration > Number of Configurable Uplink Subframes" dialog, set "UE3 > PUCCH/PUSCH" = 8

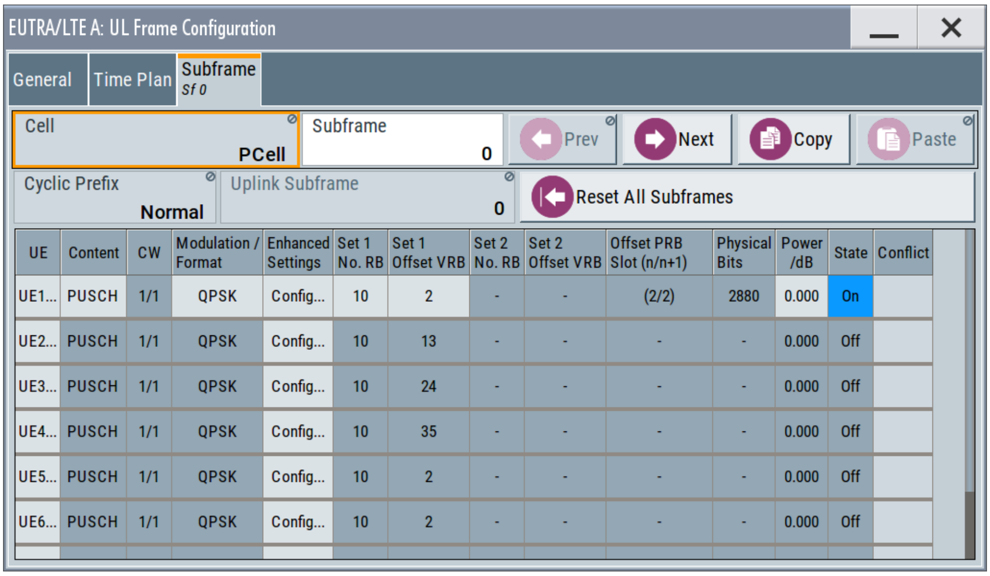
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUCCh on page 836
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUSCh on page 836

4.7.2 Subframe configuration

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "Frame Configuration > Subframe"



Provided are the settings for selecting and configuring the subframes. In the allocation table section, the individual allocation parameters for a subframe are set.

Cell

In enabled "General UL Settings > CA > Activate Carrier Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

Subframe

Sets the subframe to be configured/displayed in the frame configuration table.

All uplink subframes are filled periodically with the configured subframes except for the Sounding Reference Signal. SRS is set individually for each UE in the User equipment configuration dialog.

Subframes behind the configurable range of the corresponding UE or channel (Number Of PUCCH/PUSCH Configurations/Number Of Configurable Subframes) are displayed as read-only.

Remote command:
n.a.

Next/Prev

Navigates through the subframes.

Remote command:
n.a.

Copy/Paste Subframe Settings
Copies/pastes the settings of the selected subframe. Sounding Reference Signals are not considered.

For more detailed information, see Chapter B.1, "Copy/paste subframe", on page 1104.

Remote command:
n.a.

Cyclic Prefix (UL)
Configuration of the cyclic prefix per subframe is only enabled, if the parameter Cyclic Prefix is set to User Defined.

The number of the SC-FDMA symbols per subframe is set automatically

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:CYCPrefix` on page 836

Subframe Information
Displays the kind of the selected subframe, i.e. "Special Subframe", "Uplink Subframe", "Downlink Subframe".

For "Uplink Subframe", it is also shown the uplink subframe number, which is especially useful for TDD duplexing mode.

Remote command:
n.a.

Reset All Subframes
Resets settings of all subframes including cyclic prefix to the default values.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RSTFrame` on page 837

4.7.3 UL allocation table

The resource allocation table is where the individual allocation parameters for a subframe are set.

User Equipment
Accesses the settings of the UE the selected allocation belongs to, see Chapter 4.8, "User equipment configuration", on page 265.

Remote command:
n.a.

Content (UL)
Selects the content type of the selected allocation.

Use the setting in dialog User equipment configuration to configure the PUSCH data source.

"eMTC" and "NB-IoT" indicates UEs configured for IoT transmission ("UL Frame Configuration > General > UEx" > 3GPP Release).

The allocation table does not display information on the eMTC/NB-IoT transmission. To access the related setting, select Enhanced Settings UL > "Config".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType`
on page 837

Codeword (UL)
Option: R&S SMW-K85

Determines whether one or two codewords use the same physical resource, and whether codeword 1/2 or codeword 2/2 is configured with the selected PUSCH allocation.

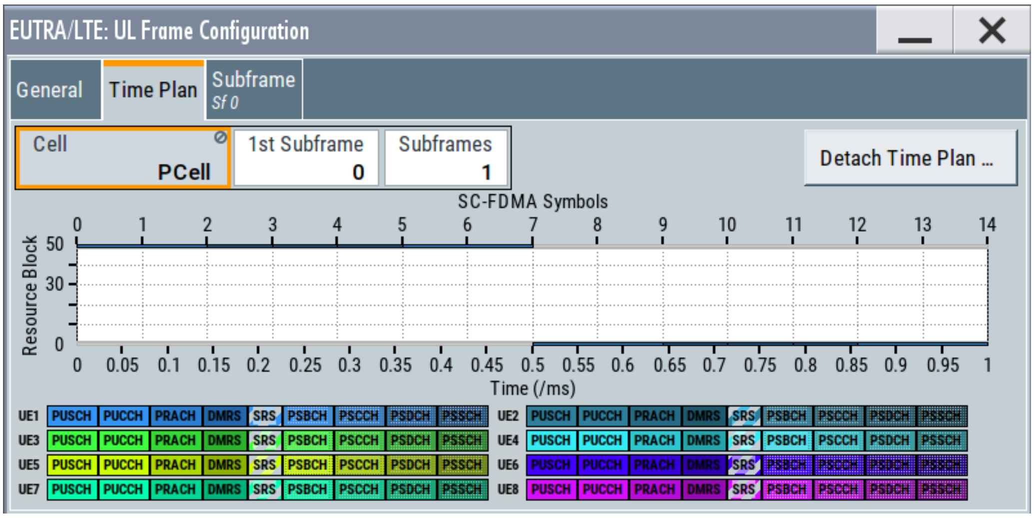
See also Figure 2-31.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CODWords` on page 846

Modulation/Format
For PUSCH allocation, this parameter sets the modulation scheme for the allocation.

This parameter is read-only, if a predefined FRC is selected.

For PUCCH allocation, this parameter sets the PUCCH Format. See Chapter 2.2.2.3, "Uplink control information transmission", on page 37 for an overview of the allowed PUCCH formats. Use the "SC-FDMA Time Plan" to visualize the position and structure of the configured PUCCH allocation.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>][:PUSCh]:MODulation on page 837
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:PUCCh]:FORMat on page 837

Enhanced Settings UL

Accesses a dialog with further channel configuration settings, see:

- Chapter 4.9, "Enhanced PUSCH settings", on page 323
- Chapter 4.10, "Enhanced PUCCH settings", on page 333
- Chapter 6.3.5.1, "NB-IoT allocation settings", on page 448
- Chapter 6.3.8.2, "UE-specific eMTC PUSCH transmissions settings", on page 495

Remote command:
n.a.

Set 1/Set 2 No. RB

Option: R&S SMW-K85

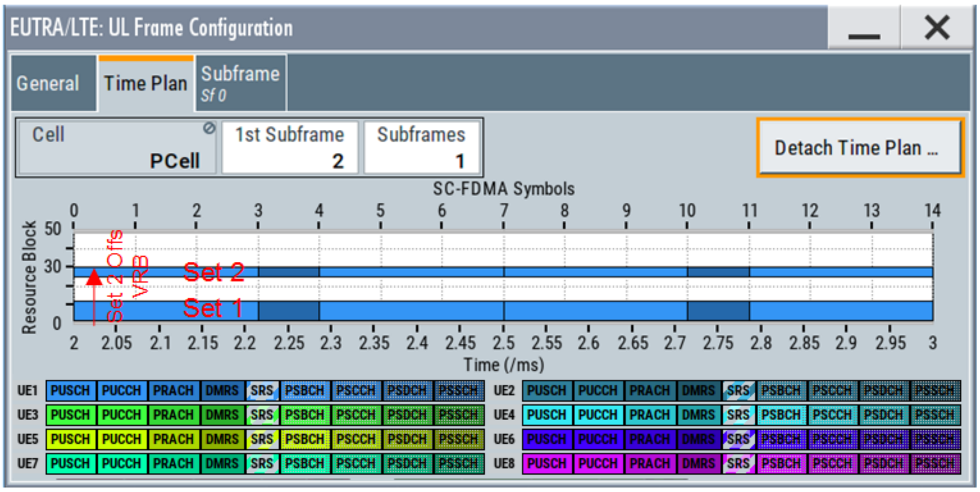
The LTE Rel. 10 specification defines PUSCH transmission not only in a continuous frequency region but also in two "sets" or "clusters" of resource blocks (see Figure 2-28).

The parameter defines the size of the selected allocation in resource blocks of the corresponding set.

This parameter is read-only, if a predefined FRC is selected.

Example: Clustered PUSCH Transmission

- Select "User Equipment Configuration (UE1) > 3GPP Release > Rel.10".
- In the "UL Frame Configuration > Subframe > Allocation Table", configure the PUSCH allocation of UE1 as follow:
  - "Set 1 No. RB" = 10, "Set 1 Offs. VRB" = 2
  - "Set 2 No. RB" = 5, "Set 2 Offs. VRB" = 25
  - "State" = ON
- Select "Show Time Plan" to visualize the configured allocations



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:RBCount
on page 838
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:RBCount?
on page 838
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:RBCount on page 838

Set 1/Set 2 Offset VRB

Option: R&S SMW-K85

For the corresponding set, sets the virtual resource block offset of the selected subframe (see also Example"Clustered PUSCH Transmission" on page 263).

This parameter is read-only, if a predefined FRC is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:VRBoffset
on page 838
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:VRBoffset on page 838

Offset PRB Slot (n/n+1)

Displays the start resource block of the selected allocation in the first and the second slot of the subframe.

Consider the following interdependencies, if frequency hopping is used:

- The start physical resource blocks in slot n and slot n+1 are set automatically

These values can deviate from the Set 1/Set 2 Offset VRB
- If an intra-subframe hopping for hopping type 2 is applied, the start resource block in slot 1 is defined by the selected Number of Sub-bands

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:RBOFfset?` on page 839
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUCCh:RBOFfset?` on page 839
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUSCh:SET<gr>:RBOFfset?` on page 839

Phys. Bits / Total Number of Physical Bits
Displays the size of the selected allocation in bits. The value is set automatically according to the current allocation's settings.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PHYSbits?` on page 839
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:PHYSbits?` on page 839
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:PHYSbits?` on page 839

Power (UL)
Sets the power for the selected allocation, i.e. PUSCH or PUCCH power level.

The PUSCH power level (P_{PUSCH}) and the PUCCH power level (P_{PUCCH}) can vary per subframe.

Further power-related parameters:
- UE Power (P_{UE}): for global adjustment of the transmit power of the UE
- DMRS Power Offset (P_{DMRS_offset}) and SRS Power Offset (P_{SRS_offset}): for boosting the reference signals, DMRS and SRS, per UE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:POWer` on page 840
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:POWer` on page 840
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:POWer` on page 840

State (UL)
Sets the allocation to active or inactive state.

"On"	Enables the allocation of the select UE. Option: R&S SMW-K119: If TDD special subframe configuration is used, the state of the PUSCH allocations is defined by the parameter State.
"Off"	Disables the allocation. The PUSCH/PUCCH and the DMRS are deactivated. Other allocations of the same UE and the SRS are not affected.

"Auto" Option: R&S SMW- K115

For IoT allocations with "Content = eMTC/NB-IoT", indicates that it is automatically configured as set in the dialogs:
- Chapter 6.3.8.2, "UE-specific eMTC PUSCH transmissions settings", on page 495
- Chapter 6.3.5.1, "NB-IoT allocation settings", on page 448

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:STATe on page 840
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:STATe on page 840
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:STATe on page 840

Conflict (UL)
Indicates a conflict between UEs and in case an allocation exceeds the available number of resource blocks.

For more information, see Chapter A.2, "Uplink", on page 1100.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONFlict? on page 840
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CONFlict? on page 840
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CONFlict? on page 840

4.8 User equipment configuration

Access:

1. Select "LTE General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".

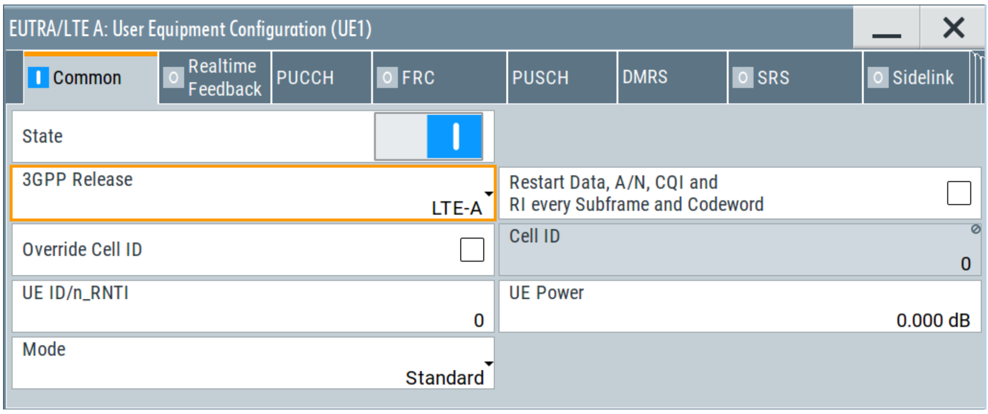
   You can configure up to four scheduled user equipments (UE) and freely distribute them over the time. You can also configure the structure of the demodulation reference signal (DMRS) and the sounding reference signal (SRS) per UE.
   In advanced mode ("System Configuration > Fading/Baseband Configuration > Mode > Advanced"), the tab names indicate whether the provided settings are cell-specific or common to all cells.

The dialog consists of the following sections:

4.8.1 Common settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)"
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "Common".



The available settings allow you to configure the state of the user equipment, the UE's release, UE ID, and the operational mode.

Settings:

State

Activates or deactivates the user equipment.

Disabling the UE deactivates its allocations: the reference signal, PUSCH (or PUCCH) allocations, and PRACH are not transmitted.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:STATe` on page 882

3GPP Release
Sets the 3GPP release version supported by the UE.

Generally, each UE can work in one of the modes: LTE, LTE-A, eMTC or NB-IoT. The available values depend on the installed options and the value of the parameter Mode.

"Mode"	Description	Required options	"3GPP Release"
"LTE"	Standalone LTE	R&S SMW-K55 R&S SMW-K85	"Release 8/9" "LTE-Advanced"
"eMTC/NB-IoT"	Standalone IoT	R&S SMW-K115	"eMTC, NB-IoT"
"LTE/eMTC/NB-IoT"	Mixed LTE and IoT	R&S SMW-K55 and R&S SMW-K115	"Release 8/9, LTE-Advanced, eMTC, NB-IoT"

Several further settings are enabled only for LTE-A or IoT UEs.

In MIMO configurations, the "3GPP Release" is set automatically to LTE-Advanced.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease` on page 881

Restart Data, A/N, CQI and RI Every Subframe and Codeword/Restart Data and A/N Every Subframe
If activated, the indicated values are restarted at the specified intervals.

This parameter is always enabled, if real-time feedback is active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:DACRestart` on page 881

Override Cell ID
If carrier aggregation is disabled, you can enable this parameter and set an user-defined cell ID for the selected user.

This cell ID value is used in the signal calculation for the particular UE instead of the common cell ID, set with the parameter "General UL Settings > Cell" > Cell ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:OCID:STATe` on page 883

Cell ID
If "Override Cell ID" on page 267 > "On", with this parameter you set an user-defined cell ID for the selected user.

This cell ID value is used in the signal calculation of UE instead of the common cell ID, set with the parameter "General UL Settings > Cell" > Cell ID.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CID` on page 883

UE ID/n_RNTI
Sets the radio network temporary identifier (RNTI) of the UE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:ID` on page 882

UE Power

Sets the power level of the selected UE (P_{UE}).

The P_{UE} determines the power levels of the reference signals (DMRS and SRS) and of the allocations, PUSCH (P_{PUSCH}) and PUCCH (P_{PUCCH}). Use the P_{UE} for global adjustment of the transmit power of the UEs.

Further power-related parameters:
- Power: varies the PUSCH and PUCCH power per subframe.
- Power, dB: varies the PUSCH and PUCCH power per eMTC transmission
  Power, dB: varies the NPUSCH (P_{NPUSCH}) power per NB-IoT transmission
- DMRS Power Offset (P_{DMRS_offset}): boosts the reference signals DMRS per UE.
- "SRS Power Offset" on page 282 (P_{SRS_offset}): boosts the reference signals SRS per UE.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:POWer` on page 882

Mode

Selects whether the user equipment is in standard or in PRACH mode.

If UL carrier aggregation is used, PRACH mode is disabled.

See:
- Chapter 4.8.10, "PRACH configuration", on page 320
- Chapter 6.3.10, "eMTC PRACH settings", on page 512
- Chapter 6.3.6, "NPRACH settings", on page 457

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:MODE` on page 882

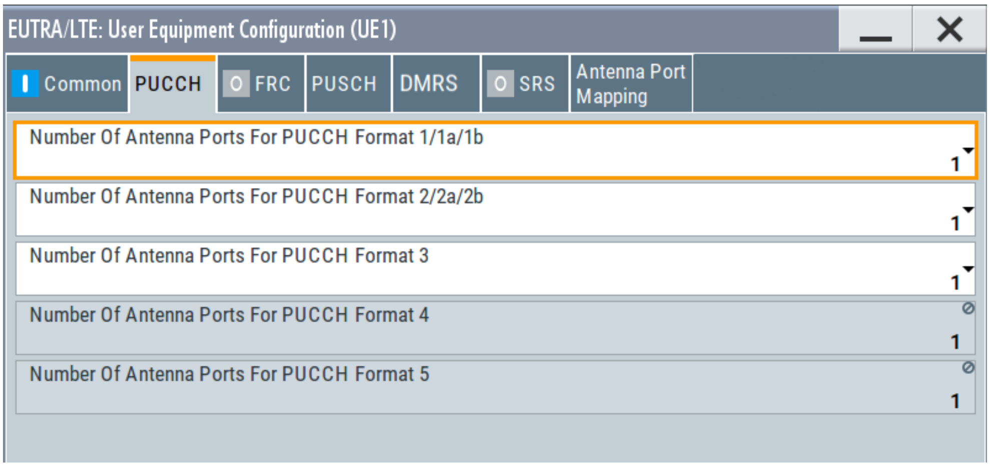
4.8.2 Physical uplink control channel (PUCCH)

Option: R&S SMW-K85 for generation of LTE signals with UL-MIMO. PUCCH is available in the primary cell (PCell) only.

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)"
2. Select "Frame Configuration > General > Select User Equipment > UEx"
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced"
4. Select "PUCCH".

   With these settings, you define the number of antenna ports used for each of the PUCCH formats.



5. Set the number of available ports for PUCCH per PUCCH format.

Settings:

Number of Antenna Ports for PUCCH per PUCCH Format
For 3GPP Release = "LTE-Advanced" UEs, sets the number of antenna ports used for every PUCCH format transmission.

eMTC UEs ("3GPP Release = eMTC") support transmission with one antenna port.

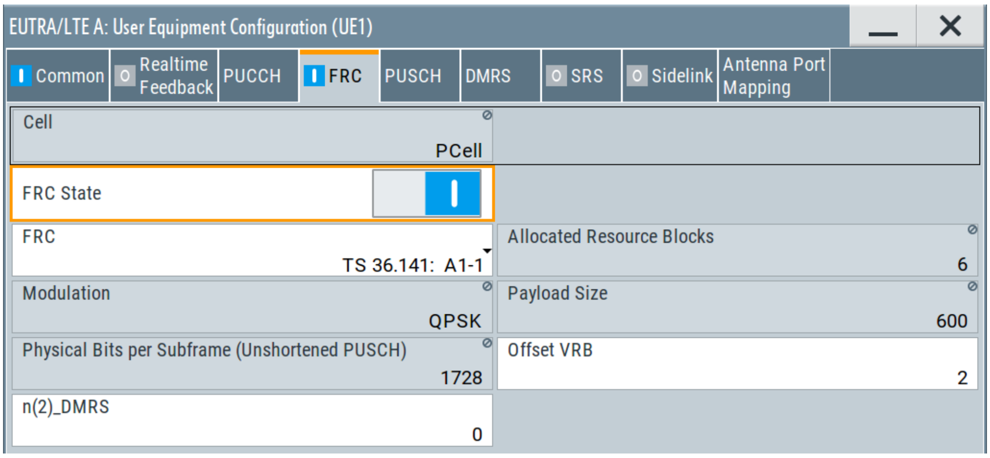
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport` on page 896
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport` on page 896
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F3Naport` on page 896
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F4Naport?` on page 895
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F5Naport?` on page 895

4.8.3 FRC configuration

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".

3. Select "FRC".



This dialog enables a quick configuration of the predefined fixed reference channels (FRC) according to:

- TS 36.141, Annex A "Reference measurement channels"
- TS 36.521, Annex A "Measurement channels".

If "FRC" is enabled, several parameters are predefined and their values are displayed as read-only values, see Table 4-13.

Table 4-13: Parameters affected by the RFC configuration

Dialog	Parameter	Value
"UE Configuration"	Scrambling	On
	Channel coding state	On
	Interleaver	On
	SRS state	Off (the SRS can be activated manually if FRC state is on)
"UL Allocation Table"	Modulation	According to the selected FRC
PUSCH allocations of the corresponding UE in all subframes	No. RB	According to the selected FRC
"Enhanced PUSCH Settings"	Frequency hopping	Off
For the corresponding UE in all subframes	HARQ ACK type	None
	Number of CQI bits	0
	Number of coded CQI bits	0
	Transport block Size/Payload	According to the selected FRC

Settings:

Cell

In enabled "General UL Settings > CA > Activate Carrier Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

FRC State

Enables/disables FRC configuration.

"On" If "FRC" is enabled, several parameters are predefined and their values are displayed as read-only values. To reconfigure any of these parameters, disable the FRC configuration.
An exception is the SRS state. You can change it even while an FRC is used.

"Off" FRC cannot be used if Cyclic Prefix = "User Defined".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:STATe`
on page 885

FRC

Selects a predefined fixed reference channel according to TS 36.141 or to TS 36.521.

3GPP specifies the FRCs for a specific channel bandwidth (i.e. number of resource blocks) and cyclic prefix. Depending on the current configuration, some FRCs are not listed.

If Cyclic Prefix = "User Defined", FRC cannot be used.

Table 4-14: Supported FRCs from 3GPP TS 36.141

FRC	Description
A1_1 to A1_7	FRC for reference sensitivity and in-channel selectivity (QPSK, R=1/3)
A2_1 to A2_3	FRC for dynamic range (16QAM, R=2/3)
A3_1 to A3_7	FRC for performance requirements (QPSK 1/3)
A4_1 to A4_8	FRC for performance requirements (16QAM 3/4)
A5_1 to A5_7	FRC for performance requirements (64QAM 5/6)
A7_1 to A7_6	FRC for UL timing adjustment (scenario 1)
A8_1 to A8_6	FRC for UL timing adjustment (scenario 2)
A12_1 to A12_6	FRC for performance requirements (QPSK 0.36)
A13_1 to A13_6	FRC for performance requirements (16QAM 1/2)
A17_1 to A17_6	Option: R&S SMW-K119 FRC for performance requirements (256QAM, 5/6)

FRC	Description
A18_1 to A18_6	Option: R&S SMW-K119 FRC for PUSCH transmission in UpTPS (16QAM, 0.56) Available in "Duplexing = TDD" and TDD Special Subframe Config = "10".
A19_1 to A19_6	Option: R&S SMW-K119 FRC for PUSCH transmission in UpTPS (256QAM, 0.69) Available in "Duplexing = TDD" and TDD Special Subframe Config = "10".
A21_1 to A21_6	Option: R&S SMW-K119 FRC for performance requirements (QPSK 3/5)
A22_1 to A22_4	Option: R&S SMW-K119 FRC for performance requirements (64QAM 1/2)

Table 4-15: Supported FRCs from 3GPP TS 36.521-1

FRC (Duplexing = FDD)	FRC (Duplexing = TDD)	Description
A.2.2.1.1	A.2.3.1.1	Reference channels for QPSK with full RB allocation
A.2.2.1.2	A.2.3.1.2	Reference channels for 16-QAM with full RB allocation
A.2.2.2.1	A.2.3.2.1	Reference channels for QPSK with partial RB allocation
A.2.2.2.2	A.2.3.2.2	Reference channels for 16-QAM with partial RB allocation
A.2.2.3	A.2.3.3	Uplink reference channels for sustained data-rate test

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE`
on page 886

Allocated Resource Blocks

Displays the number of the allocated resource blocks for the selected FRC. For FRCs "A.2.2.2.1" and "A.2.2.2.2", this parameter can also be set to different values according to TS 36.521.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:ALRB`
on page 883

Modulation (FRC)

Displays the modulation for the selected FRC.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:MODulation?`
on page 884

Payload Size (FRC)

Displays the payload size for the selected FRC.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:PASize?
on page 884

Physical Bits Per Subframe (Unshortened PUSCH)

Displays the total number of physical bits available for the PUSCH allocation per subframe, in that unshortened PUSCH is transmitted. Shortened PUSCH transmission occurs in a cell-specific SRS subframe or in subframes where SRS is transmitted.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TNOBits?
on page 885

Offset VRB (FRC)

Sets the virtual resource block (VRB) offset for all PUSCH allocation of the selected UE in all subframes.

The VRB Offset set for the individual subframes in the "UL Allocation Table" are overwritten.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:VRBoffset
on page 886

n(2)_DMRS (FRC)

Sets the UE-specific part of the demodulation reference signal (DMRS) index for all PUSCH allocation of the selected UE in all subframes.

The "Enhanced PUSCH Settings" > n(2)_DMRS,λ (Layer λ) set for the individual subframes for the corresponding UE is overwritten.

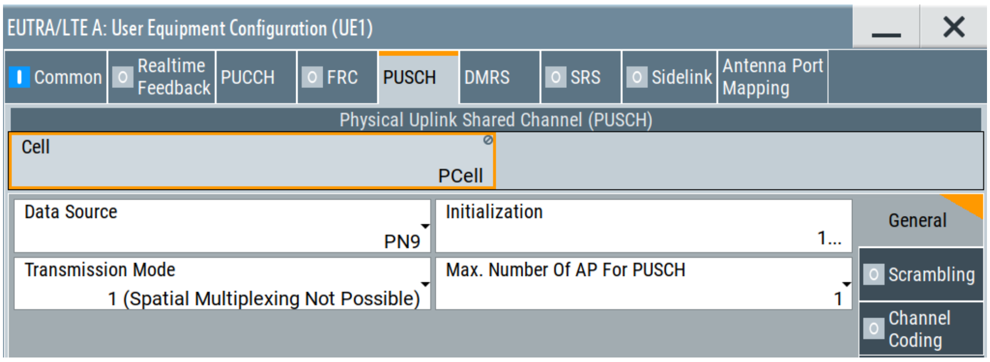
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:N2DMrs
on page 884

4.8.4 Physical uplink shared channel (PUSCH)

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx"

3. Select "PUSCH"



In this dialog, the data source for the PUSCH can be selected and the channel coding can be configured. Use the Enhanced PUSCH settings dialog to adjust the additional settings for channel coding of the control information and the multiplexing of the data and control information.

Settings:

Cell

In enabled "General UL Settings > CA > Activate Carrier Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

NPUSCH + SRS simultaneous Tx

For "UEx > 3GPP Release = NB-IoT", enables simultaneous transmission of NPUSCH and SRS.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NPSSim` on page 1049

Data Source (tab General)
Selects the data source for the PUSCH allocation.

If Restart Data, A/N, CQI and RI Every Subframe and Codeword > Off, new data is retrieved from the data source for every subframe where PUSCH is configured.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  - Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  - Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  - Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DATA`
on page 890
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:PATTern`
on page 890
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DSELect`
on page 891

Initialization (tab General)
Selects the starting seed for data sources for the PUSCH allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:INITpattern`
on page 891

Transmission Mode (tab General)
Option: R&S SMW-K85

For 3GPP Release = "LTE-A", sets the PUSCH transmission mode according to TS 36.213.

"1 (Spatial Multiplexing not Possible)"
This is the predefined value if:
- "FRC State > On"
- 3GPP Release = "eMTC/NB-IoT"

"2 (Spatial Multiplexing Possible)"
This is the predefined value in MIMO configurations.
See also "Uplink MIMO" on page 50.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:TXMode on page 891

Max. Number of AP for PUSCH (tab General)
Option: R&S SMW-K85

For 3GPP Release = Release 10 UEs, sets the number of antenna ports (AP) for PUSCH transmission for that the UE is configured.

Transmission Mode (tab General)	"1 (Spatial Multiplexing not Possible)"	"2 (Spatial Multiplexing Possible)"
"Number of Antenna Ports for PUSCH"	1	2 or 4

To set the currently used number of antenna ports, use the parameter Number of Used Antenna Port.

In MIMO configurations, the "Max. Number of Antenna Ports for PUSCH" is set automatically to 2.

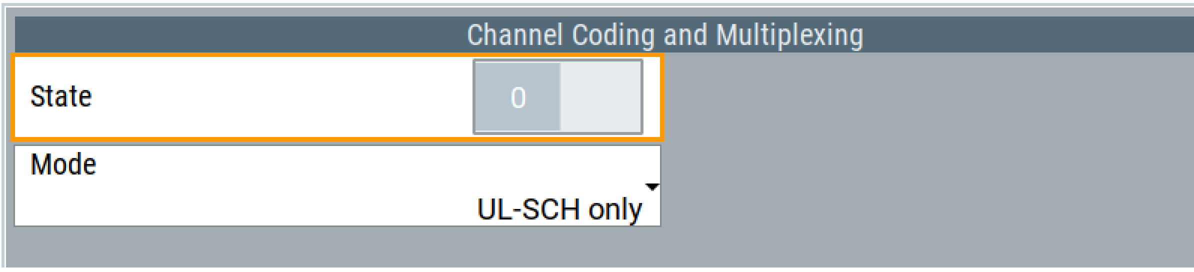
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort on page 892

State (PUSCH tab Scrambling)
Enables/disables scrambling for all PUSCH allocations of the corresponding UE.

This parameter is always enabled, if a predefined FRC is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:SCRambling:STATe on page 892

Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
Comprises the following settings:



State ← Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
Enables/disables channel coding and multiplexing of data and control information for all PUSCH allocations of the corresponding UE.

If this parameter is disabled, the content retrieved from the Data Source is forwarded to the scrambler without any coding processing.

Additional parameters for the encoding of control information can be set in Enhanced PUSCH settings dialog.

This parameter is always enabled, if a predefined FRC is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:STATe on page 892

Mode ← Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
Defines the information transmitted on the PUSCH.

"UCI+UL-SCH"	Control information and data are multiplexed into the PUSCH.
"UL-SCH"	Only data is transmitted on PUSCH.
"UCI only"	Only uplink control information is transmitted on PUSCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:MODE on page 893

I_HARQ_offset ← Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
Sets the HARQ-ACK offset index for control information MCS offset determination according to TS 36.213, chapter 8.6.3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IHARqoffset on page 893

I_RI_offset ← Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
Sets the RI offset index for control information MCS offset determination according to TS 36.213, chapter 8.6.3.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IRIoffset on page 894

I_CQI_offset ← Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
Sets the CQI offset index for control information MCS offset determination according to TS 36.213, chapter 8.6.3.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:ICQioffset` on page 893

O_CQI-Min ← Channel Coding and Multiplexing (PUSCH) (tab Channel Coding)
(Enabled in "UCI only" transmission)

Sets the parameter O-CQI-Min, where O_CQI-Min is the number of CQI bits including CRC bits assuming rank equals to 1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:OCQimin` on page 894

PUSCH in UpPTS
Option: R&S SMW-K119

Access: "Link Direction = Uplink", "Duplexing Mode = TDD", "General Settings > Physical > TDD Special Subframe Configuration = 10", "Frame Configuration > UEx > PUSCH > PUSCH in UpPTS".

The following parameters are defined for each cell, if TDD is used and the cell is configured with TDD Special Subframe Config = "10".

State ← PUSCH in UpPTS
Enables PUSCH transmission in the UpTPS part of the special subframe.

If enabled, you can further configure the PUSCH for the corresponding subrame in the "UL Frame Configuration > Subframe > Allocation table". The PUSCH state ("State (UL)" on page 264) is read-only and is set as set with the "UL Frame Configuration > General > UEx > PUSCH > State" parameter.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:STATe` on page 894

Less DMRS ← PUSCH in UpPTS
If enabled, the number of used demodulation reference signals (DMRS) is reduced.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:LDMRs` on page 895

Number of Symbols ← PUSCH in UpPTS
Sets the number of symbols used for the PUSCH transmission.

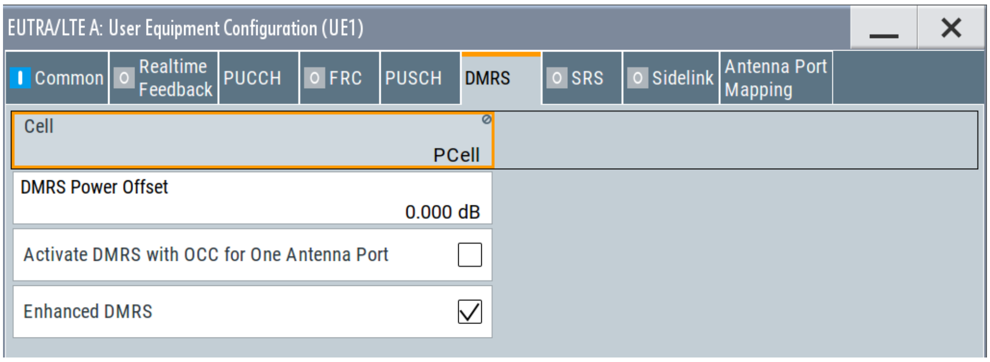
The available number of symbols depends on the used Cyclic Prefix and whether Less DMRS is enabled.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:NSYM` on page 895

4.8.5 Demodulation reference signal (DMRS)

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "DMRS".



Comprises the parameters of the demodulation reference signal.

Settings:

Cell

In enabled "General UL Settings > CA > Activate Carrier Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

DMRS Power Offset

Sets the power offset of the DMRS relative to the power level of the PUSCH or PUCCH allocation of the corresponding subframe.

The selected DMRS power offset (P_{DMRS_Offset}) applies for all subframes.

Depending on the allocation of the subframe, the effective power level of the DMRS is calculated as following:

$P_{DMRS}=P_{UE}+P_{PUSCH/PUCCH}+P_{DMRS\_Offset}$

The PUSCH and PUCCH power levels (P_{PUSCH} and P_{PUCCH}) can vary per subframe.

For global adjustment of the transmit power of the corresponding UE, use the parameter UE Power (P_{UE}).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:POWoffset` on page 896

Activate DMRS with OCC for One Antenna Port
Option: R&S SMW-K85

For UEs with 3GPP Release = "LTE-A", activate demodulation reference signal (DMRS) with an orthogonal cover code (OCC) even if only one antenna port is used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:DWOCc` on page 896

Enhanced DMRS
Option: R&S SMW-K119

Sets the higher-layer parameter `ul-DMRS-IFDMA` as defined in TS 36.211 and TS 36.212.

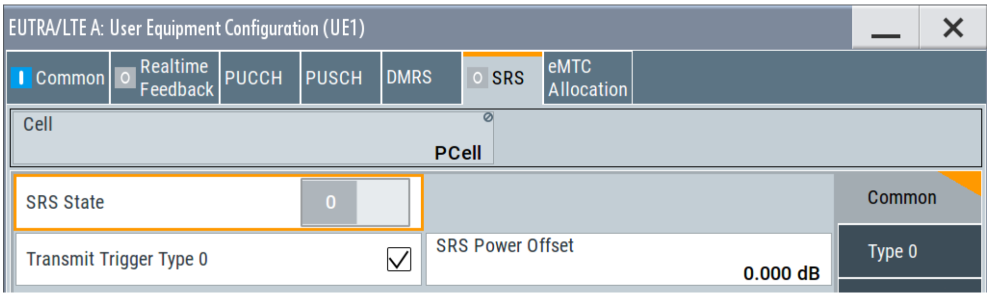
The combination of the two parameters Enhanced DMRS > "On" and Bit for DMRS Mapping Table > "On" enables mapping the DMRS sequence on each second subcarrier.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:ENHanced` on page 897

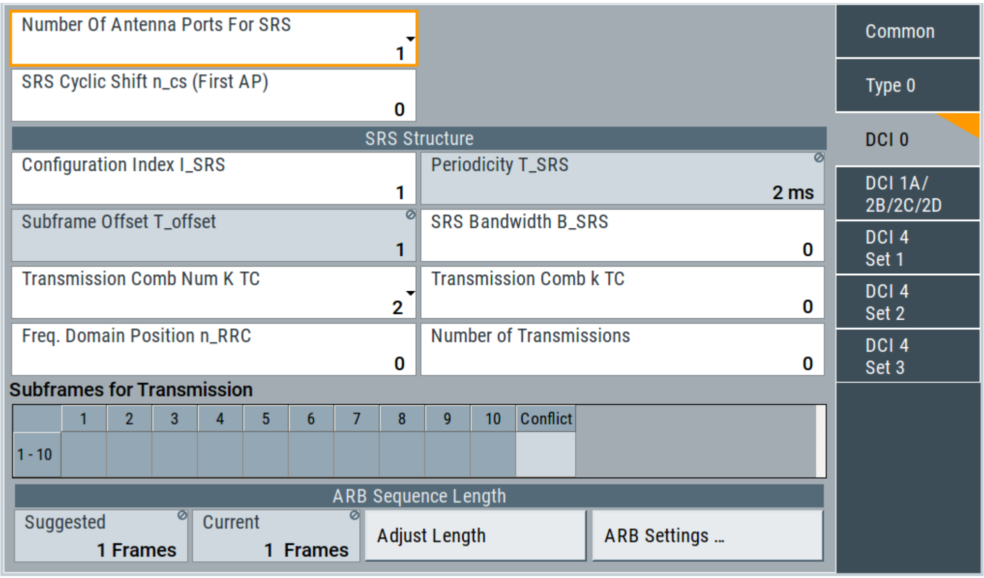
4.8.6 Sounding reference signal (SRS)

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "3GPP Release > LTE-Advanced".
4. Select "SRS".



For LTE-Advanced UEs, the dialog consists of several subtabs, one for the "trigger type 0" SRS and further for the SRS sets.



In the "SRS Structure" section, you can configure the **UE-specific SRS parameters** according to TS 36.213 and TS 36.211.

The **cell-specific parameters**, necessary for the complete definition of the SRS structure and SRS mapping, are configurable in the "General UL Settings" dialog.

See General UL settings.

To visualize the SRS transmission, use the SC-FDMA time plan.

Settings:

Cell

In enabled "General UL Settings > CA > Activate Carrier Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

SRS State

Enables/disables sending of SRS for the corresponding UE.

In the symbols reserved for SRS transmission, PUSCH is not transmitted.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:STATe` on page 897

Transmit Trigger Type 0

The 3GPP specification defines two types of SRS transmission:

- **Periodic SRS**
  SRS occurs at regular time intervals.
  Periodic SRS is referred as "trigger type 0" SRS. It is known form LTE Rel. 8
- **Aperiodic SRS**
  The aperiodic SRS transmission is a single (one-shot) transmission.
  Aperiodic SRS is referred as "trigger type 1" SRS. It is introduced by LTE Rel. 10.

"On" Trigger type 0 is used.
The SRS is configured by higher levels.
To configure the SRS structure, use the settings in the "Type 0" dialog .

"Off" Trigger type 1 is used.
The SRS is triggered by the PDCCH DCI content, in particular by the DCI format 0/4/1A/2B/2C/2D (DCI formats 2B/2C for TDD only).
To configure the SRS structure, use the dedicated settings in the "DCI 0/1A/2B/2C/2D/4 Set 1 to 3" dialogs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0` on page 897

SRS Power Offset

Sets the power offset of the SRS relative to the power of the corresponding UE.

The selected SRS power offset applies for all subframes.

The effective power level of the SRS is calculated as follows:

$P_{SRS} = P_{UE}+P_{SRS\_Offset}$

For global adjustment of the transmit power of the corresponding UE, use the parameter UE Power (P_{UE}).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:POWoffset` on page 898

SRS Set Configuration
Rel. 8/9 UEs support only "trigger type 0" SRS. There is one SRS set of parameters and one tab, "Type 0", where the SRS structure is defined.

For LTE-Advanced/eMTC UEs, the aperiodic SRS is triggered by the "SRS Request" flag in one of the DCI formats 0/1A/4/2B/2C/2D:
- Triggering aperiodic SRS by using DCI format 0 requires one dedicated SRS set of parameters ("DCI 0")
- The triggering by using DCI formats 1A/2A/2B/2C uses a common SRS set ("DCI 1A/2B/2C/2D")
- For the triggering by DCI format 4, the specification defines 3 SRS sets ("DCI 4 Set 1", "DCI 4 Set 2" and "DCI 4 Set 3")

Number of Antenna Ports for SRS ← SRS Set Configuration
Option: R&S SMW-K85

For 3GPP Release = "LTE-Advanced/eMTC" UEs, sets the number of antenna ports used for every SRS transmission.

"Max. Number of Antenna Ports for PUSCH"	**1**	**2**	**4**
"Number of Antenna Ports for SRS"	1, 2, 4	1, 2	1, 4

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NAPort on page 898

SRS Cyclic Shift n_CS (First AP) ← SRS Set Configuration
Sets the cyclic shift n_CS used for the generation of the sounding reference signal CAZAC sequence for the first port. The n_cs for the other ports are calculated automatically; they have a fixed relation to the first one.

The different shifts of the same Zadoff-Chu sequence are orthogonal to each other. Thus, you can apply different SRS cyclic shifts to schedule different users to transmit simultaneously their sounding reference signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:CYCShift on page 899

SRS UpPTS Add ← SRS Set Configuration
Option: R&S SMW-K119

In TDD mode, sets the higher layer parameter `srs-UpPtsAdd`, as specified in TS 36.211.

This parameter defines the number of additional SC-FDMA symbols in UpPTS and thus determines the total length of GP and UpPTS.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:UPPTsadd on page 899

SRS Structure ← SRS Set Configuration
Use the following parameters to define the SRS structure:

Configuration Index I_SRS ← SRS Structure ← SRS Set Configuration
Sets the UE-specific parameter SRS configuration index I_{SRS}.

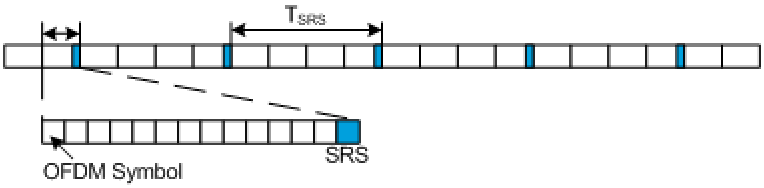
Depending on the selected "Duplexing Mode", this parameter determines the parameters SRS Periodicity T SRS and SRS Subframe Offset T_offset as defined in the TS 36.213, table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:ISRS on page 901

Periodicity T_SRS ← SRS Structure ← SRS Set Configuration
Displays the UE-specific parameter SRS periodicity T_{SRS}, i.e. displays the interval of milliseconds after which the SRS is transmitted. The displayed value depends on the selected SRS Configuration Index I_SRS and "Duplexing Mode" as defined in the TS 36.213, table 8.2-1 (FDD) and 8.2-2 (TDD) respectively.

Adjust the SRS configuration index to enable more frequent SRS transmission like each 2 ms or an infrequently SRS transmission like each 320 ms for instance.

For TDD duplexing mode, a T_SRS of 2 ms means that SRS is transmitted two times in 5 ms.



Example:

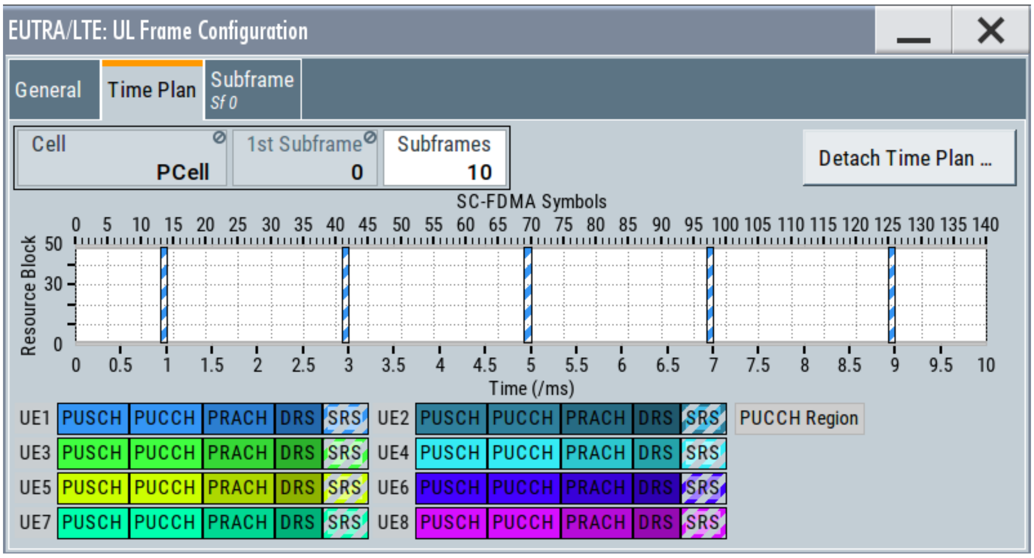
"Configuration Index = 0", i.e. "Periodicity T_SRS = 2 ms" and "Subframe Offset T_offset = 0"

"SRS State > On"

"Duplexing > FDD"

The default values of all other SRS parameters are left unchanged.

The SRS is transmitted every 2 ms and occupies the entire channel bandwidth, i.e. frequency hopping is not enabled.

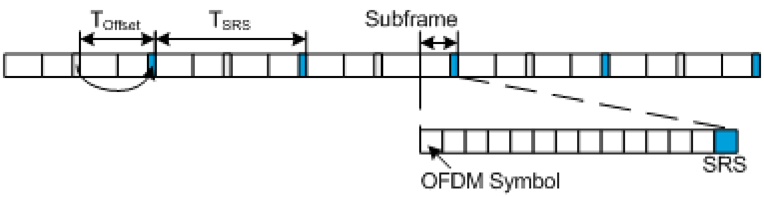


Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TSRS? on page 901

Subframe Offset T_offset ← SRS Structure ← SRS Set Configuration

Displays the UE-specific parameter SRS subframe offset T_{offset}, depending on the selected SRS Configuration Index I_SRS and "Duplexing Mode" as defined in the TS 36.213, table 8.2-1 (FDD) and 8.2-2 (TDD).

An SRS subframe offset shifts the SRS pattern. While SRS periodicity T_SRS remains constant, the SRS transmission is delayed with period of time equal to the SRS subframe offset T_offset.

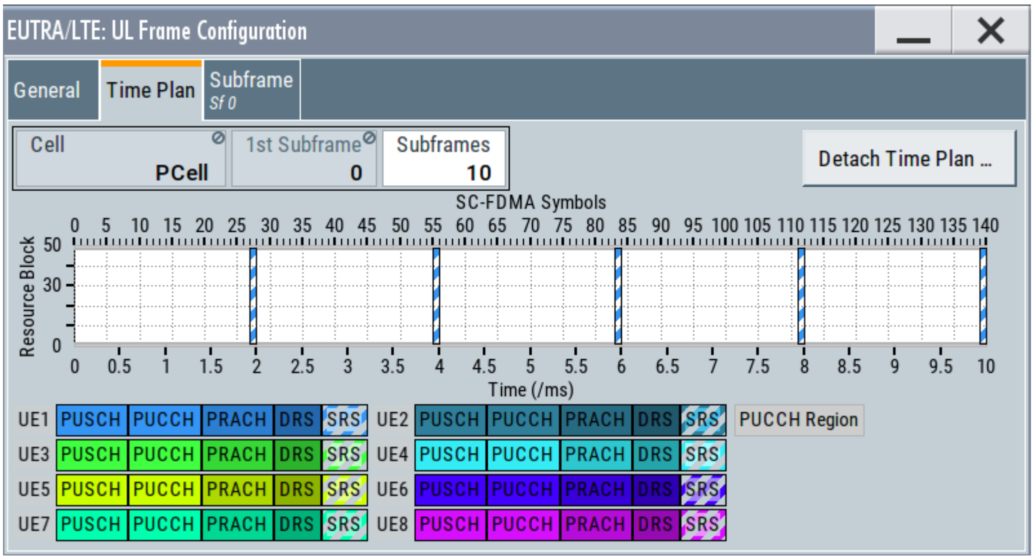


Example:

- "Configuration Index = 1", i.e. "Periodicity T_SRS = 2 ms" and "Subframe Offset T_offset = 1"
- "SRS State > On"
- "Duplexing > FDD"

The default values of all other SRS parameters are left unchanged.

The SRS is transmitted every 2 ms and occupies the entire channel bandwidth, i.e. frequency hopping is not enabled. Compared to the SRS transmission with T_{offset} = 0, the SRS transmission is delayed with 1 ms.



For TDD duplexing mode, a T_offset of 0 or 5 means that SRS is transmitted in the second last symbol of the special subframe (in the UpPTS part). For this case, adjust the parameter TDD Special Subframe Config so that an UpPTS field length of two symbols is assured.

For TDD duplexing mode with T_SRS value of 2 ms, two T_offset values are displayed, corresponding to the two SRS transmissions per 5 ms. For example, the values 0, 1 mean that two SRS transmissions occur, both in the special subframe. One of them is in the second last symbol and the other one, in the last symbol of the subframe.

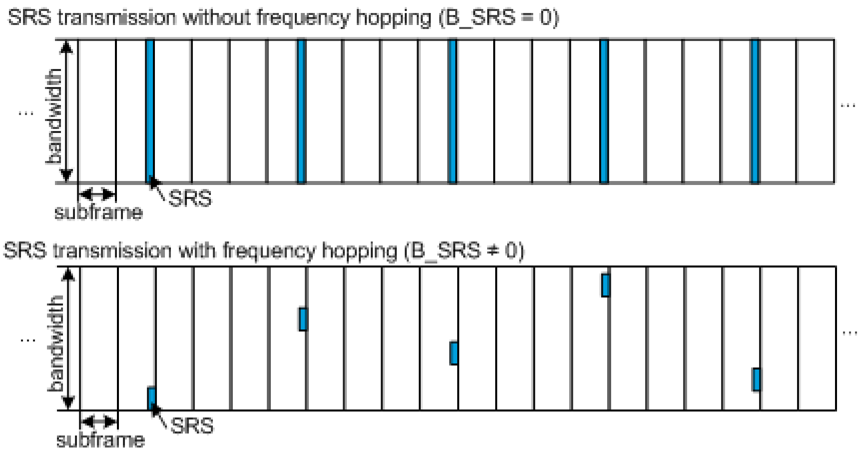
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TOFFset?` on page 902

SRS Bandwidth B_SRS ← SRS Structure ← SRS Set Configuration

Sets the bandwidth covered by a single SRS transmission. That is the UE-specific parameter SRS bandwidth B_{SRS}, as defined in the TS 36.211, chapter 5.5.3.2.

The SRS can span the entire frequency bandwidth or use frequency hopping where several narrowband SRSs cover the same total bandwidth.

There are 4 SRS bandwidths defined in the standard. The most narrow SRS bandwidth (B_SRS = 3) spans 4 resource blocks and is available for all channel bandwidths. The other 3 values of the parameter B_SRS define more wideband SRS bandwidths, available depending on the channel bandwidth.



The SRS transmission bandwidth is determined also by the "SRS Bandwidth Configuration C_{SRS}".

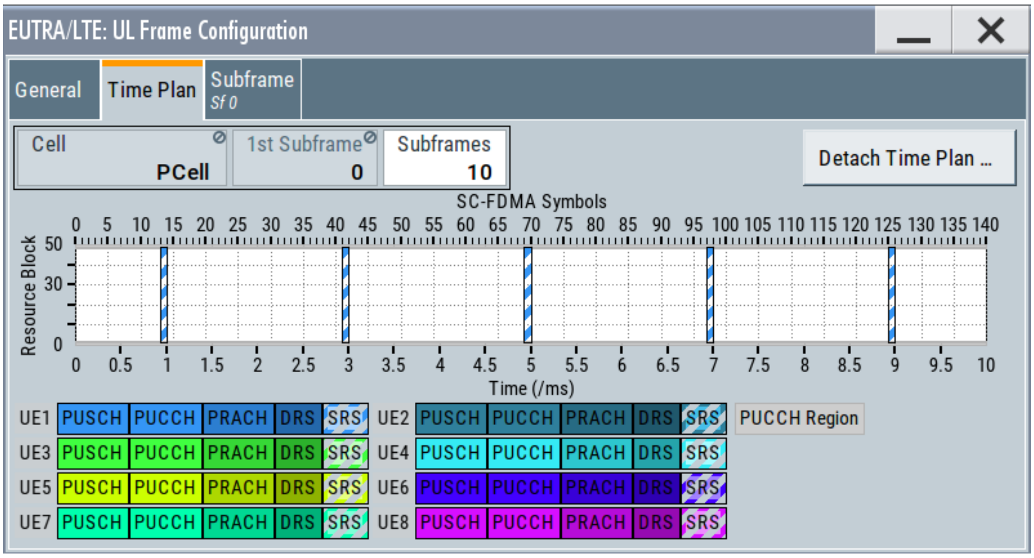
Example:

"SRS State > On"

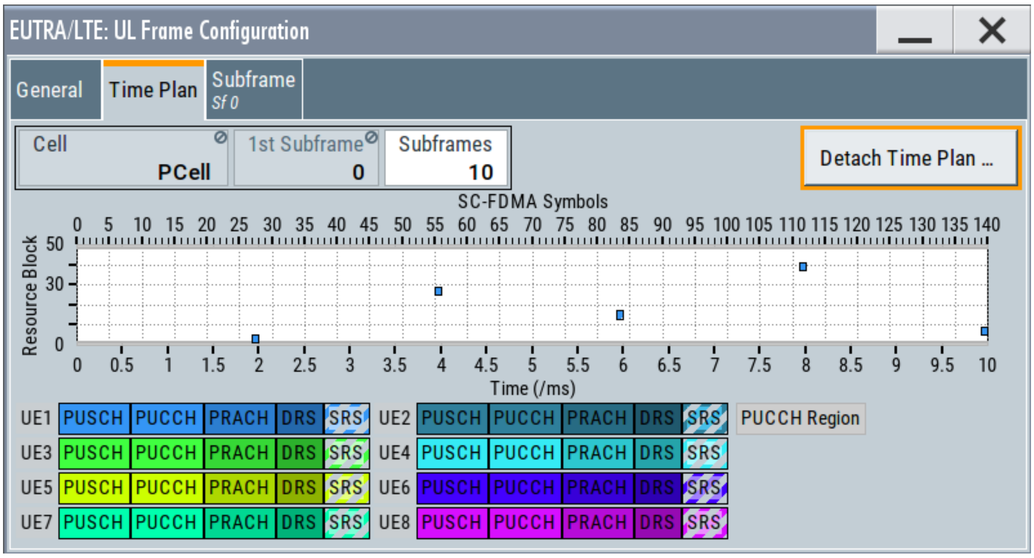
"Duplexing > FDD"

The default values of all other SRS parameters are left unchanged.

For "B_SRS = 0", the SC-FDMA time plan shows a wideband SRS without frequency hopping.



Changing the SRS bandwidth to "B_SRS = 3" results in the most narrowband SRS transmission with SRS bandwidth of 4 RBs and enabled frequency hopping.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:BSRS on page 900

Transmission Comb Num k TC ← SRS Structure ← SRS Set Configuration
Option: R&S SMW-K119

In TDD mode, sets the UE-specific parameter number of combs (transmissionCombNum), as defined in the TS 36.211.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NKTC on page 902

Transmission Comb k TC ← SRS Structure ← SRS Set Configuration
Sets the UE-specific parameter transmission comb parameter k_{TC}, as defined in the TS 36.211, chapter 5.5.3.2.

The SRS is transmitted on alternating subcarriers, where with k_{TC} = 1 every odd and with k_{TC} = 0 every even subcarrier is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:TRComb on page 902

Hopping Bandwidth b_hop ← SRS Structure ← SRS Set Configuration
(for trigger type 0 SRS ("Type 0"))

Sets the UE-specific parameter frequency hopping bandwidth b_{hop}, as defined in the TS 36.211, chapter 5.5.3.2.

SRS frequency hopping is enabled, if b_{HOP}<B_{SRS}. Hopping bandwidth is the frequency band in that the SRS hops.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:BHOP on page 900

Freq. Domain Position n_RRC ← SRS Structure ← SRS Set Configuration

Sets the UE-specific parameter `frqDomainPosition` n_{RRC}, as defined in the TS 36.211, chapter 5.5.3.2.

This parameter determines the starting physical resource block of the SRS transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NRRC` on page 903

Number of Transmissions ← SRS Structure ← SRS Set Configuration

(enabled for "LTE-Advanced" UEs and "Realtime Feedback > Off")

Sets the number of SRS transmissions.

That is, the number of cells in the table Subframes for Transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NTRans` on page 899

Subframes for Transmission ← SRS Structure ← SRS Set Configuration

(enabled for "LTE-Advanced" UEs and "Realtime Feedback > Off")

Sets the subframes in that the SRS is transmitted. The values correspond to the values of the SRS parameter Configuration Index I_SRS.

A conflict is indicated in the following situations:
- The subframe number is already used in the SRS set
- The subframe number is used in another SRS set of the same UE

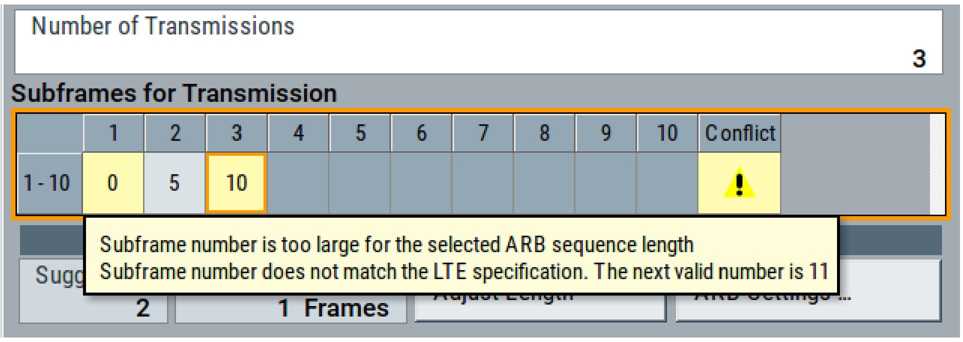


Figure 4-16: Example of conflict indication: DCI 4 Set 2 and DCI 1A/2B/2C/2D SRS sets use configuration index (subframe number) = 2

- The subframe number is outside the current ARB sequence length.

Note: If there is conflict, observe the tooltip.
Change the subframe index or select Adjust Length to set the "ARB Sequence Length" to the proposed value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:SUBF<subfidx>` on page 900

Suggested ← SRS Structure ← SRS Set Configuration

Indicates the suggest ARB sequence length as number of frames.

Select "Adjust Length" to set the ARB sequence length to the proposed value.

Adjust Length ← SRS Structure ← SRS Set Configuration
Set the ARB sequence length to the proposed value.

This function is active, if an SRS transmission is configured in subframe number that is outside of the frames in the current "ARB Sequence Length".

ARB Settings ← SRS Structure ← SRS Set Configuration
Access the "ARB" dialog and displays the "ARB Sequence Length" value.

See Chapter 10.2.3, "ARB settings", on page 662.

4.8.7 Sidelink settings

- D2D communication and discovery modes
  Option: R&S SMW-K113
- V2X communication mode
  Option: R&S SMW-K119

Access:

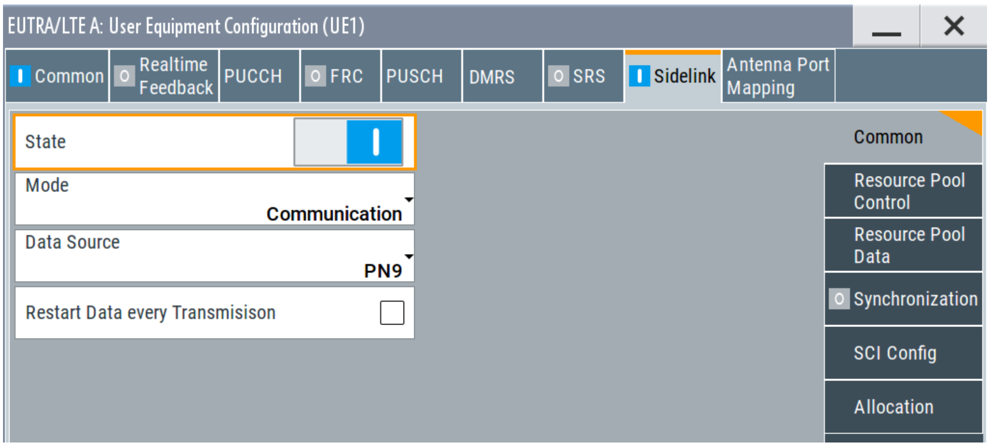
1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "General > General UL Settings > Cell" > "Cyclic Prefix = Normal or Extended".
3. Select "Frame Configuration > General > Select User Equipment > UEx".
4. Select "Sidelink".
5. Open the "Time Plan" to observe the configuration.

4.8.7.1 Common sidelink settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".

3. Select "User Equipment Configuration > Sidelink > Common".



With the provided settings, you can select the mode in that the sidelink is working.

State

Enables transmission of the sidelink.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:STATe` on page 912

Mode

Sets the mode of the sidelink communication.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:MODE` on page 912

Data Source

Selects the sidelink data source.

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.

– Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
– Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:DATA on page 912
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:DSELect on page 912
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:PATTern on page 913

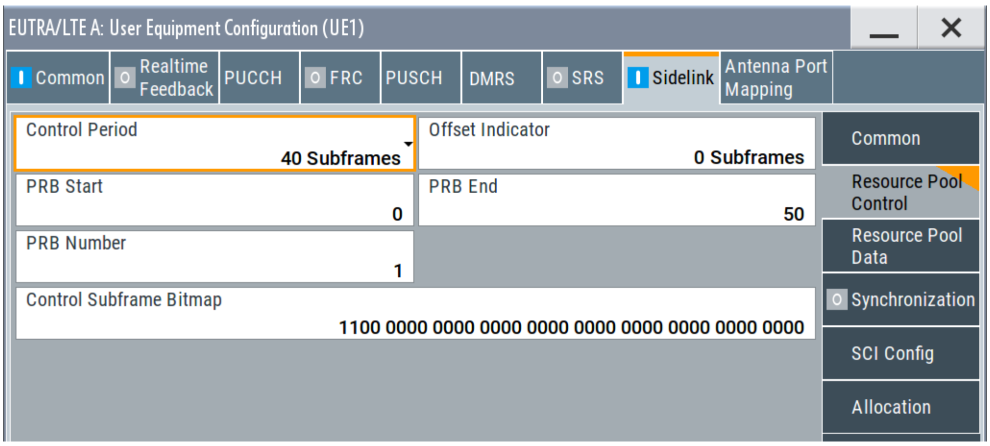
Restart Data every Transmission
If enabled, the data source is restarted at each SL transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RESTart on page 913

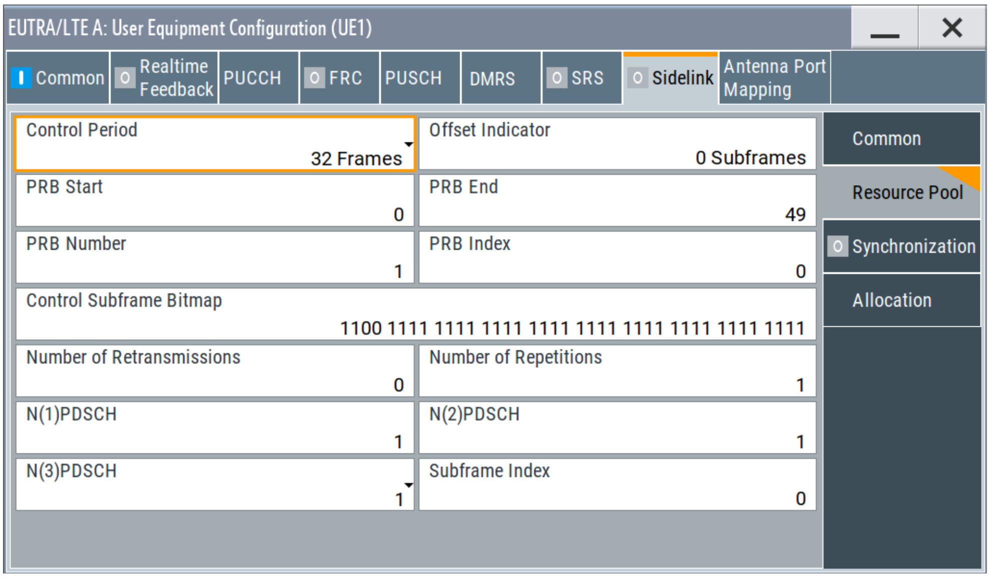
4.8.7.2 Resource pool control and resource pool settings

Access:

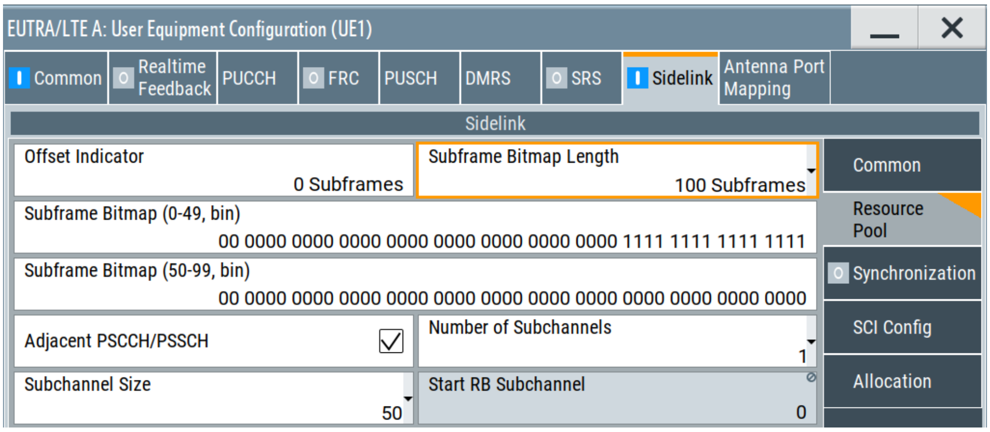
1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Sidelink > Common > Mode > Communication".
4. Select "Sidelink > Resource Pool Control".



5. Select "Sidelink > Common > Mode > Discovery".
   Select "Sidelink > Resource Pool".



6. Select "Sidelink > Common > Mode > V2X Communication".
   Select "Sidelink > Resource Pool".



The provided settings depend on the selected SL mode. For "Mode = Communication", for example, you can configure the resource pool for the sidelink control region.
Here, you can define the resource blocks reserved for sidelink transmission by setting the three parameters PRB Start, PRB End and PRB Number.

Control Period

For "Sidelink > Common > Mode > Discovery/Communication", sets the period over which resources are allocated for sidelink control period (SC period).

Depending on the "Sidelink > Common > Mode", this parameter sets one of the parameters listed in Table 4-16. As shown in the table, the SL communication is based on equal-sized PSCCH periods, with period length depending on the duplexing mode.

Table 4-16: Value range depending on the duplexing mode and the SL mode

"Sidelink > Common > Mode"	Parameter according to TS 36.331	Duplexing	TDD UL/DL configuration	Control period
Communication	`SL-CommResourcePool`	FDD	-	40, 80, 160, 320 subframes
		TDD	0	70, 140, 280 subframes
			1 to 5	40, 80, 160, 320 subframes
			6	60, 120, 240 subframes
Discovery	`discPeriod`	-	-	32, 64, 128, 256, 512, 1024 frames

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:CPERiod` on page 913
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:CPERiod` on page 913

Offset Indicator

Sets the parameter `SL-OffsetIndicator`, i.e. the offset from the SFN=0 after that the SL control region starts and thus defines the starting subframe of the repeating subframe bitmap (Control Subframe Bitmap/Subframe Bitmap)

If "Control Period Offset = 0", then the first subframe of the resource pool starts from the first subframe of SFN = 0.

"User Equipment Configuration > Sidelink > Common > Mode"	Value range
Communication V2X communication	0 to 319
Discovery	0 to10239

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:OFFSetind` on page 914
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:OFFSetind` on page 914
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:OFFSet` on page 914

PRB Start, PRB End
For "Sidelink > Common > Mode > Communication/Discovery", sets the parameters `prb-Start` and `prb-End` and define allocation of the two SL bands. The two bands occupy equal bandwidth, that is set in terms of resource blocks by the parameter `prb-Num`, see PRB Number.

The default values for the "PRB Start" and "PRB End" depend on the selected "Channel Bandwidth".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:PRBStart on page 914
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:PRENd on page 914
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRBStart on page 914
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRENd on page 914

PRB Number
For "Sidelink > Common > Mode > Communication/Discovery", sets the parameter `prb-Num` and defines the number of resource blocks each of the SL bands occupies.

The SL transmission is allowed on set of resources (subframes and resource blocks) called resource pool. If a subframe is used or not for SL transmission is defined by the subframe bitmap.

Within a subframe allowed for SL transmission, the resources used for SL are divided into two bands, where the first one starts at the `prb-Start` and the second ends at the `prb-End`. Each of the two bands occupies a `prb-Num` resource blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:PRBNumber on page 915
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRBNumber on page 915

Control Subframe Bitmap/Subframe Bitmap
Sets the subframe bitmap (`SubframeBitmapSL`) and thus defines which subframes are allowed for SL transmission (PSCCH).

The bitmap is a sequence of bits and has different length depending on the duplexing mode. The bitmap must contain at least two bits set to 1, because the PSCCH transmission occurs in two subframes.

The bit value indication is as follows:
- 1: indicates subframes used for PSCCH transmission
- The last 1: indicates the the beginning of the PSSCH transmission
- 0: indicates subframes used for PSSCH transmission.

Table 4-17: Bitmap length range depending on the duplexing mode for Mode > Communication/ Discovery

Duplexing	TDD UL/DL configuration	Bitmap length, bits
FDD	-	40
TDD	0	42
	1	16
	2	8
	3	12

Duplexing	TDD UL/DL configuration	Bitmap length, bits
	4	8
	5	4
	6	30

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:SFBMp on page 915
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:SFBMp on page 915

Resource pool (RP) settings dedicated to the discovery mode
Access: select "Sidelink > Common > Mode > Discovery" and "Sidelink > Resource Pool".

Number of Retransmission ← Resource pool (RP) settings dedicated to the discovery mode
Sets the parameter `numRetx` and defines how many times the PSDCH is retransmitted while working in discovery mode. The PDSCH comprises of 232 transport blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:NRETrans on page 915

Number of Repetitions ← Resource pool (RP) settings dedicated to the discovery mode
Sets the parameter `numRepetition` and defines how many times the PSDCH is repeated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:NREPetitions on page 916

N(1)PDSCH/N(2)PDSCH/N(3)PDSCH ← Resource pool (RP) settings dedicated to the discovery mode
Sets the PDSCH resource index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:N1PDsch on page 916
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:N2PDsch on page 916
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:N3PDsch on page 916

Subframe Index ← Resource pool (RP) settings dedicated to the discovery mode
Sets the subframe index `discSF-Index` as defined in TS 36.331.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:SFINdex on page 919

PRB Index ← Resource pool (RP) settings dedicated to the discovery mode
Sets the physical resource block index `discPRB-Index` as defined in TS 36.331.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRINdex on page 919

Resource pool (RP) settings dedicated to the V2X communication mode
Option: R&S SMW-K119

The V2X communication mode commonly describes the three scenarios:
- V2V: vehicle-to-vehicle operation
- V2P: vehicle-to-pedestrian operation
- V2I: vehicle-to-network/infrastructure operation.

The V2X communication reuses the resource grid of the SL transmission. The resource pools are defined by the parameters:
- RPStart (Start RB Subchannel)
- NubSubchannels (Number of Subchannels)
- SizeSubchannels (Subchannel Size).

Subframe Bitmap Length ← Resource pool (RP) settings dedicated to the V2X communication mode
For "Sidelink > Common > Mode > V2X Communication", set the bitmap length.

Table 4-18: Value range depending on the duplexing mode and the SL mode

"Sidelink > Common > Mode"	Duplexing	TDD UL/DL configuration	Control period, subframes
V2X communication	FDD	-	16, 20, 100
	TDD	0	60
		1	40
		2, 4	20
		3	30
		5	10
		6	50

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BMPLength` on page 917

Subframe Bitmap (0-49, bin)/Subframe Bitmap (50-99, bin) ← Resource pool (RP) settings dedicated to the V2X communication mode
Sets the subframe bitmap (`SubframeBitmapSL`) and thus defines which subframes are allowed for SL transmission (PSCCH).

The bitmap is a sequence of bits and has different length depending as selected with the parameter Subframe Bitmap Length.

The "Subframe Bitmap (50-99, bin)" is enabled, if "Subframe Bitmap Length ≥ 60 Subframes".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITLow` on page 917
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITHigh` on page 917

Adjacent PSCCH/PSSCH ← Resource pool (RP) settings dedicated to the V2X communication mode
If enabled, the PSCCH and PSSCH channels are allocated on contiguous resources, where the PSCCH is allocated at the lower end of the subchannel.

If "Number of Subchannels > 1", the PSCCH is transmitted in the subchannel as set with the parameter Subchannel.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:ADJC` on page 918

Number of Subchannels ← Resource pool (RP) settings dedicated to the V2X communication mode
Sets the number of subchannels.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:SUBChannels` on page 918

Subchannel Size ← Resource pool (RP) settings dedicated to the V2X communication mode
Sets the number of resource blocks the subchannel spans.

The allowed value depends on whether "Adjacent PSCCH/PSSCH" are used or not.

The value is also limited by the constraint: "Subchannel Size"*"Number of Subchannels" ≤ N_RB, where N_RB is the number of resource blocks depending on the selected "Channel Bandwidth".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:SUBSize` on page 919

Start RB Subchannel ← Resource pool (RP) settings dedicated to the V2X communication mode
Sets the first RB in the subchannel.

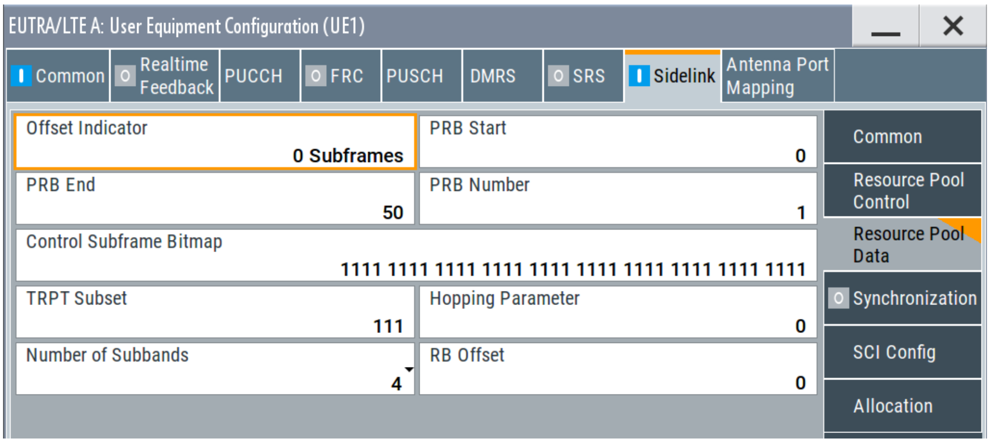
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:SRBSubchan` on page 918

4.8.7.3 Resource pool data settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".
4. Select "Sidelink > Common > Mode" > **"Communication"**.

5. Select "Sidelink > Resource Pool Data".



With the provided settings, you can configure the resource pool (RP) for the side-link data region.
The data region starts directly after the last bit of the Control Subframe Bitmap(`SubframeBitmapSL`) which is set to 1. The data region itself contains a bitmap, the TRTP bitmap (TRPT Subset). The latter indicates the subframes which are used for the data transmission. The TRTP bitmap is repeated until the end of the SC period is reached.
Two types of resource pools are defined, the reception resource pool (Rx RP) and the transmission resource pool (Tx RP).

Offset Indicator
Sets the parameter `SL-OffsetIndicator`, i.e. the offset from the SFN=0 after that the SL control region starts and thus defines the starting subframe of the repeating subframe bitmap (Control Subframe Bitmap).

If "Control Period Offset = 0", then the first subframe of the resource pool starts from the first subframe of SFN = 0.

"User Equipment Configuration > Sidelink > Common > Mode"	Value range
Communication	0 to 319
Discovery	0 to10240

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:OFFSetind` on page 914

PRB Start, PRB End
Sets the parameters `prb-Start` and `prb-End` and define allocation of the two SL bands. The two bands occupy equal bandwidth, that is set in terms of resource blocks by the parameter `PRB-Num`.

The default values for the "PRB Start" and "PRB End" depend on the selected "Channel Bandwidth".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:PRBStart on page 914
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:PRENd on page 914

PRB Number
Sets the parameter `prb-Num` and defines the number of resource blocks each of the SL bands occupies.

The SL transmission is allowed on set of resources (subframes and resource blocks) called resource pool. Whether a subframe is used or not for SL transmission is defined by the subframe bitmap.

Within a subframe allowed for SL transmission, the resources used for SL are divided into two bands, where the first one starts at the `prb-Start` and the second ends at the `prb-End`. Each of the two bands occupies a `prb-Num` resource blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:PRBNumber on page 915

Control Subframe Bitmap
Sets the subframe bitmap (`SubframeBitmapSL`) and thus defines which subframes are allowed for SL transmission (PSCCH).

The bitmap is a sequence of bits and has different length depending on the duplexing mode. The bitmap must contain at least two bits set to 1, because the PSCCH transmission occurs in two subframes.

The bit value indication is as follows:
- 1: indicates subframes used for PSCCH transmission
- The last 1: indicates the the beginning of the PSSCH transmission
- 0: indicates subframes used for PSSCH transmission.

Table 4-19: Bitmap length range depending on the duplexing mode

Duplexing	TDD UL/DL configuration	Bitmap length, bits
FDD	-	40
TDD	0	42
	1	16
	2	8
	3	12
	4	8
	5	4
	6	30

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:SFBMp on page 915

TRPT Subset
The TRPT subset is a kind of an additional restriction for PSSCH subframe allocations form the total subframes available for PSSCH transmission. The TRPT subset is a time resources pattern that indicates the set of available subframes to be used for sidelink communication. If the TRPT subset is not signaled, the UE assumes that the whole TRPT set is available.

The TRPT bitmap is repeated until the end of the SC period is reached.

Table 4-20: TRPT subset length depending on the duplexing mode

Duplexing	TDD UL/DL configuration	TRTP subset length, bits
FDD	-	3
TDD	0	5
	1	3
	2	3
	3	4
	4	3
	5	3
	6	4

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:TRPTsubset on page 920

Hopping Parameter
Sets the frequency hopping parameter.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:HOPPingparam on page 920

Number of Subbands
Sets the number of subbands. The SL transmission can use 1, 2 or 4 subbands.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:NSUBbands on page 920

RB Offset
Shifts the band in the frequency domain by the selected number of resource blocks (RB).

Table 4-21: Value range depending on the bandwidth

Bandwidth	RB offset
1.4 MHz	0 to 4
3 MHz	0 to 12
5 MHz	0 to 22

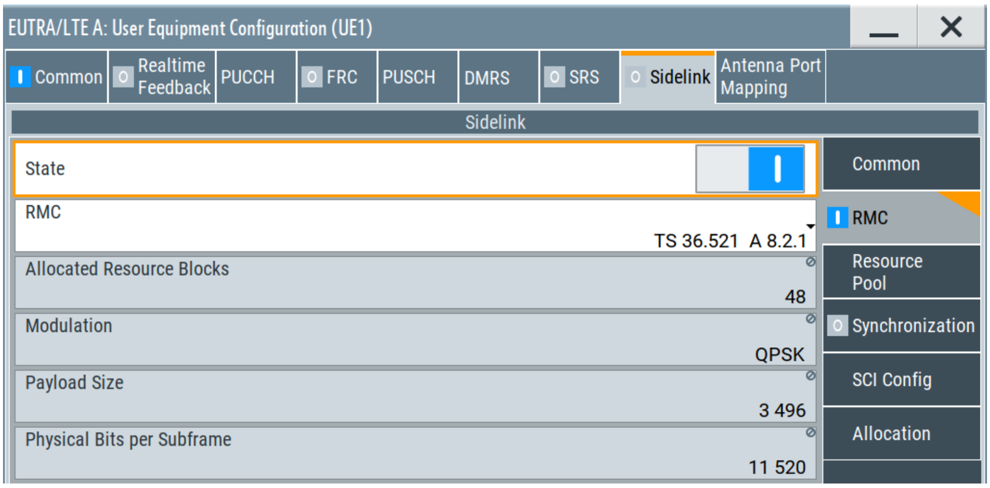
Bandwidth	RB offset
10 MHz	0 to 48
15 MHz	0 to 72
20 MHz	0 to 98

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:RBOFfset on page 920

4.8.7.4 RMC settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".
4. Select "Sidelink > Common > Mode" > **"V2X Communication"**.
5. Select "Sidelink > RMC".



With the provided settings, you can select a preconfigured reference measurement channel (RMC).

State

If enabled, the settings according to the selected reference measurement channel (RMC) are applied.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:STATe` on page 932

RMC

Selects one of the predefined reference measurement channels.

All further settings in this dialog are set automatically.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:RMC` on page 932

Allocated Resource Blocks

Indicates the number of resource blocks the allocation spans.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:ARBLocks?` on page 932

Modulation

Indicates the used modulation scheme.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:MODulation?` on page 932

Payload Size

Indicates the payload size.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:PAYSize?` on page 933

Physical Bits per Subframe

indicates the number of used physical bits per subframe

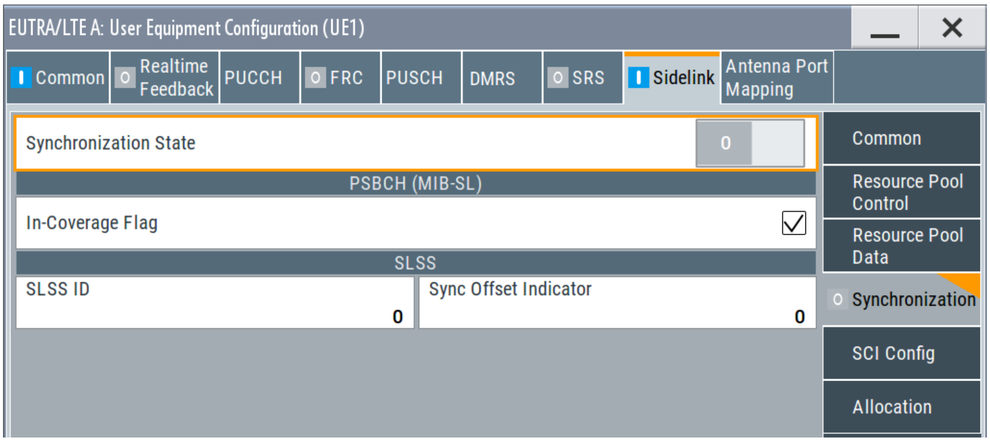
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:PHYSbits?` on page 933

4.8.7.5 Synchronization settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".

4. Select "Sidelink > Synchronization".



The dialog comprises the settings of the sidelink synchronization signal (SLSS) and the sidelink common control information, carried by a single message on the PSBCH (physical sidelink broadcast channel).

Depending on the SL "Sidelink > Common" > Mode, this single message is:

- Option: R&S SMW-K113
  The master information block-SL (MIB-SL) message for sidelink discovery and sidelink communication
- Option: R&S SMW-K119
  The master information block-SL-V2X (MIB-SL-V2X) message for V2X sidelink communication.

The MIB-SL transmission on a fixed schedule with a periodicity of 40 ms and without repetitions, where the subframes in that the MIB-SL is scheduled are defined by the parameter "Sync Offset Indicator" on page 305.
The MIB-SL-V2X is also transmitted on a fixed schedule but it uses a periodicity of 160 ms without repetitions.

Synchronization State

Enables using the two types of synchronization signals for the SL transmission:

- Sidelink synchronization signals (SLSS) used for synchronization in time and frequency
- Master information block SL (MIB-SL) that provides additional information.

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:STATe on page 921

PSBCH (MIB-SL)

The MIB-SL is one of the SL synchronization signals. It is transmitted over the PBCCH and carries the following information:

In-coverage Flag ← PSBCH (MIB-SL)
Sets the parameter `inCoverage` according to TS 36.331. It indicates whether the sender is in the coverage of a cell or not.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:INCoverage` on page 921

SLSS
There are primary and secondary SL synchronization signals (SLSSs), the PSSS and the SSSS. Each of the synchronization signals spans 62 resource elements, located around the center carrier. In the time domain, the SLSS span two subsequent symbols.

The SLSS is additionally defined by the following parameters:

SLSS ID ← SLSS
Sets the SLSS ID form that the receiving UE detects if the transmitting UE is in coverage of at least if it receives its synchronization from the LTE cell.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:SLSSid` on page 921

Sync Offset Indicator ← SLSS
Sets the parameter `syncOffsetIndicator` according to TS 36.331 that defines the subframes in that the MIB-SL is scheduled.

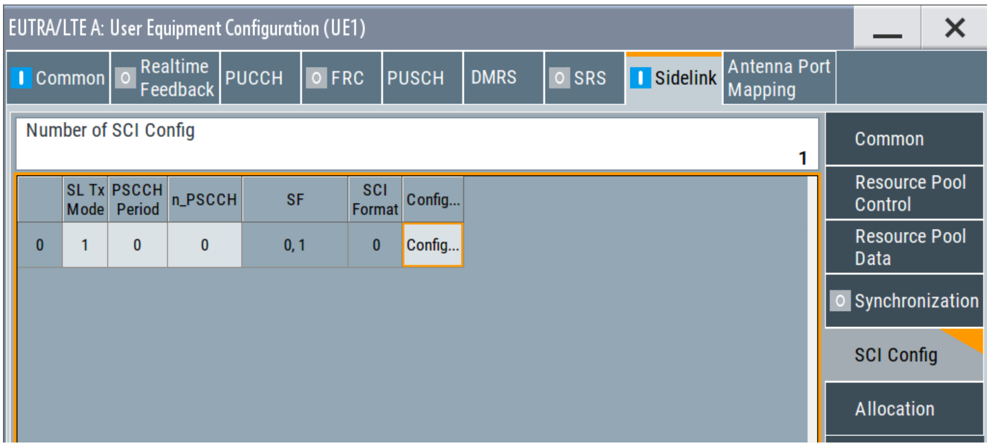
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:OFFSetind` on page 921

4.8.7.6 SCI configuration settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".
4. Select "Sidelink > Common > Mode > Communication".
   Or "Sidelink > Common > Mode > V2X Communication"

5. Select "Sidelink > SCI Config".



With the provided settings, you can configure the number of SCI (SL control information) configurations, the SCI format and the content of the SCI.

Number of SCI Config
Sets the number of SCI (SL control information) configurations. In the SCI table, there is one table row per SCI configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:NSCI` on page 922

SCI Table
In the SCI table, there is one table row per SCI configuration.

SL Tx Mode ← SCI Table
Sets the transmission mode of the SL transmission.

The Tx mode defines how the resources from a resource pool (RP) are assigned and influence the start of the data part.

"1" (Mode 1) The resource assignment, incl. the resources within an RP is indicated by the eNB.

"2" (Mode 2) The UE uses a set of predefined pools and selects the resources thereof.

"3", "4" (Mode 3 and 4)	Option: R&S SMW-K119 Set the transmission mode for "Sidelink > Common > Mode > V2X Communication".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TXMode on page 922

PSCCH Period ← SCI Table
For "Sidelink > Common > Mode > Communication", the subframes used for SL transmissions are distributed over different PSCCH periods. The PSCCH period is defined with the parameter "Resource Pool Control" > Control Period.

This parameter defines the PSCCH period in that the SCI configuration is performed.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:PSCPeriod on page 922

n_PSCCH ← SCI Table
For "Sidelink > Common > Mode > Communication", sets the parameter n_PSCCH and determines the resources in the time and the frequency domain that a transmitting UE uses for the PSCCH transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:NPSCch on page 922

Start SF ← SCI Table
Option: R&S SMW-K119

For "Sidelink > Common > Mode > V2X Communication", sets the first subframe used for the SL transmission, where the starting SF of the subsequent configuration has to be greater than the period of the previous one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:STARtsf on page 923

Subchannel ← SCI Table
Option: R&S SMW-K119

For "Sidelink > Common > Mode > V2X Communication", sets the used subchannel.

The number of subchannels is set with the parameter Number of Subchannels.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:SUBChannel
on page 923

SF ← SCI Table
Indicates the subframe numbers of the subframes that can be used for SL transmission. The values are calculated automatically.

- In "Sidelink > Common > Mode > Communication/Discovery" mode, the PSCCH allocation uses two subframes.
- In "Sidelink > Common > Mode > V2X Communication" mode, the PSCCH allocation uses one or 2 subframes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:SF? on page 923

SCI Format ← SCI Table

Sets the SCI (SL control information) format.

"0"	SCI format 0, required for "Sidelink > Common" > Mode = "Communication"
"1"	Option: R&S SMW-K119 SCI format 1, required for V2X transmission ("Sidelink > Common" > Mode = "V2X Communication").

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:FORMat` on page 923

Config ← SCI Table

Opens a dialog with further settings to configure the content of the SCI with the selected format, see Chapter 4.8.7.7, "SCI format configuration", on page 308.

4.8.7.7 SCI format configuration

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".
4. Select "Sidelink > Common > Mode > Communication".
   Or "Sidelink > Common > Mode > V2X Communication"
5. Select "Sidelink > SCI Config > SCI Format = e.g. 0".
6. Select "Config".

   In this dialog, you configure the content of the SCI (SL control information) in the selected format ("Sidelink > SCI Config" > SCI Format).

The SCI carries information from that the receiving device detects the PSSCH and retrieves information on the set of resources in which the PSSCH is transmitted.

Settings:

Bit Data

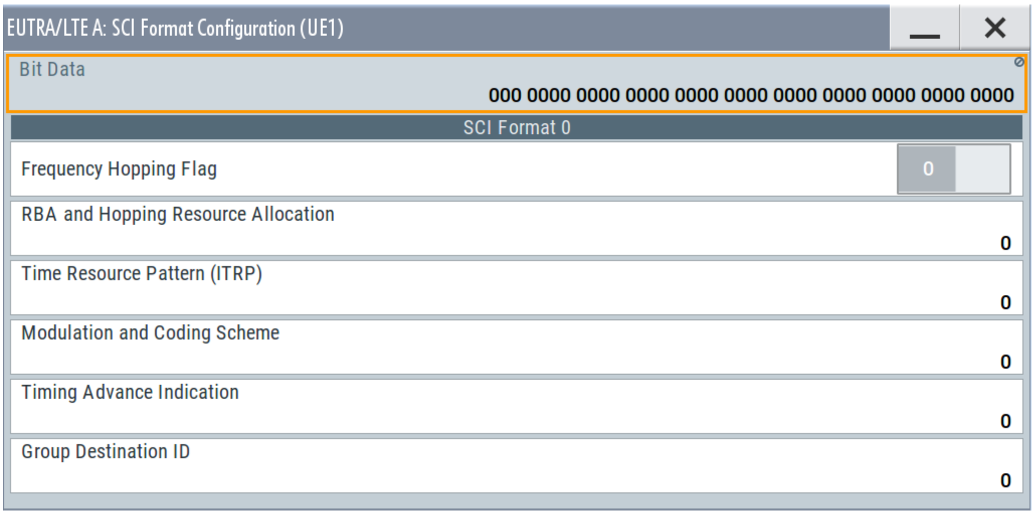
Displays the resulting bit data as selected with the SCI format parameters.

Mapping of the information bits is according to TS 36.212.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:BITData?` on page 924

SCI Format 0

The SCI format 0 is defined for SL transmission in communication mode ("Sidelink > Common > Mode > Communication").



The fields defined in the SCI format are mapped to the information bits according to the 3GPP specification and the resulting "Bit Data" on page 308 is displayed.

The bit data length depends on the "Channel Bandwidth" and the value of the SCI parameter "RBA and Hopping Resource Allocation".

"Channel Bandwidth", MHz	Number of bits in the "Bit Data" field
1.4	37
3	39
5	41
10	43
15	44
20	45

Control information field	SCPI command	Dependencies
"Frequency Hopping Flag"	`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:FHFLag` on page 924	
"RBA and Hopping Resource Allocation"	`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:RBAHoppalloc` on page 924	Value range depends on the "Channel Bandwidth"

Control information field	SCPI command	Dependencies
"Time Resource Pattern (ITPR)"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TRP on page 925	Value range for "SL Tx Mode = 1" • For FDD and "TDD Config = 1, 2, 4, and 5": 0 to 106 • For "TDD Config = 0": 1 to 127 • For "TDD Config = 3 and 6": 1 to 63 For "SL Tx Mode = 2", automatically set.
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:MCS on page 925	
"Timing Advance"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TAINd on page 925	For "SL Tx Mode = 1": 0 to 2047 For "SL Tx Mode = 2": 0
"Group Destination ID"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:GRID on page 925	

SCI Format 1
Option: R&S SMW-K119

The SCI format 1 is defined for SL transmission in V2X communication mode ("Sidelink > Common > Mode > V2X Communication").

The fields defined in the SCI format are mapped to the information bits according to the 3GPP specification and the resulting "Bit Data" on page 308 is displayed.

The bit data is 32 bits long; filling zeros are appended in case the resulting bit data is shorter than 32 bits.

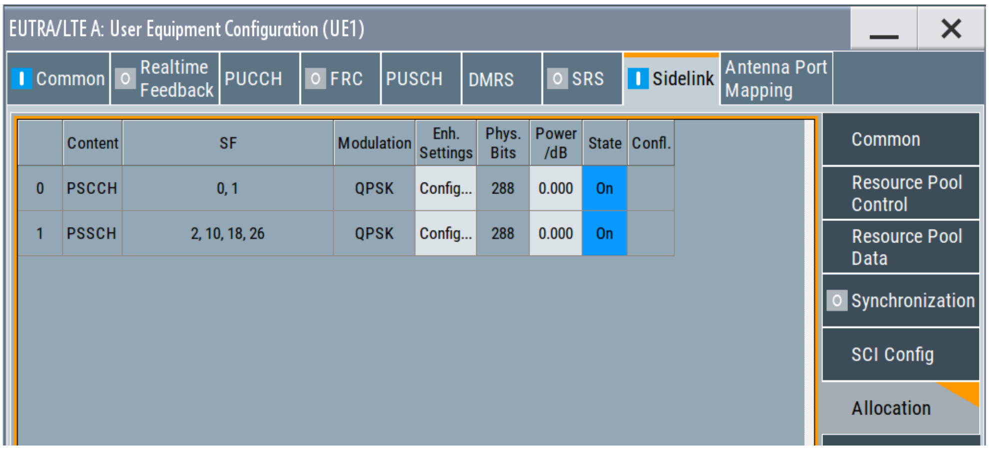
Control information field	SCPI command	Dependencies
"Priority"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:PRIRity on page 926	
"Resource Reservation"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:RREServation on page 926	Value range: • For "Tx Mode = 3": 0 • For "Tx Mode = 4": 0 to 12

Control information field	SCPI command	Dependencies
"Frequency Resource Location of initial Tx and ReTX"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:FREQresloc on page 926	Length in bits and value range depends on the "Number of Subchannels": ● 1: 0 bits ● 3: 3 bits [0 to 7) 5: 4 bits [0 to 15] 8: 6 bits [0 to 63] 10: 6 bits [0 to 63] 15: 7 bits [0 to 127] 20: 8 bits [0 to 255] ● For TDD config = 0: 0 to 127 ● For TDD config = 3 and 6: 1 to 63 For "SL Tx Mode = 2", automatically set.
"Time Gap between initial Tx and ReTx"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TIMGap on page 926	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:MCS on page 925	
"Retransmission Index"	[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TXINdex on page 927	

4.8.7.8 Allocation settings

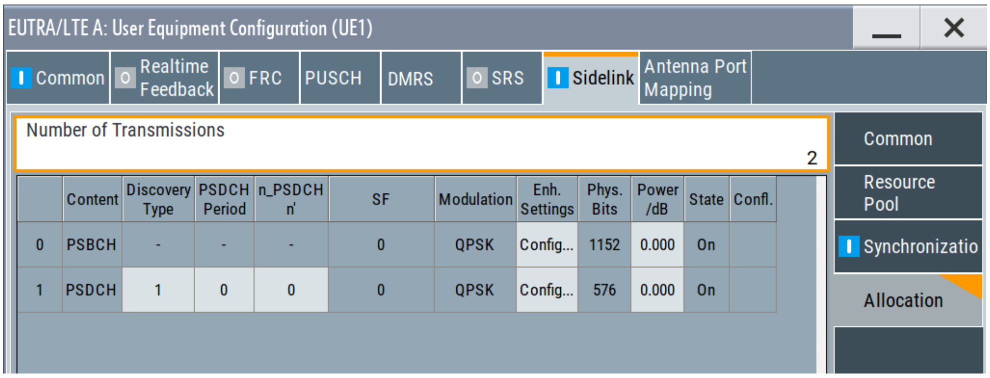
Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".
4. Select "Sidelink > Common > Mode > Communication".
   Or "Sidelink > Common > Mode > V2X Communication"
5. Select "Sidelink > Allocation".



The number of channels is set automatically, depending on the number of SCIs, the SCI format and its content.

6. Select "Sidelink > Common > Mode > Discovery".
   Select "Sidelink > Allocation".



With the provided settings, you can configure the SL allocations.
The provided settings depend on the selected SL mode.

Number of Transmissions

For "Sidelink > Common > Mode > Discovery", sets the number of transmissions.

The value defines the number of rows in the allocation table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:NALLoc on page 927

Content
Indicates allocation content, i.e. selects the channel to be transmitted:
- PSCCH: physical sidelink control channel
- PSDCH: physical sidelink discovery channel
- PSSCH: physical sidelink shared channel

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CONTent?
on page 927

Discovery Type
For "Sidelink > Common > Mode > Discovery" and "Content = PSDCH", selects one of the discovery types, type 1 or type 2B.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:DISCtype
on page 928

PSDCH Period
For "Sidelink > Common > Mode > Discovery" and "Content = PSDCH", sets the period of the PSDCH, where the period of the subsequent channel has to be greater than the period of the previous one.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:PSDPeriod
on page 928

n_PSDCH/n'
For "Sidelink > Common > Mode > Discovery" and "Content = PSDCH", sets the parameter n_PSDCH or n' as defined in TS 36.213, where n_PSDCH applies for discovery type 1 and n' - for discovery type 2B.

Value range depends on the selected Discovery Type and the resource pool configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:NPDSch on page 928

SF
Indicates the subframe numbers of the allocated subframe. The values are calculated automatically.

The PSCCH is transmitted over 2 subframes, whereas the PSSCH over 4.

The PSDCH transmission depends on the Number of Retransmission defined in the resource pool.

For "Sidelink > Common > Mode > V2X Communication", the subframes depend on the value of the SCI Format 1 > "Time Gap between initial Tx and ReTx".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:SF? on page 928

Modulation
Indicates or sets the used modulation, depending on the selected channel type ("Content").

- PSCCH: QPSK
- PSDCH: QPSK
- PSSCH: QPSK, 16QAM
  In addition, 64QAM is supported with R&S SMW-K119.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:MODulation?
on page 929

Enchanced Settings > Config
Opens a dialog with further settings for the selected channel.

Physical Bits
Indicates the number of physical bits occupied by the channel.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:PHYSbits?
on page 929

Power
Sets the power of the selected channel.

The value is set relative to the UE power.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:POWer on page 929

State
Enables the transmission of the selected channel.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:STATe on page 930

Conflict
A conflict is indicated if two allocations overlap.

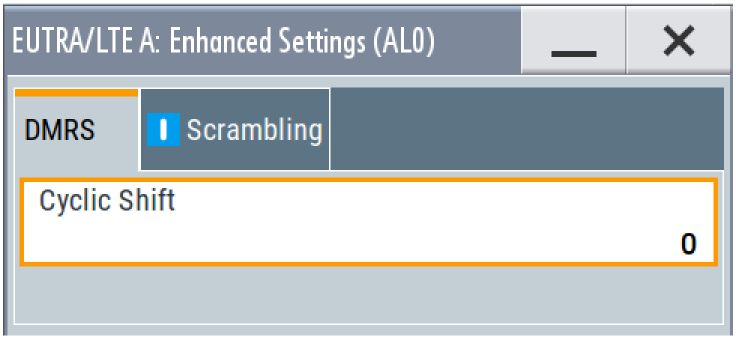
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CONFlict?
on page 930

4.8.7.9 PSCCH, PSDCH and PSSCH enhanced settings

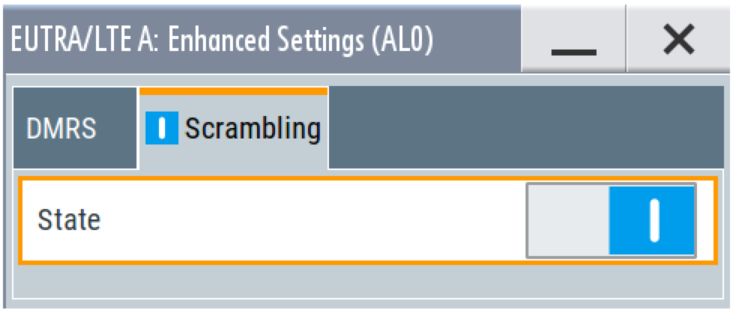
Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".
3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".

4. Select "Sidelink > Common > Mode > Communication".
   Or "Sidelink > Common > Mode > V2X Communication"
5. Select "Sidelink > Allocation > Enhanced Settings > Config".



6. Select "Enhanced Settings > Scrambling".



With the provided settings, you can configure the channel coding and scrambling settings of the selected channel.

DMRS > Cyclic Shift

Sets the cyclic shift used by the generation of the DMRS (demodulation reference signal) sequence.

For "Sidelink > Common > Mode > Communication/Discovery", the value for PSCCH is fixed to "Cyclic Shift = 0".

For "Sidelink > Common > Mode > V2X Communication", the value for PSCCH is one of the following {0, 3, 6, 9}.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CYCShift`
on page 930

Scrambling
Comprises the scrambling settings:

State ← Scrambling
Enables scrambling.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:SCRambling:STATe
on page 930

Channel coding
Access: select "Sidelink > Allocation > Content > PSSCH" and select "Enhanced Settings > Config".

State ← Channel coding
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CCODing:STATe
on page 931

Number of Physical Bits ← Channel coding
Indicates the resulting number of physical bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:PHYSbits?
on page 929

Transport Block Index ← Channel coding
Indicates the resulting transport block index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CCODing:TBSI?
on page 931

Transport Block Size ← Channel coding
Indicates the resulting transport block size.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CCODing:TBSize?
on page 931

4.8.8 Antenna port mapping

Option: R&S SMW-K85

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx".

3. Select "User Equipment Configuration > Common > 3GPP Release > LTE-Advanced".
4. Select "Antenna Port Mapping".

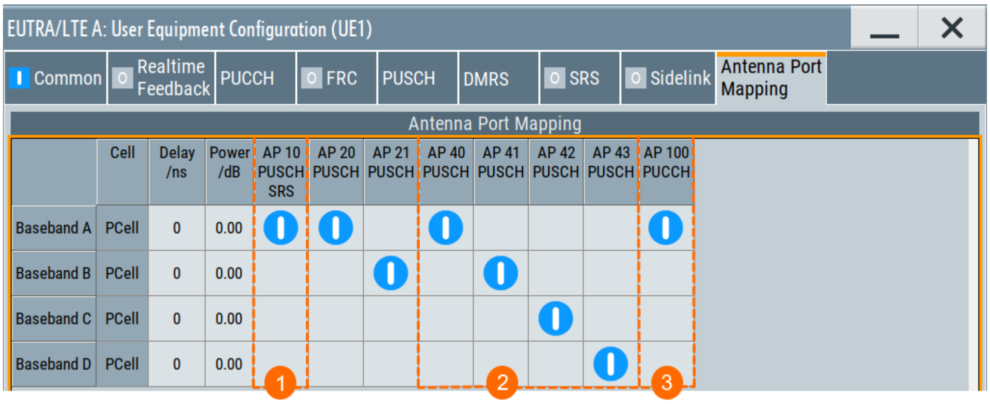


Figure 4-17: Antenna port mapping setting in "System Configuration > Fading/Baseband Configuration > Advanced", 4xN MIMO and "BB Source > Coupled"

1 = Number of AP for PUSCH/SRS = 1
2 = Number of AP for PUSCH/SRS = 4
2 = Number of AP for PUCCH = 1
2 = Number of AP for PUCCH = 2

The "Antenna Port Mapping" settings define which baseband generates which antenna port.

Settings:

Cell

Indicates the cell (primary cell or secondary cell).

Delay

In advanced configuration with coupled sources, delays the signal of the selected cell.

This result in signal delay between the generated baseband signals.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:APMap:ROW<bbid>:DELay` on page 904

Power

Applies a power offset to the selected PCell or SCell.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CELL<dir0>:POFFset` on page 904

Antenna port mapping table

The mapping table is a matrix with the following dimension:

- Nnumber of rows equal to the number of physical Tx antennas (Basebands)
- Number of columns equal of the number of antenna ports (AP).

The available antenna ports depend on:

- Max. Number of AP for PUSCH (tab General)
- Number of Antenna Ports for PUCCH per PUCCH Format
- Number of Antenna Ports for SRS

The Table 4-22 gives an overview of the available antenna port numbers as a function of the enabled "Number of Antenna Ports" per channel/signal.

Table 4-22: Available antenna port numbers

Number of antenna ports	1	2	4
Physical channel/signal			
PUSCH	10	20 21	40 41 42 43
PUCCH	100	200 201	-
SRS	10	20 21	40 41 42 43
Sidelink PSBCH SL Synch	1000 1010 1020		

Per activated baseband, you can activate exactly one PUSCH, one PUCCH, and one SRS antenna port.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP10Map:ROW<bbid>`
on page 903

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP20Map:ROW<bbid>`
on page 903

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP21Map:ROW<bbid>`
on page 903

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP40Map:ROW<bbid>`
on page 903

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP41Map:ROW<bbid>`
on page 903

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP42Map:ROW<bbid>`
on page 903

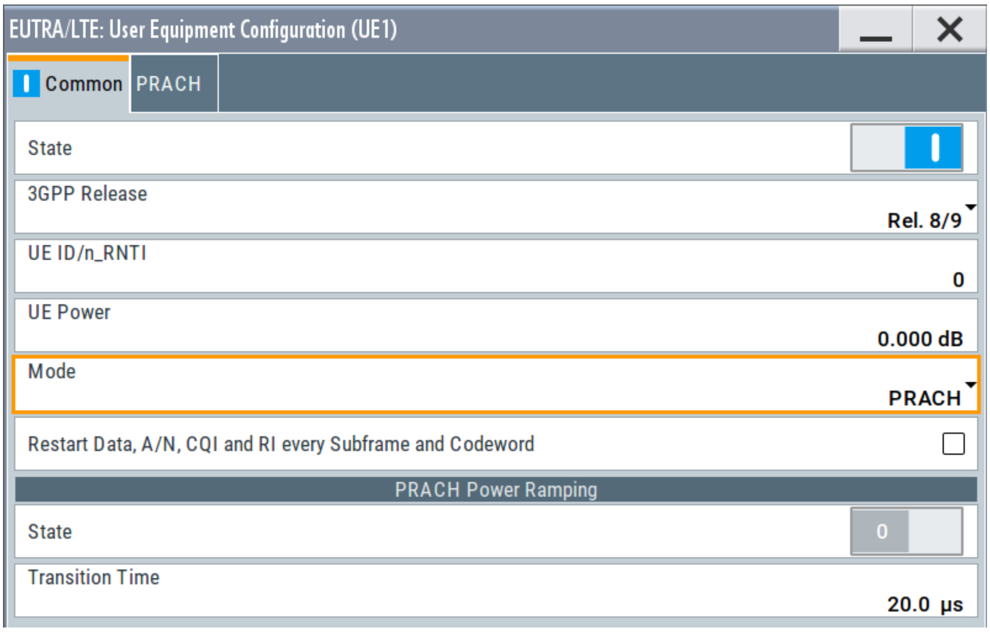
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP43Map:ROW<bbid>`
on page 903

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP100Map:ROW<bbid>
on page 903
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP200Map:ROW<bbid>
on page 903
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP201Map:ROW<bbid>
on page 903
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP1000Map:ROW<bbid>
on page 903
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP1010Map:ROW<bbid>
on page 903
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP1020Map:ROW<bbid>
on page 903

4.8.9 PRACH power ramping

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx"
3. Select "Common > Mode > PRACH"



This dialog comprises the settings needed for configuring the PRACH power ramp-ing.

Settings:

State PRACH Power Ramping
Activates power ramping for the PRACH preamble. The start and the end of the preamble is cyclically extended and multiplied with a ramping function (sin ^ 2).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRSTate` on page 886

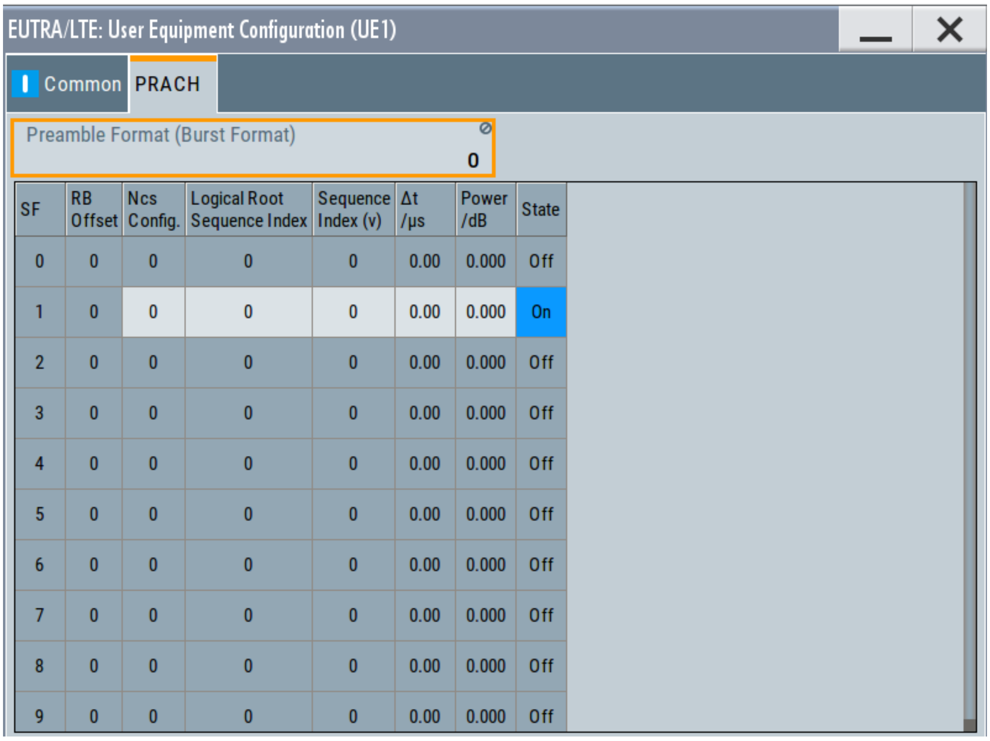
Transition Time
Defines the transition time from beginning of the extended preamble to the start of the preamble itself.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRTT` on page 887

4.8.10 PRACH configuration

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UEx"
3. Select "Common" > **"Mode = PRACH"**
4. Select "PRACH".



In this dialog, the UE-specific parameters according to TS 36.211 are enabled for configuration.

The cell-specific parameters, necessary for the complete definition of the PRACH, are configurable in the dialog "General UL Settings" > "PRACH".

Settings:

Preamble Format (Burst Format)

Displays the preamble format.

The "Preamble Format" is automatically derived from the PRACH Configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRFormat?` on page 887

Number of Configurable Frames

Shows how many frames can be configured.

A maximum number of 20 frames are available for configuration; the currently available number of frames depends on the selected ARB ARB settings.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:CFRames?` on page 887

SF

Displays the consecutive number of the subframe.

The subframes available for configuration depend on the selected "Duplexing" mode and "PRACH Configuration".

Remote command:
n.a.

RB Offset

Displays the starting RB, as set with the parameter PRACH Frequency Offset.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RBOFfset`
on page 888

Frequency Resource Index

This parameter is enabled in TDD duplexing mode only.

Sets the frequency resource index f_{RA} for the selected subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:FRINdex
on page 888

Ncs Configuration
Selects the Ncs configuration of the selected subframe, i.e. determines the Ncs value for the selected preamble set according to TS 36.211, table 5.7.2.-2 and 5.7.2-3.

The value range of this parameter depends on the selected duplexing mode, PRACH configuration and whether a restricted preamble set is enabled or not.

Table 4-23: Value range Ncs configuration

Parameter	Value range
PRACH Restricted Set = "Off"	0 to 15
"Restricted Preamble Set = Type A"	0 to 14
"Restricted Preamble Set = Type B"	0 to 12
TDD + PRACH Configuration > 47	0 to 6

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:NCSConf
on page 888

Logical Root Sequence Index
Selects the logical root sequence index for the selected subframe.

The value range of this parameter depends on the combination of selected duplexing mode and PRACH configuration.

Parameter	Value range "Logical Root Sequence Index"
TDD + PRACH Configuration > 47 i.e. preamble format 4	0 to 137
All other cases	0 to 837

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RSEQuence
on page 889

Sequence Index (v)
Selects the sequence index **v** for the selected subframe, i.e. selects which one of the 64 preambles available in a cell is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:SINDex
on page 889

Delta t/us
Sets the parameter Delta_t in us.

A value of delta t different than 0 causes a time shift of the configured preamble.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:DT on page 889

Power
Sets the PRACH power relative to the UE power. The PRACH power can be adjusted independently for every configured preamble.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:POWer on page 888

State
Enables/disables the PRACH for the selected subframe.

The subframes available for configuration depend on the selected PRACH configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:STATe on page 890

4.9 Enhanced PUSCH settings

This dialog allows you to define and configure PUSCH parameters, such as the settings of the uplink shared channel (UL-SCH), HARQ control information, and the Channel Quality Control Information (CQI).

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUSCH".
3. Select "Enhanced Settings > Configure".

   In this dialog you can:
   - Define the precoding parameters, see "Precoding" on page 325
   - Enable and configure frequency hopping, see "Frequency Hopping" on page 326
   - Set the cyclic shift used by the demodulation reference signal (DMRS), see Chapter 4.9.2, "Demodulation reference signal (DMRS)", on page 326
   - Adjust the parameters for channel coding of the control information (HARQ and CQI), see Chapter 4.9.3, "Channel coding / multiplexing", on page 328
   - Configure the multiplexing of the control information with the data transmission over the UL-SCH

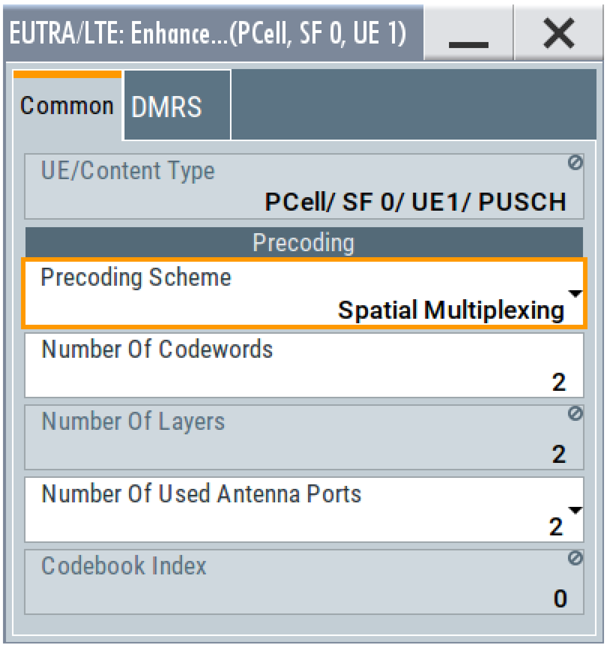
4.9.1 Common PUSCH settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".

2. Select "Frame Configuration > Subframe > Content > PUSCH".
3. Select "Enhanced Settings > Configure".
4. Select "Frequency Hopping".
5. To enable spatial multiplexing, select "Precoding > Precoding Scheme > Spatial Multiplex".
   a) Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
   b) Select "3GPP Release = Release 10"
   c) Select "PUSCH"
   d) Select "Transmission Mode = 2 (Spatial Multiplexing)"
   e) Select "Number of Antenna Ports for PUSCH = 2 or 4"
   f) In the "Enhanced PUSCH Settings" dialog, select "Precoding > Precoding Scheme > Spatial Multiplexing"

   The frequency hopping is automatically disabled.



The provided further settings depend on the selected channel coding, see Chapter 4.9.3, "Channel coding / multiplexing", on page 328.
The common settings comprise the following precoding and frequency hopping settings:

UE/Content Type
Displays the UE number and the content type of the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType`
on page 837

Precoding
The generation of LTE signals with UL-MIMO is an LTE Rel. 10 feature that requires the additional option R&S SMW-K85 LTE-Advanced.

Precoding Scheme ← Precoding
For Max. Number of AP for PUSCH (tab General) > 1, enables spatial multiplexing for the PUSCH of the current user in the current subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme` on page 846

Number of Codewords ← Precoding
Displays the number of the used codewords.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CODWords` on page 846

Number of Layers ← Precoding
Sets the number of layers.

The combination of number of codewords and number of layers determines the layer mapping for the selected precoding scheme, see also Figure 2-31.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NOLayers` on page 847

Number of Used Antenna Port ← Precoding
Sets the number of used antenna ports form the number of antenna ports that are configured for PUSCH transmission (see Max. Number of AP for PUSCH (tab General)).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NAPused` on page 847

Codebook Index ← Precoding
Sets the codebook index and selects the predefined pre-coder matrix.

The number of available codebook indices depends on the number of used antenna ports.

The combination of the codebook index and the Number of Layers determines the pre-coding matrix used for precoding (see also Figure 2-31).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:CBINdex` on page 847

Frequency Hopping
Frequency hopping is applied according to TS 36.213.

Frequency hopping is disabled, if spatial multiplexing is used (see Precoding Scheme).

Frequency Hopping ← Frequency Hopping
Enables/disables frequency hopping for PUSCH.

Based on the Information in Hopping Bits, a UE performing PUSCH frequency hopping applies one of the two possible Hopping Type.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:STATe` on page 848

Information in Hopping Bits ← Frequency Hopping
Sets the information in hopping bits according to the PDCCH DCI format 0 hopping bit definition. This information determines whether type 1 or type 2 hopping is used in the subframe, and - in case of type 1 - also determines the exact hopping function to use.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:IIHBits` on page 849

Hopping Type ← Frequency Hopping
Displays the frequency hopping type used.

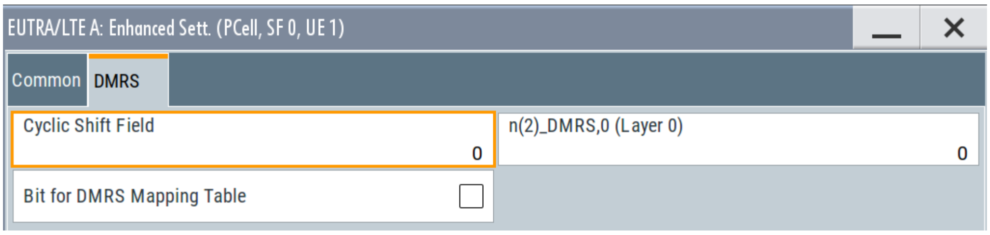
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:TYPE?` on page 849

4.9.2 Demodulation reference signal (DMRS)

Option: R&S SMW-K85

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUSCH".
3. Select "Enhanced Settings > Configure".
4. Select "DMRS".



Cyclic Shift Field

Cyclic shifts are used to separate the DMRS signals of different users in the time domain. This parameter sets the cyclic shift field in the uplink-related DCI formats, see Table 4-24.

See also "DCI Format 3/3A" on page 210.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:CYCShift on page 849

n(2)_DMRS,λ (Layer λ)

Displays the part of the demodulation reference signal (DMRS) index $n^{(2)}_{DMRS, \lambda}$ per layer, where the number of layers λ is defined with Number of Layers.

Table 4-24: DMRS index n(2)_DMRS,λ as function of the cyclic shifts and number of layers λ

Cyclic Shift Field in DCI Formats	λ = 0 (1 layer)	λ = 1 (2 layers)	λ = 2 (3 layers)	λ = 3 (4 layers)
000	0	6	3	9
001	6	0	9	3
010	3	9	6	0
011	4	10	7	1
100	2	8	5	11
101	8	2	11	5
110	10	4	1	7
111	9	3	0	6

The DMRS index is part of the uplink scheduling assignment and valid for one UE in the subframe. This index applies when multiple shifts within a cell are used and is used by the calculation of the DMRS sequence.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>? on page 848

Bit for DMRS Mapping Table

Option: R&S SMW-K119

Sets the *Cyclic Shift Field mapping table for DMRS bit* field as defined in TS 36.211 and TS 36.212.

The combination of the two parameters Enhanced DMRS > "On" and Bit for DMRS Mapping Table > "On" enables mapping the DMRS sequence on each second subcarrier.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:MAPPing` on page 848

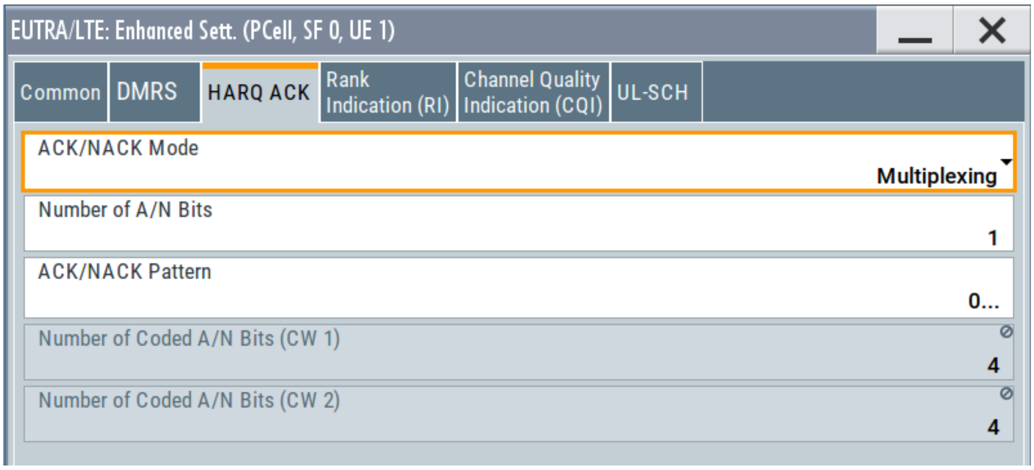
4.9.3 Channel coding / multiplexing

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > General > Select User Equipment > UE1... UE4"
3. Select "PUSCH > Channel Coding and Multiplexing > State > On" (refer to Channel Coding)
4. Select "Mode > UCI+UL-SCH" or "Mode > UCI only" (refer to Mode)
5. Select "Frame Configuration > Subframe > Content > PUSCH"
6. Select "Enhanced Settings > Configure > HARQ ACK"

   In this dialog, you can adjust the parameters for channel coding of the control information (HARQ and CQI) and configure the multiplexing of this control information with the data transmission over the UL-SCH.

HARQ ACK Settings



The following HARQ ACK settings are available:

ACK/NACK Mode ← HARQ ACK Settings
Sets the ACK/NACK mode to Multiplexing or Bundling according to TS 36.212, chapter 5.2.2.6.

ACK/NACK mode Bundling is defined for TDD duplexing mode only.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:MODE` on page 850

N_bundled ← HARQ ACK Settings
For "ACK/NACK Mode Bundling", sets the parameter N_bundled according to TS 36.212, section 5.2.2.6.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:NBUNdled` on page 850

Number of A/N Bits ← HARQ ACK Settings
Sets the number of ACK/NACK bits.

Set this parameter to 0 to deactivate the ACK/NACK transmission for the corresponding subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:BITS` on page 850

ACK/NACK Pattern ← HARQ ACK Settings
Sets the ACK/NACK bits in form of a 64 bits long pattern.

A "1" indicates an ACK, a "0" - a NACK.

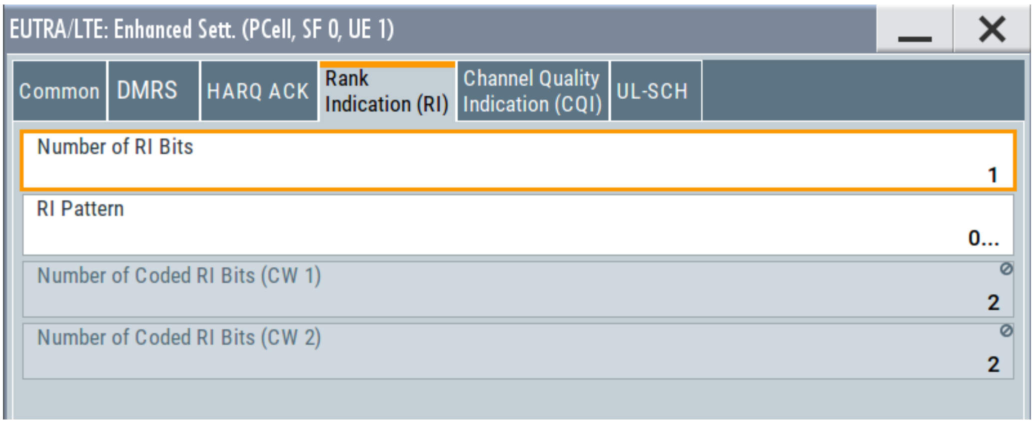
The pattern is read out cyclically and if the pattern is longer than the selected "Number of ACK/NACK Bits", different bits are transmitted in different subframes using this configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:PATTern on page 851

Number of Coded A/N Bits (CW) ← HARQ ACK Settings
Displays the number of coded ACK/NACK bits per codeword.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:HARQ:CBITs? on page 851

Rank Indication (RI) Settings



Following RI settings are available:

Number of RI Bits ← Rank Indication (RI) Settings
Sets the number of rank indication (RI) bits.

Set this parameter to 0 to deactivate the RI for the corresponding subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:BITS on page 854

RI Pattern ← Rank Indication (RI) Settings
Sets the RI bits in form of a 64 bits long pattern.

The pattern is read out cyclically and if the pattern is longer than the selected "Number of RI Bits", different bits are transmitted in different subframes using this configuration.

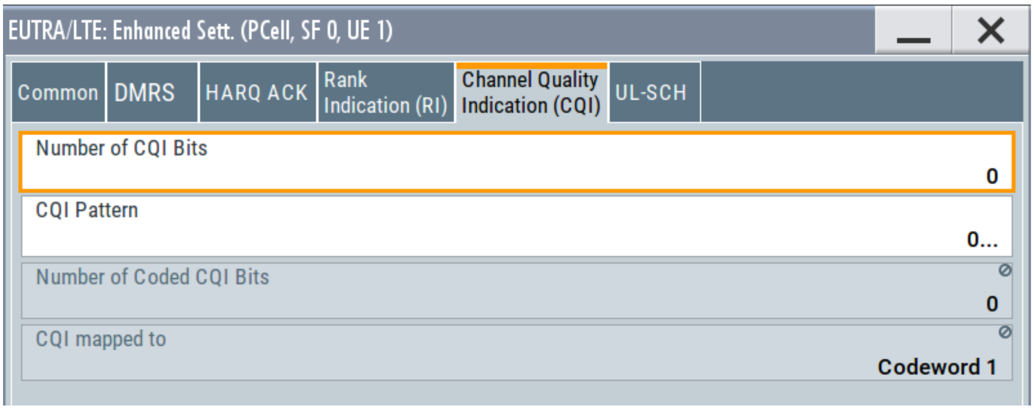
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:PATTern on page 854

Number of Coded RI Bits (CW) ← Rank Indication (RI) Settings
Displays the number of coded RI bits per codeword.

If a "Channel Coding Mode UCI + UL-SCH" is selected, the Number of Physical Bits for UL-SCH is determinate by the number of coded bits used for CQI and RI transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:RI:CBITs? on page 853

Channel Quality Indication (CQI) Settings



Following CQI settings are available:

Number of CQI Bits ← Channel Quality Indication (CQI) Settings
Sets the number of CQI bits before channel coding.

If a "Channel Coding Mode UCI + UL-SCH" is selected, the Number of Physical Bits for UL-SCH is determinate by the number of coded bits used for CQI and RI transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:BITS on page 852

CQI Pattern ← Channel Quality Indication (CQI) Settings
Sets the CQI pattern for the PUSCH.

The pattern is read out cyclically and if the pattern is longer than the selected "Number of CQI Bits", different bits are transmitted in different subframes using this configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:PATTern on page 852

Number of Coded CQI Bits ← Channel Quality Indication (CQI) Settings
Displays the number of coded CQI bits.

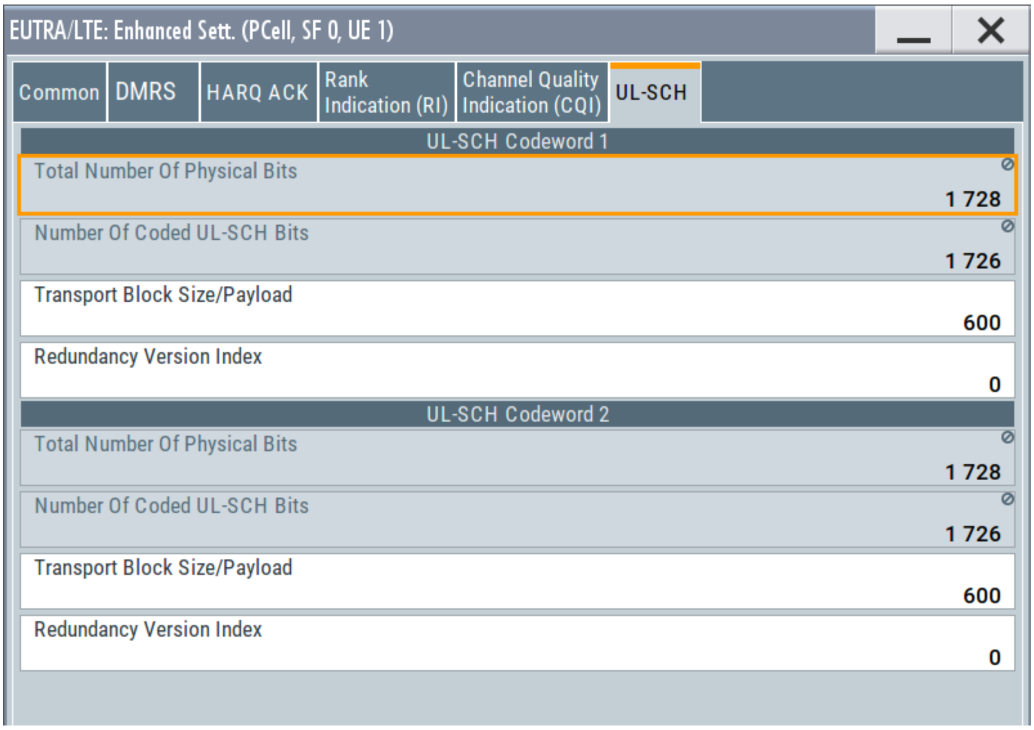
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CBITs? on page 852

CQI mapped to ← Channel Quality Indication (CQI) Settings
Indicates the codeword the CQI is mapped to.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CODWord? on page 853

UL-SCH Settings

Displays the UL-SCH parameters per codeword.



Phys. Bits / Total Number of Physical Bits ← UL-SCH Settings

Displays the size of the selected allocation in bits. The value is set automatically according to the current allocation's settings.

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PHYSbits? on page 839

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:PHYSbits? on page 839

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:PHYSbits? on page 839

Number of Coded UL-SCH Bits ← UL-SCH Settings

Displays the number of physical bits used for UL-SCH transmission.

If a "Channel Coding Mode UCI + UL-SCH" is selected, the value is calculated as follow:

"Number of Coded UL-SCH Bits" = Total Number of Physical Bits - Number of Coded CQI Bits - Number of Coded RI Bits (CW)

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:ULSCh:BITS? on page 854

Transport Block Size/Payload (PUSCH) ← UL-SCH Settings

Sets the size of the transport block per codeword.

In "Channel Coding Mode = UCI + UL-SCH", if "UL-SCH Codeword 1 > Transport Block Size = 0", "UL-SCH Codeword 2 > Transport Block Size" is set to 0, too.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:TBSize` on page 855

Redundancy Version Index (PUSCH) ← UL-SCH Settings
Sets the redundancy version index.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:RVINdex` on page 856

4.10 Enhanced PUCCH settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH".
3. Select "Enhanced Settings > Configure".

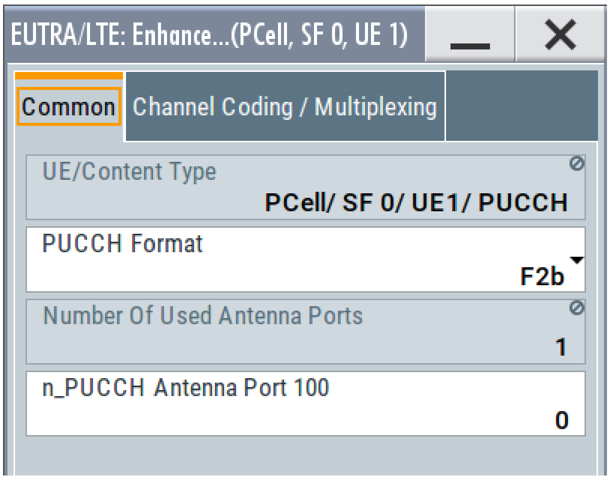
   This dialog displays the PUCCH relevant settings and allows you to define and configure the PUCCH resource index:
   - Chapter 4.10.1, "Common settings", on page 333
   - Chapter 4.10.2, "Channel coding / multiplexing", on page 335

4.10.1 Common settings

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH"

3. Select "Enhanced Settings > Configure > Common".



This dialog displays the PUCCH relevant settings and allows you to define and configure the PUCCH resource index.

Provided are the following settings:

UE/Content Type

Displays the UE number and the content type of the selected allocation.

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType
on page 837

PUCCH Format

Sets the PUCCH Format.

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:PUCCh]:FORMat
on page 837

Number of Used Antenna Ports

Option: R&S SMW-K85

Displays the number of antenna ports used for transmissions of the current PUCCH format, see Number of Antenna Ports for PUCCH per PUCCH Format.

Remote command:

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NAPused?
on page 856

n_PUCCH

Sets the PUCCH resource index.

3GPP Release	Parameter name	Description
Release 8/9	"n_PUCCH"	Sets the PUCCH resource index
LTE-Advanced	"n_PUCCH Antenna Port 100/200"	Sets the resource index for the first or the only one PUCCH antenna port
LTE-Advanced	"n_PUCCH Antenna Port 201"	Sets the resource index for the second PUCCH antenna port

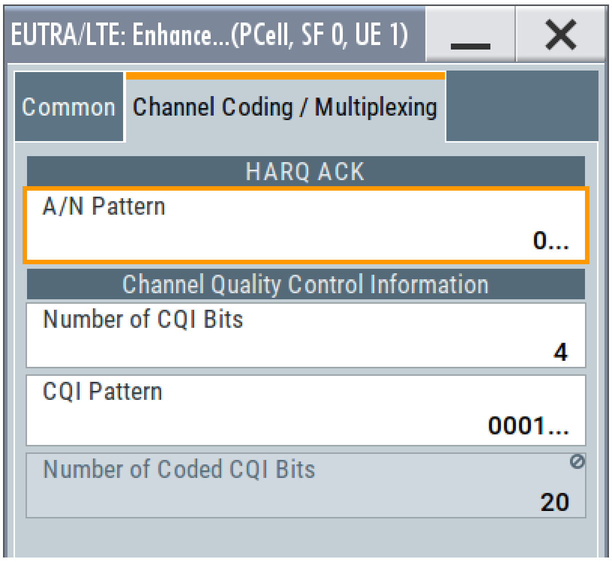
For configuration of multi-user PUCCH tests according to TS 36.141, annex A9, set the n_PUCCH parameter to the value defined in table A.9-1, column "RS orthogonal cover / ACK/NACK orthogonal cover". The R&S SMW calculates and configures automatically the values defined in the columns "Cyclic shift index" and "Orthogonal cover index".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NPAR<ap>`
on page 856

4.10.2 Channel coding / multiplexing

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH"
3. Select "Enhanced Settings > Configure > Channel Coding/Multiplexing"



This dialog and the parameters available for configuration depend on the selected PUCCH Format for the corresponding allocation.
PUCCH Format 1 carries no control information, i.e. the entire "Channel Coding/ Multiplexing" section is not displayed.

CQI control information is carried by PUCCH formats 2/2a/2b and the CQI parameters are enabled if one of these formats is selected.

Provided are the following settings:

A/N Pattern / A/N+SR+CSI Pattern

("A/N Pattern" required for PUCCH formats 1a/1b, 2a/2b; "A/N+SR+CSI Pattern" - all other PUCCH formats)

Use this parameter to set the ACK/NACK pattern for the PUCCH for the selected subframe. A "1" indicates an ACK, a "0" - a NACK

In PUCCH format 3, the bits given by the "ACK/NACK+SR Pattern" represent the $o^{\sim ACK}$ bits according to TS 36.212; these are the up to 22 bits that contain ACK/NACK information for up to two codewords and optionally SR and CSI. The number of bits used per subframe is defined by the value of the parameter "Number of A/N+SR+CSI Bits" on page 338.

To enable the generation of signals with ACK/NACK respectively ACK/NACK+SR information that varies not only per subframe but also differs over the frames, set a pattern with:

- More than 1 bit for the PUCCH formats 1a/2a
- More than 2 bits for the PUCCH formats 1b/2b
- More than "Number of A/N+SR+CSI Bits" on page 338 for PUCCH format 3

The ACK/NACK pattern has a maximal length of 32 bits and is read out cyclically.

Example:

"Duplexing Mode > FDD"

"Sequence Length = 4 Frames"

"Number of Configurable Subframes = 8"

"PUCCH Format = 1a or 2a"

"A/N Pattern = 01001"

The generated signal carries ACK/NACK information as shown on Figure 4-18.

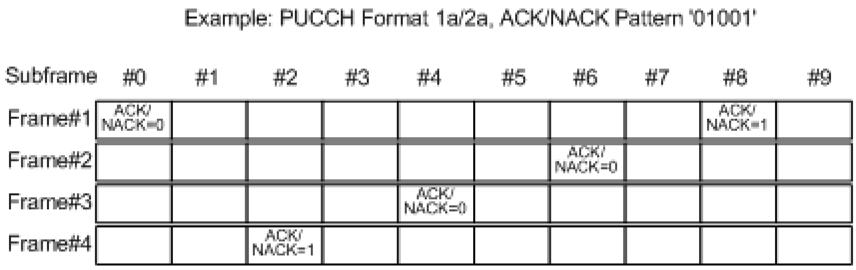


Figure 4-18: ACK/NACK information per subframe for PUCCH format 1b

By changing only the PUCCH Format to 1b or 2b, the ACK/NACK information per sub-frame changes, see Figure 4-19.

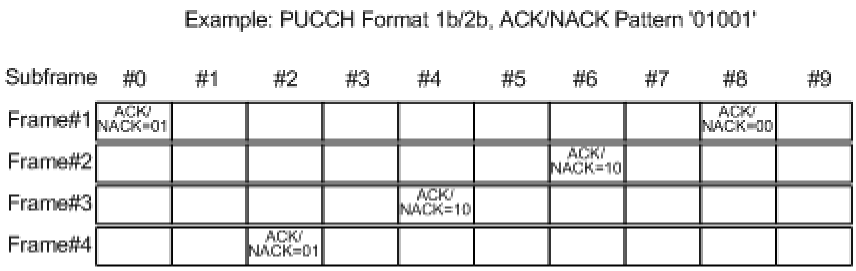


Figure 4-19: ACK/NACK information per subframe for PUCCH format 2b

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:PATTern on page 857

Number of CQI Bits
(PUCCH formats 2/2a/2b)

Sets the number of CQI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:BITS on page 858

PUCCH Format ≥ 3 Settings
The PUCCH format 3 is required for sending of the ACK/NACK messages in case DL carrier aggregation with more than two component carriers is used.

PUCCH formats 4/5 require R&S SMW-K119

See also:
- Chapter 2.2.5, "LTE Release 10 (LTE-Advanced) introduction", on page 46
- Chapter 4.2.2, "DL carrier aggregation configuration", on page 73.

Number of A/N+SR+CSI Bits ← PUCCH Format ≥ 3 Settings
Sets the number of ACK/NACK+SR+CSI bits before channel coding.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:BITS` on page 857

A/N+SR+CSI Pattern ← PUCCH Format ≥ 3 Settings
See "A/N Pattern / A/N+SR+CSI Pattern" on page 336.

Number of Coded A/N+SR+CSI Bits ← PUCCH Format ≥ 3 Settings
Displays the number of coded ACK/NACK+SR bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:CBITs?` on page 857

M_RB ← PUCCH Format ≥ 3 Settings
Option: R&S SMW-K119

Sets the PUCCH format 4 parameter M_RB, that defines the number of contiguous resource blocks used for the PUCCH transmission. All other PUCCH formats use one resource block.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:MRB` on page 859

n_oc ← PUCCH Format ≥ 3 Settings
Option: R&S SMW-K119

For PUCCH format 5, sets the sequence index n_{oc} used for the generation of the demodulation reference signal (DMRS).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NOC` on page 859

Number of Coded CQI Bits
Displays the number of coded CQI bits.

The number of coded CQI bits for PUCCH is always 20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:CBITs?` on page 858

CQI Pattern
Sets the CQI pattern for the PUCCH.

The length of the pattern is determinate by the value of the parameter Number of CQI Bits.

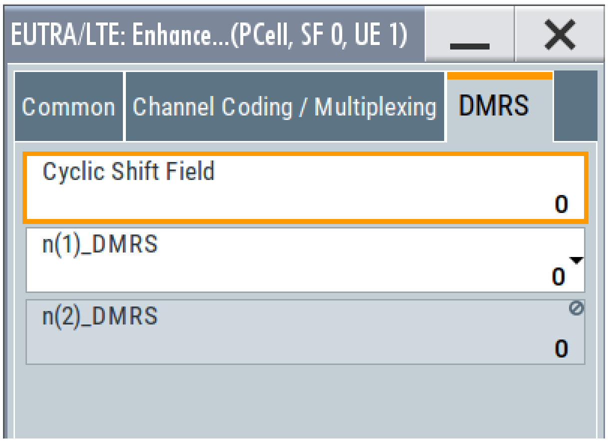
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:PATTern on page 858

4.10.3 Demodulation reference signal (DMRS)

Option: R&S SMW-K119

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Subframe > Content > PUCCH".
3. Select "Enhanced Settings > Configure".
4. Select PUCCH Format > Format 4/Format 5
5. Select "DMRS".



Cyclic Shift Field
Cyclic shifts are used to separate the DMRS signals of different users in the time domain. This parameter sets the cyclic shift field in the uplink-related DCI formats.

The cyclic shifts and the index $n^{(1)}_{DMRS}$ are interdependent, see Table 4-25.

Table 4-25: DMRS index n(1)_DMRS as function of the cyclic shifts

Cyclic Shift Field in DCI Formats	n(1)_DMRS
0	0
1	2
2	3
3	4
4	6
5	8

Cyclic Shift Field in DCI Formats	n(1)_DMRS
6	9
7	10

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CYCShift
on page 859

n(1)_DMRS
Sets the part of the demodulation reference signal (DMRS) index $n^{(1)}_{DMRS}$.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:DMR1
on page 860

n(2)_DMRS
Displays the part of the demodulation reference signal (DMRS) index $n^{(2)}_{DMRS}$, set according to Table 4-26.

Table 4-26: DMRS index n(2)_DMRS as function of the PUCCH format

PUCCH format	n_oc	n(2)_DMRS
Format 4	-	0
Format 5	0	0
	1	6

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:DMR2?
on page 860

5 Real-time feedback for closed loop BS tests

Some test scenarios, like for example the performance test cases specified in TS 36.141, require a feedback line. With R&S SMW equipped with the following options, you can perform closed loop performance tests with feedback.

Required options

Option:

- R&S SMW-K69
- R&S SMW-K55
  Or
  R&S SMW-K115
- Further options, like R&S SMW-K62 or R&S SMW-B14/-K71/-K72/-K73/-K74

Real-time feedback principle in the context of LTE/LTE-A testing

The real-time feedback allows the DUT to control dynamically the transmission of channel coded data packets. With the feedback sent from the DUT to the R&S SMW, **ACK/NACK signaling (HARQ feedback) and timing adjustment** is possible. This is similar to the feedback sent from a base station to a user equipment over the air interface (PDCCH/PHICH channels).

- ACK/NACK signaling (HARQ feedback)
  With the ACK/NACK commands, the DUT can control the channel coding configuration (i.e. the redundancy version) of the transmitted PUSCH packets in real time. The behavior of the R&S SMW is similar to the behavior of the HARQ entity / the HARQ processes of a real user equipment (TS 36.211).
- Timing adjustment
  By using timing adjustment/timing advance commands, the DUT can request time shifts of the uplink signal generated by the R&S SMW. It can thus cause a delay or advance of the uplink signal in real time (according to TS 36.213).

Real-time feedback principle in the context of eMTC/NB-IoT testing

The real-time feedback functionality in the eMTC/NB-IoT case is similar to the one for the LTE/LTE-A testing. Consider, however, the following differences:

- Redundancy version (RV) signaling
  In the eMTC/NB-IoT case, there are no HARQ messages transmitted over the feedback line. The DUT merely sends feedback signal carrying the **redundancy version (RV)** to be applied for the subsequent PUSCH bundle or NPUSCH F1 transmission.
  Within a PUSCH bundle, the redundancy versions are determined automatically, according to TS 36.213.
- Asynchronous HARQ
  Signaling only the RV is necessary, because the eMTC/NB-IoT relays on an **asynchronous HARQ**.
- Feedback timing

In eMTC/NB-IoT, the feedback timing reference point is derived from the uplink transmission.
If your test situation requires it, you can set an Additional User Delay and back shift feedback timing.
See Chapter 5.3.3, "Feedback timing for eMTC/NB-IoT tests", on page 353.

5.1 Exemplary testing scenario

The testing specifications in TS 36.141, chapter 8, specifies the test setups. For example, the test "Performance requirements for UL timing adjustment"" (TS 36.141, section 8.2.2) can be setup according to the Figure 5-1.

One single instrument is sufficient.

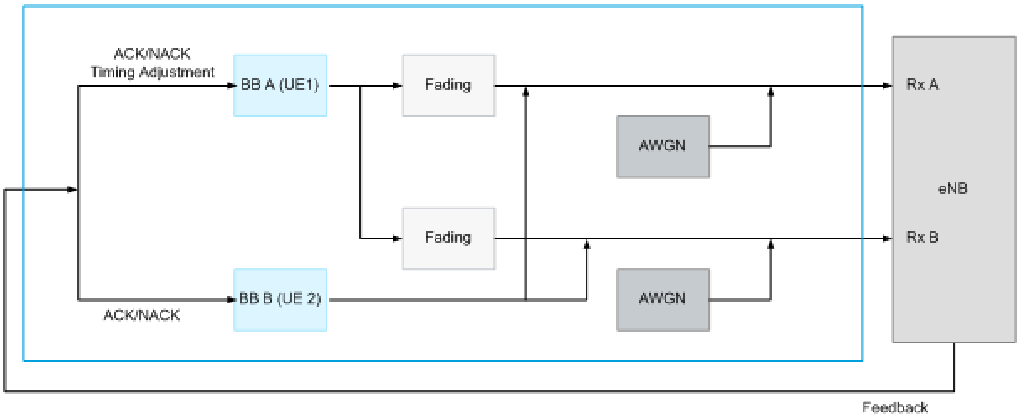


Figure 5-1: Exemplary test scenario

If your instrument is equipped with internal fading and AWGN generators, no more test equipment is required to perform the performance requirement tests. The simulation of the propagation conditions according to the specified test scenarios is achieved by selecting the required fading profiles and an additive white Gaussian noise.

For information on the available fading profiles and how to work with the fading simulator:

See user manual R&S®SMW-B14/-K71/-K72/-K73/-K74/-K75/-K820/-K821/-K822/-K823 Fading Simulation.

The feedback is transmitted from the DUT to the R&S SMW by the serial protocol (serial mode). The test setup requires a 10 MHz external reference line between the DUT and R&S SMW, and a common trigger source (downlink timing) for synchronization of the R&S SMW and the DUT.

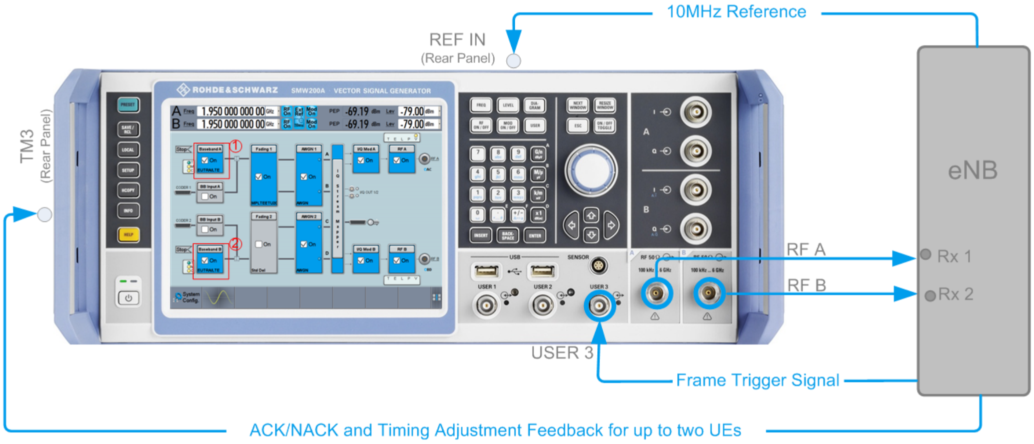


Figure 5-2: Setup with R&S SMW-B10

1 = Baseband A generates the signal of the moving UE
2 = Baseband B generates the signal of the stationary UE

5.2 Feedback modes

Some test setups, like for example the performance verification tests, require a feedback line from the DUT (base station) to the signal source.

Input connectors

The R&S SMW expects the feedback signal at one of the input connectors:

- Option: R&S SMW-B10
  – "T/M 3"
  – "T/M 6"
- Option: R&S SMW-B9
  – "T/M 2"
  – "T/M 4"

In LTE/LTE-A testing, feedback signals in both a binary and a serial mode are suitable for HARQ feedback tests. For testing of an UL timing adjustment, however, a connection over a serial feedback line has to be established.

How to route and enable feedback signal

The R&S SMW uses a flexible signal-to-connector mapping concept. In the default instrument state, the local "T/M x" connector is not configured as inputs of the feedback and the baseband feedback signal.

1. Select "Feedback > Connector" = "Local".
2. If R&S SMW-B10 is available, configure the connectors as follows:
   a) "Local Connectors > Connector > T/M 3 > Direction > Input".

   b) "Local Connectors > Connector > T/M 3 > Signal > Feedback".

3. If R&S SMW-B9 is available, configure the connectors as follows:
   a) "Local Connectors > Connector > T/M 2 > Direction > Input".
   b) "Local Connectors > Connector > T/M 2 > Signal > Feedback".
4. Connect the feedback line to the configured connector.

5.2.1 Binary mode

Binary mode is not supported for eMTC/NB-IoT testing, because the used 1-bit feedback command is not sufficient for signaling asynchronous HARQ.

A binary line carries the information in form of a high and low voltage level and is sufficient for the transmission of ACK and NACK commands. In the binary mode, the instrument detects the voltage level at the input connector and depending on the configuration (see parameter ACK Definition), the input level is interpreted as ACK or NACK.

5.2.2 Serial modes

The serial line uses a serial protocol that is similar but not identical to the RS232.

It carries information in form of serial commands that are transmitted as a sequence of 1-bit long symbols. Symbols are interpreted as 1, if the signal voltage level exceeds a certain threshold, or as 0, if the voltage level is below this threshold.

The input impedance of the input connectors for the feedback line and the low/high threshold voltage are configurable parameters. Use the Local and global connectors settings dialog and adjust the parameters "Threshold Clock/Trigger Input" and "Impedance Clock/Trigger Input" as required.

Symbol rate

The serial feedback commands can be transmitted with a symbol rate of 115.2 kbps, 1.6 Mbps or 1.92 Mbps.

See "Serial Rate" on page 361.

The R&S SMW starts the sampling process at middle of the start bit. It then samples the subsequent received bits according to the selected sampling rate. Deviations between the selected sampling rate and the actual sampling rate are tolerated, if the used sampling point for each of the bits is within the stable bit duration.

See also Chapter 5.3, "Timing aspects", on page 349.

Structure

Serial commands consist of *16 data bits (D0 to D15)*. These commands can be transmitted in **serial** or **serial 3x8** modes. Serial commands start with one low-level start bit and ends with one high-level stop bit. Between two consecutive commands (or packets) or before the first command, the line has to be held on high level (idle). Parity bit are not used. The least significant bit (LSB) is transmitted first.

Figure 5-3: Structure of a serial command (Serial mode)

Idle = Always high
SB = Start bit, always low
EB = Stop bit, always high
D0 to D15 = Data bits, LBS first; see Chapter 5.2.3, "Structure of a serial and 3x8 serial feedback command", on page 345
D0 = LSB (least significant bit)
D15 = MSB (most significant bit)

In the serial 3x8 mode, a command does not consist of one singular serial packet, but is distributed over *three serial packets*, see Figure 5-4.

Figure 5-4: Structure of one feedback command in Serial 3x8 mode

Idle = Always high
SB = Start bit, always low
EB = Stop bit, always high
L, H = Low/high bits, used for synchronization purposes
D0 to D15 = Data bits, LSB first; see Chapter 5.2.3, "Structure of a serial and 3x8 serial feedback command", on page 345
D0 = LSB (least significant bit)
D15 = MSB (most significant bit)

The structure illustrated on Figure 5-4 is mandatory. The 16 data bits (D0 to D15) are distributed among the three 8-bits long packets. The remaining serial bits must comply with the specified low or high levels for synchronization purposes.

5.2.3 Structure of a serial and 3x8 serial feedback command

Table 5-1 shows the structure and the meaning of the 16 data bits (D0 to D15) in a feedback command; the LSB is D0, the MSB - D15.

Table 5-1: Structure of one feedback command

D15 to D14	D13 to D11	D10 to D0
BB selector	Message type selector	Message bits

Meaning of the bits for UE1 > 3GPP Release = eMTC/NB-IoT

- The **BB selector** (D15 to D14) determines for which of the baseband blocks the feedback command is for.
  The R&S SMW can be equipped with up to two baseband blocks, where each baseband block can simulate one UE with closed loop feedback. The BB selector takes value in the range from 0 to 3 and can be arbitrarily assigned to each baseband block. Each baseband processes only the feedback commands that are labeled with its BB selector. To set the BB selector per baseband, use the parameter Baseband Selector.

You can send (i.e. multiplex) different feedback commands to different baseband blocks over the same shared feedback line. To provide the feedback signal to all related basebands, use a T-connector to split the feedback line form the DUT and feed the signals to the corresponding T/M connectors simultaneously.
Alternatively, several baseband blocks that use the same BB selector can share the feedback commands, even if these baseband blocks are in different instruments connected to the same feedback line.

- The **Message type selector** (D13 to D11) determines the message type and the command that is signaled.
  The message type selector is always **1**.
- **Message bits** (D10 to D0) have the following meaning:
  – D10 to D2: reserved
  – D1 to D0: Requested **starting redundancy version**, where the value range is as follows:
  "UE1 > 3GPP Release = eMTC": 0 to 3
  "UE1 > 3GPP Release = NB-IoT": 0 or 2

  The specified starting redundancy version corresponds to the parameter *rv_idx* defined in TS 36.213, not to the counter *rv*, as it is signaled in a DCI6-0A or DCI N0.
  For example, for eMTC transmission with enabled repetitions and message bits set to 0, the RV = 0 is used in the first repetition. RV = 2, 3, 1 are used for the subsequent repetitions, as defined in TS 36.213.

Meaning of the bits for UE1 > 3GPP Release = Release 8/9/LTE-Advanced

- The **BB selector** (D15-D14) determines for which of the baseband blocks the feedback command is for.
  The R&S SMW can be equipped with up to two baseband blocks, where each baseband block can simulate one UE with closed loop feedback. The BB selector takes value in the range from 0 to 3 and can be arbitrarily assigned to each baseband block. Each baseband processes only the feedback commands that are labeled with its BB selector. To set the BB selector per baseband, use the parameter Baseband Selector.
  You can send (i.e. multiplex) different feedback commands to different baseband blocks over the same shared feedback line. To provide the feedback signal to all related basebands, use a T-connector to split the feedback line form the DUT and feed the signals to the corresponding T/M connectors simultaneously.
  Alternatively, several baseband blocks that use the same BB selector can share the feedback commands, even if these baseband blocks are in different instruments connected to the same feedback line.
- The **Message type selector** (D13 to D11) determines the message type and the command that is signaled.
  See Table 5-2.

Table 5-2: Message types (UE1 > 3GPP Release = Release 8/9/LTE-Advanced)

Message type selector	Message type	Description
0	HARQ feedback auto	Carries only ACK/NACK feedback. The redundancy version (RV) to be used in the next PUSCH transmission of the affected HARQ process is determined automatically
1	HARQ feedback with RV request	Carries ACK/NACK feedback and a request for a specific redundancy version (RV). This RV is then applied in the next PUSCH transmission of the affected HARQ process. This command causes the instrument's HARQ process logic to "jump" to the first occurrence of the requested redundancy version in the configured RV sequence. (According to the HARQ process description in TS 36.321).
2	Timing advance command (absolute)	Requests an absolute timing advance of the uplink signal
3	Timing adjustment command (relative)	Requests a relative timing adjustment of the uplink signal
4	Combined HARQ feedback auto and relative timing adjustment command	Combination of both commands "HARQ feedback auto" and the "Timing adjustment (relative)". The instrument behaves exactly as if the HARQ feedback and the timing adjustment would be sent in two separate commands
5-7	reserved	-

- **Message bits** (D10 to D0)
  The table on Figure 5-5 gives an overview of the structure of the different commands and the information they carry.

<table>
<tr><th rowspan="2">Message Type</th><th colspan="11">Message Bits</th></tr>
<tr><th>D10</th><th>D9</th><th>D8</th><th>D7</th><th>D6</th><th>D5</th><th colspan="1">D4</th><th>D3</th><th>D2</th><th>D1</th><th>D0</th></tr>
<tr><td>HARQ Feedback Auto</td><td colspan="6" rowspan="2">reserved</td><td colspan="2" rowspan="2">For FDD mode: reserved
For TDD mode and UL/DL configurations 1..6: reserved
For TDD mode and UL/DL configuration 0:
– 1: adjust subframe "n+7"
– 2: adjust subframe "n+k"
– 0 or 3: adjust both subframes "n+k" and "n+7"</td><td rowspan="2">0: NACK
1: ACK</td><td colspan="2">reserved</td></tr>
<tr><td>HARQ Feedback with RV request</td><td colspan="2">Requested redundancy version (RV).
D1 is MSB, D0 is LSB</td></tr>
<tr><td>Timing Advance Command (Absolute)</td><td colspan="11">11-bit timing advance command T_A according to TS 36.213, chapter 4.2.3.
The D10 is MSB and D0 is the LSB.</td></tr>
<tr><td>Timing Adjustment Command (Relative)</td><td colspan="5">reserved</td><td colspan="6">6-bit timing adjustment command T_A according to TS 36.213, chapter 4.2.3.
– T_A = 31 means no adjustment
– T_A > 31 means an increasing advance of the uplink signal
– T_A < 31 means the advance of the uplink signal is decreased by delaying the signal
The D5 is MSB, the D0 is LSB.</td></tr>
<tr><td>Combined HARQ Feedback Auto and Relative Timing Adjustment Command</td><td colspan="6">6-bit timing adjustment command T_A according to TS 36.213, chapter 4.2.3.
– T_A = 31 means no adjustment
– T_A > 31 means an increasing advance of the uplink signal
– T_A < 31 means the advance of the uplink signal is decreased by delaying the signal
The D10 is MSB, the D5 is LSB.</td><td colspan="2">For FDD mode: reserved
For TDD mode and UL/DL configurations 1..6: reserved
For TDD mode and UL/DL configuration 0:
– 1: adjust subframe "n+7"
– 2: adjust subframe "n+k"
– 0 or 3: adjust both subframes "n+k" and "n+7"</td><td>0: NACK
1: ACK</td><td colspan="2">reserved</td></tr>
</table>

Figure 5-5: Message bits (UE1 > 3GPP Release = Release 8/9/LTE-Advanced)

Example:

The figure below depicts the example of a serial feedback command with the following settings:

- BB selector = 01
- Message type selector = 000, i.e. HARQ feedback auto
- ACK/NACK bit = 1, i.e. ACK is transmitted
- Message bits D3-D4 are reserved for FDD mode.

The least significant bit (LBS) is transmitted first.

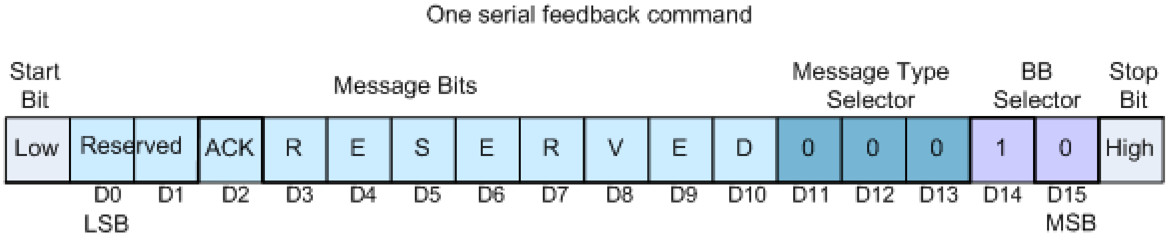


Figure 5-6: Example of a serial feedback command (HARQ feedback auto)

5.3 Timing aspects

The available number of messages per subframe in the downlink timing depends on the feedback line used. Over the serial or the serial 3x8 line, zero, one ore several feedback messages can be sent.

A binary feedback line, however, allows only one feedback message per subframe in downlink timing.

5.3.1 Parameterization of the feedback timing for LTE/LTE-A tests

The parameterization of the feedback timing depends on the "Feedback Mode" (binary, serial or serial 3x8) and the selected "Distance Mode" (3GPP or direct response).

5.3.1.1 Timing in the 3GPP distance mode case

Figure 5-7 illustrates the parameterization of the feedback timing. The example shows timing of feedback commands in comparison to the downlink signal of the air interface. The feedback command in this example carries the information that would be sent in a PDCCH/PHICH channel in downlink subframe n. It is a prerequisite that the base station and the instrument are synchronized, i.e. that they use common trigger source and a common 10 MHz reference frequency.

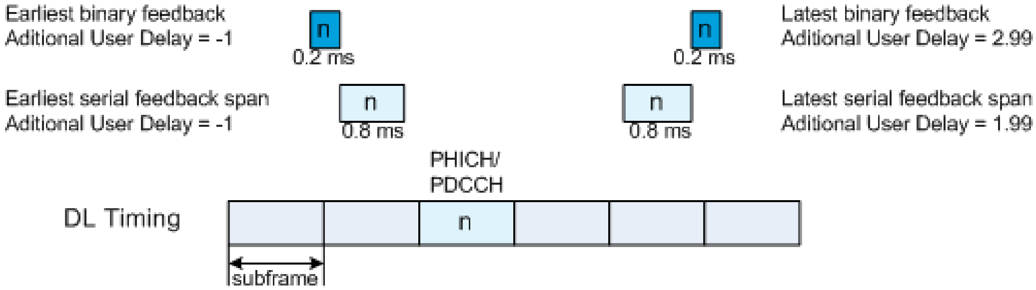


Figure 5-7: Parameterization of the feedback timing

To adjust the exact timing of the feedback commands, use the parameter Additional User Delay.

Consider the following differences in the value range and in the way the timing advance commands are interpreted in the different feedback modes:

- **Binary mode**
  - Meaning of "Additional User Delay = 0"
    Binary feedback is read at the moment that coincides with the beginning of the downlink subframe, in which the respective information would be sent in the PDCCH/PHICH channels over the air interface.
    It is required that the feedback level is constant from 0.1 ms before this point in time until 0.1 ms after this point in time.
  - Additional user delay value range: -1.00 to 2.99 subframes.
- **Serial** and **serial 3x8 mode**
  - Meaning of "Additional User Delay = 0"
    All serial feedback commands that contain information which would be sent in the PDCCH/PHICH channels in one specific subframe, have to be sent inside a reception time interval, defined as follows:
    Reception Interval duration: 0.8 ms
    Reception start: 0.1 ms after the beginning of this PDCCH/PHICH subframe (downlink timing)
    Reception end: 0.1 ms before the end of this PDCCH/PHICH subframe.
  - Additional user delay value range: -1.00 to 1.99 subframes.

5.3.1.2 Maximum number of serial feedback commands

The serial feedback commands and the individual serial packets of the serial 3x8 feedback command can be transmitted asynchronously inside the serial feedback span. Technically, the instrument is able to process a maximum number of 40 serial commands in one serial feedback span, independently from the baseband selectors. For Serial Rate = "115.2 kbps", the number of commands is further limited due to their length and the low bit rate. A maximum number of 5 commands fit into the 0.8 ms serial feedback span. Up to three commands consisting each of three serial packets can be transmitted within the 0.8 ms while using the serial 3x8 feedback.

5.3.1.3 Timing for binary mode with direct response distance mode

In **binary mode**, there is also another possibility for determining the uplink subframe, in which the signaled feedback has the desired effect. In this "Direct Response Distance Mode", the influenced uplink subframe is calculated from the position of the last sent uplink packet of a HARQ process (see the example on Figure 5-8).

If both initial timing advance and user delay are zero, the binary feedback to a specific uplink HARQ packet is expected at the beginning of this uplink subframe. Because this situation is not feasible and realistic, for the "Direct Response Distance Mode", the allowed range of the parameter "Additional User Delay" starts with +1.00 subframes.

The uplink subframe in which the signaled HARQ feedback has the desired effect is the next uplink subframe corresponding to the HARQ process the feedback was for.

Note that the feedback level has to be held constant from 0.1 ms before until 0.1 ms after the point in time when the instrument expects the binary feedback.

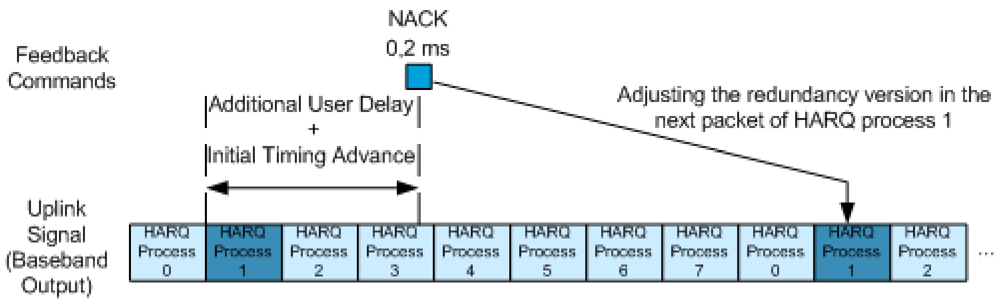


Figure 5-8: Timing of feedback commands in Direct Response Distance Mode (example for FDD).

5.3.2 Uplink timing for LTE/LTE-A tests

If binary mode with 3GPP distance mode used, the uplink subframe in which the signaled feedback has the desired effect is calculated from the downlink subframe number n. The calculation is according to:

- TS 36.213, section 4.2.3 (timing adjustment/timing advance commands) and
- TS 36.213, chapter 8 (HARQ feedback commands).

Figure 5-9 depicts the principle of the uplink timing. The example shows an FDD mode with 8 active HARQ processes.

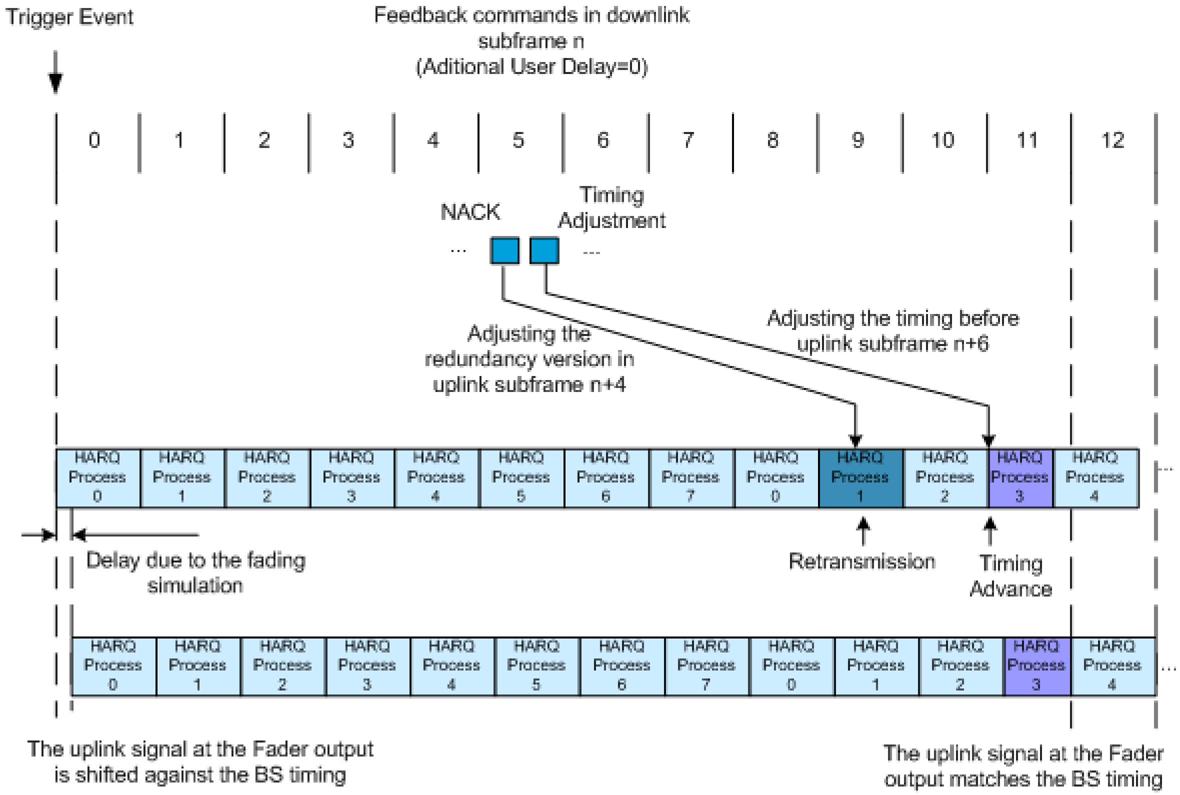


Figure 5-9: Timing of feedback commands for serial or serial 3x8 mode (example for FDD).

In FDD, due to invariant DL and UL subframe configuration and continuous DL and UL transmission, the retransmission of data occurs in a predefined time after the initial transmission. In TDD however, such a fixed relation is not possible and the time varies depending on the active UL/DL configuration.

- A **timing adjustment command** corresponding to downlink subframe **n** causes a timing adjustment of the uplink signal at the beginning of uplink subframe **n+6**.
- A HARQ feedback command corresponding to downlink subframe n causes an adjustment of the redundancy version in:
  - Uplink subframe **n+4**, if FDD is used without subframe bundling operation and if there is a PUSCH transmission scheduled in uplink subframe **n+4**.
  - Uplink subframe **n+k**, with **k** given in table 8.2 of TS 36.213
    Applies if TDD is used with UL/DL configurations 1 to 6 without subframe bundling operation and if there is a PUSCH transmission scheduled in uplink subframe **n+k**
  - Uplink subframe determined by the bits D4-D3 of the HARQ feedback command, "HARQ feedback auto" or "HARQ feedback with RV request" (see Table 5-2)
    Applies for TDD transmission with UL/DL configuration 0.
  - For binary HARQ feedback, both the subframes **n+k** and **n+7** are modified, if TDD transmission with UL/DL configuration 0 is used.

5.3.2.1 General timing rules

The first HARQ feedback recognized by the instrument after triggering is the feedback responding to the first uplink PUSCH transmission. Example: if a PUSCH is scheduled in uplink subframe#0 and FDD without subframe bundling is used, the first recognized HARQ feedback is the one affecting uplink subframe#8.

If no HARQ feedback command is received for a specific HARQ process in serial mode, the instrument behaves as if NACK was signaled in a command "HARQ feedback auto". If there is a conflict between several HARQ feedback commands (because they would affect the same uplink PUSCH transmission), only the last received HARQ feedback command is considered.

The first timing advance or timing adjustment command that is recognized by the instrument after triggering is the one causing a timing adjustment at the beginning of uplink subframe 8.

If no timing advance or timing adjustment command is received, then no timing adjustment is applied, (i.e. the timing advance in subframe n+6 is not modified). If there is a conflict between several timing advance or timing adjustment commands, only the last received timing advance is considered. Such a conflict can appear if the timing advance commands would affect the same uplink subframe.

If the serial or serial 3x8 mode is used, the serial line has to be held idle (high) during downlink subframe 0.

5.3.3 Feedback timing for eMTC/NB-IoT tests

Depending on the time a serial feedback command arrives at the instrument, it is associated with a specific PUSCH bundle or NPUSCH format 1 transmission. The received starting redundancy version is then applied for this PUSCH or NPUSCH F1 transmission, see Figure 5-10.

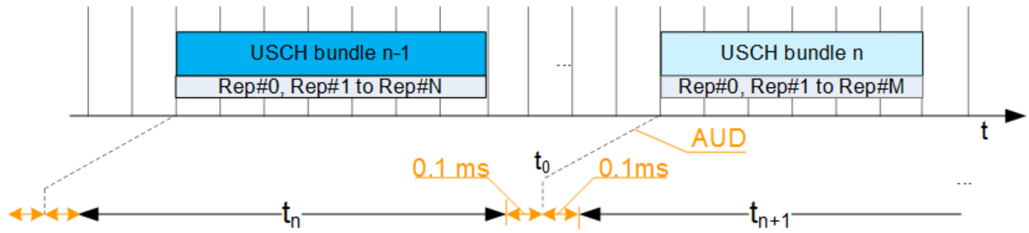


Figure 5-10: Feedback timing for PUSCH and NPUSCH F1 transmissions

t	= Uplink timing (subframes)
USCH bundle n-1 and n	= PUSCH/NPUSCH bundles, can be of different duration. Duration in time depends on the number of repetitions and on the availability of invalid subframes
t_0	= Subframe border
t_n, t_{n+1}	= Time periods during which an arrived serial command is applied to bundle n and n+1 respectively
AUD	= "Additional User Delay", negative values shift the feedback timing back in time
0.1 ms	= Fixed guard period before and after subframe border
	= No feedback command should arrive in the time period (t_0 - 0.1 ms) to (t_0 + AUD)

As shown on Figure 5-10, the UL feedback timing t_0 depends on the UL transmission. You can, however, use the parameter "Additional User Delay" to shift the feedback timing, if it is required in your particular test situation. The starting point of the time period corresponds to the moment t_0 + AUD.

The R&S SMW expects and uses one feedback command per PUSCH or NPUSCH F1 bundle. The following applies, if there is a deviation:

- If no feedback command is received, a starting RV = 0 is assumed.
- If more than one feedback commands are received for a bundle, the last one is evaluated and the starting RV signaled by its message bits is applied.

5.4 Avoiding synchronization problems

Transmitted uplink packets can be decoded only if both the R&S SMW and the DUT have to monitor the redundancy versions used in the HARQ processes. This monitoring is required so that the DUT has information on the redundancy version expect at a certain point in time (subframe).

Using the parameter Assume ACK until first received ACK command is required, in the following situations:

- If the instrument is triggered by a normal frame marker of the DUT
- If the DUT is already expecting uplink transmissions before the generator is triggered.

Examples

Consider the following examples:

- "Redundancy Version Sequence = 0, 2, 3, 1"
- "Maximum Number of Transmissions = 4"
- The example shows one HARQ process

The DUT already is expecting uplink transmissions before the generator is triggered. But as no uplink transmissions take place before the generator starts its signal output, the DUT is not able to decode packets. Therefore, the DUT expects retransmission with different redundancy versions. After triggering the generator by a frame marker, the following situation occurs, e.g. if the DUT expects RV 3 after the generator was triggered.

Example: Effect of "Assume ACK Until First Received ACK Command > Off"

The following table shows the situation after triggering the generator if the parameter "Assume ACK until first received ACK command" is disabled.

The generator schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 3.	The DUT sends a NACK to the generator.
The generator received NACK and schedules a retransmission with RV 2.	The DUT expects a retransmission with RV 1.	The DUT sends a NACK to the generator.

The generator received NACK and schedules a retransmission with RV 3.	The DUT reached the maximum number of transmissions and expects a new transmission with RV 0.	The DUT sends a NACK to the generator.
The generator received NACK and schedules a retransmission with RV 1.	The DUT expects a retransmission with RV 2.	The DUT sends a NACK to the generator.
The generator reached the maximum number of transmissions and schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 3.	The DUT sends a NACK to the generator.

The generator and the DUT would keep on being out of synchronization.

Example: Effect of "Assume ACK Until First Received ACK Command > On"

The situation described in the first example does not occur if the generator is triggered by the DUT at a point in time when the DUT expects new transmissions. However, if only a frame marker is available from the DUT, the "Assume ACK until first received ACK command" functionality can be enabled, and the above example changes.

The generator schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 3.	The DUT sends a NACK to the generator.
The generator ignores the NACK and schedules a new transmission with RV 0.	The DUT expects a retransmission with RV 1.	The DUT sends a NACK to the generator.
The generator ignores the NACK and schedules a new transmission with RV 0.	The DUT reached the maximum number of transmissions and expects a new transmission with RV 0.	The DUT sends an ACK to the generator.
The generator received ACK and schedules a new transmission with RV 0.	The DUT expects a new transmission with RV 0.	The DUT sends an ACK to the generator.
The generator received ACK and schedules a new transmission with RV 0.	The DUT expects a new transmission with RV 0.	The DUT sends an ACK to the generator.

Now the generator and the DUT are synchronized.

5.5 Limitation

Although an arbitrary data source can be selected, the used user data before the channel coding is the same in all subframes for all HARQ processes and for all transmissions.

Example:

Suppose that "Transport Block Size = 47520" and "Data Source = PN9" are used.

The first 47520 bits of the PN9 sequence are used as an input for all HARQ processes (even after an ACK), regardless of the performed transmission. However, since different redundancy versions are applied during the channel coding, the bit stream at the output of the channel coder is different for the different retransmissions.

5.6 Real-time feedback configuration settings

Option: R&S SMW-K69

See "Required options" on page 341.

Interdependencies

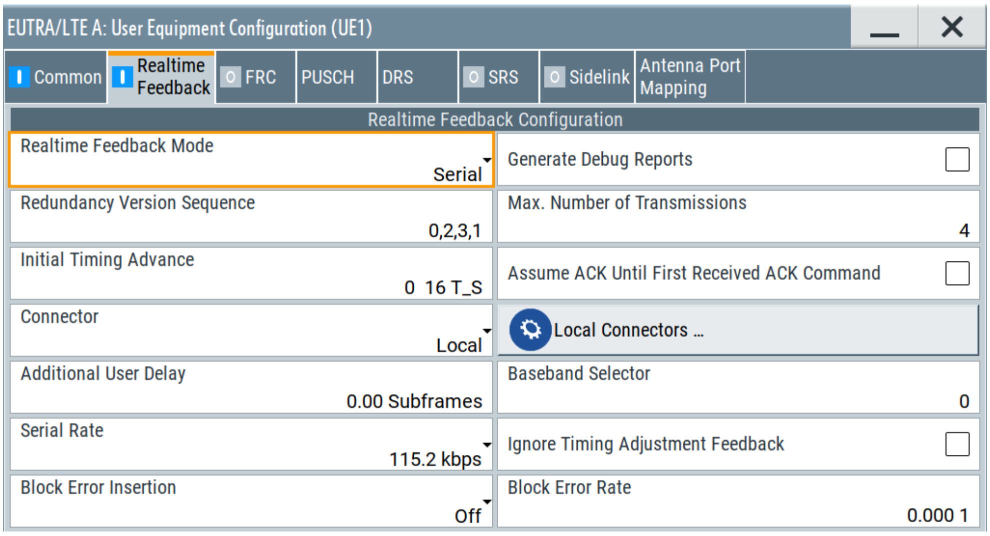
The real-time feedback configuration is enabled:

- Only for UE1
- In UL, if coupled mode is used and in 1xMxN configuration, where M > 2 (i.e. one entity and more than 2 Tx antennas)
- If the UL carrier aggregation is disabled

Access:

1. Select "System Configuration > Fading/Baseband Configuration > Mode > Standard"
2. Select "General > Link Direction > Uplink (SC-FDMA)"
3. Select "Frame Configuration > General > Select User Equipment" > **"UE1"**
4. Select "RT Feedback"

5. To enable the real-time feedback, set the "Realtime Feedback Mode" to a value different than "Off".



This dialog provides access to the parameters required for generating signals in accordance to the HARQ feedback or UL timing adjustments test cases. The provided parameters depend on the selected Realtime Feedback Mode.
You can enable realtime feedback once per baseband block.

For background information, see Chapter 5, "Real-time feedback for closed loop BS tests", on page 341.

The remote commands required to define these settings are described in Chapter 11.27, "Realtime feedback", on page 933.

Settings:

Realtime Feedback Mode
Enables real-time feedback and determines the mode of the feedback line.

"Off" Real-time feedback is disabled.

"Binary ACK/NACK"
Option: R&S SMW-K55/-K69
The ACK/NACK feedback is implemented as low/high voltage level on the feedback line connector.
Use the parameter ACK Definition to determine whether a high or a low voltage level represents an ACK.
Timing adjustments feedback is not supported in this mode.

"Serial/Serial 3x8"
The feedback is implemented by a serial protocol.
In "Serial 3x8" mode, a serial command consists of three serial packets.
See Chapter 5.2.2, "Serial modes", on page 344.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MODE` on page 938

Generate Debug Reports
Enables the R&S SMW to create and store debug reports, i.e. log files with detailed information on the real-time feedback.

The instrument generates two types of reports:
- Transmission report
  - This file contains information about what is *sent* (e.g. redundancy versions,) during the first 100 subframes after triggering and elapsing the Logging Offset.
  - File is created after the 100 subframes are sent.
  - Default filename and location
    `C:\EUtraRealtimeUplinkFeedback_TransmissionReport_BBA_BBSel0.txt`
    `/var/user/EUtraRealtimeUplinkFeedback_TransmissionReport_BBA_BBSel0.txt`
- Reception report
  - This file contains information about the first 100 *received* feedback commands, like serial value or binary value.
  - File is created after 100 commands are successfully received.
  - Default filename and location
    `C:\EUtraRealtimeUplinkFeedback_ReceptionReport_BBA_BBSel0.txt`
    `/var/user/EUtraRealtimeUplinkFeedback_ReceptionReport_BBA_BBSel0.txt`

Use these debug files for troubleshooting of complex real-time feedback tests.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:GENReports` on page 939

Redundancy Version Sequence
Option: R&S SMW-K55/-K69

Determines the sequence of redundancy versions for the individual HARQ processes.

Unless otherwise requested by serial feedback commands, the first value in the sequence of redundancy versions is used each time an ACK is received or for the first transmission of a process.

The sequence of redundancy versions is read out cyclically, i.e. whenever a NACK is received and a retransmission is requested, the next redundancy version in the sequence is used.

The first value in the sequence is used again even in case a NACK is received, if the Max. Number of Transmissions in a process was reached.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:RVSequence` on page 939

Max. Number of Transmissions
Option: R&S SMW-K55/-K69

After this maximum number of transmissions (incl. first transmission), the first redundancy version of the redundancy version sequence is used even if there is NACK.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MAXTrans` on page 938

Initial Timing Advance
Option: R&S SMW-K55/-K69

The initial timing advance of the uplink signal (at the output of the instrument's baseband unit) in units of 16 TS.

An initial timing advance greater than zero means that the beginning of the first subframe of the uplink signal is omitted.

For binary feedback, the timing advance of the uplink signal stays constant (and equal to the initial timing advance) throughout the whole signal output.

The additional timing offset $N_{TA\ offset}$ for TDD, as defined in TS 36.211, is set by the parameter Signal Advance N_TA_offset.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITADvance` on page 937

Assume ACK until first received ACK command
Option: R&S SMW-K55/-K69

("Serial/Serial 3x8" mode)

If this parameter is enabled, the signal generator does not use any external HARQ feedback from the device under test for its HARQ processes until an ACK command is received the first time. Until that, the generator behaves as if ACK was received for all transmissions - no matter if actually a NACK was received or if no HARQ feedback was received at all. It therefore does not schedule any retransmission until ACK is received the first time.

This function can be useful for synchronization purposes, see Chapter 5.4, "Avoiding synchronization problems", on page 354.

Note: This function applies independently for every HARQ process. If this parameter is enabled, an ACK has to be received in every HARQ process first, before the generator stops ignoring any NACKs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:AACK on page 934

ACK Definition
Option: R&S SMW-K55/-K69

For "Binary ACK/NACK" mode, determines whether a high or a low binary level on the feedback line connector represents an ACK.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ACKDefinition on page 935

Connector
Determines the feedback line connector, Chapter 5.2, "Feedback modes", on page 343.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:CONNector on page 937

Additional User Delay
Determines the point in time when the feedback can be sent to the instrument.

See also:
- Chapter 5.3, "Timing aspects", on page 349
- Chapter 5.3.3, "Feedback timing for eMTC/NB-IoT tests", on page 353

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ADUDelay on page 935

Distance Mode
Option: R&S SMW-K55/-K69

In "Binary ACK/NACK" mode, determines how the number of the uplink subframe is calculated, in which the signaled feedback has the desired effect.

See also Chapter 5.3.1, "Parameterization of the feedback timing for LTE/LTE-A tests", on page 349.

"3GPP" The uplink subframe in which the signaled feedback has the desired effect is calculated from the downlink subframe number n, in which the feedback was received, according to TS 36.213.

"Direct Response"
The uplink subframe in which the signaled feedback has the desired effect is calculated from the last sent uplink packet of the HARQ processes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:DMODe on page 937

Baseband Selector
In "Serial/Serial 3x8" mode, this parameter is required for multiplexing serial commands for different baseband units to one feedback line.

Configuring different baseband selectors for the different basebands enables you to send different feedback commands to two basebands even if they share a common feedback line (i.e. the same physical cable). A baseband receives only the feedback commands that contain the same baseband selector as configured in its dialog (with the parameter "Baseband Selector"). A baseband ignores all feedback commands with different baseband selectors.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BBSelector` on page 936

Serial Rate
("Serial/Serial 3x8" mode)

Determines the bit rate of the serial transmission. Possible rates are 115.2 kbps, 1.6 Mbps and 1.92 Mbps.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:SERate` on page 939

Ignore Timing Adjustment Feedback
Option: R&S SMW-K55/-K69

If enabled, the instrument ignores timing adjustment feedback and by missing feedback, no error message is indicated.

If disabled, the instrument indicates error for missing TA adjustment commands from the base station.

The setting is relevant for Realtime Feedback Mode = "Serial" or "Serial 3x8"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITAFeedback` on page 938

Block Error Insertion
Option: R&S SMW-K55/-K69

Enables/disables the statistical insertion of block errors into PUSCH packets.

The block error insertion can be enabled for a single HARQ process or for all processes. In the single HARQ process case, the used process is always the one that corresponds to the first activated PUSCH.

Do not use further impairments like the fading simulator or AWGN if you use the block error insertion. AWGN and fading can influence the measured block error rate and the measured value can deviate from the configured block error rate.

If block error insertion is enabled, the generator ignores any externally received HARQ ACK/NACK feedback. The following applies: It behaves in the following way:
- as if **ACK** was received for a HARQ process if **no block error was generated** for the previous transmission of that process
- as if **NACK** was received for a HARQ process if **a block error was generated** for the previous transmission of that process.

If a block error is generated in a new transmission, block errors are also generated in all retransmissions, until the maximum number of transmissions is reached. The reason for this is that otherwise the measured block error rate could deviate from the configured one if for example a non-erroneous retransmission cannot be decoded by the DUT if the first transmission (which was erroneous) was impaired too much.

If the block error insertion functionality is used together with the Assume ACK until first received ACK command functionality, no block errors are inserted before the first received ACK. This is done to speed up the synchronization process. This situation is also the exceptional case where an external HARQ feedback is needed if block error insertion is activated.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BEINsertion on page 936

Block Error Rate
Option: R&S SMW-K55/-K69

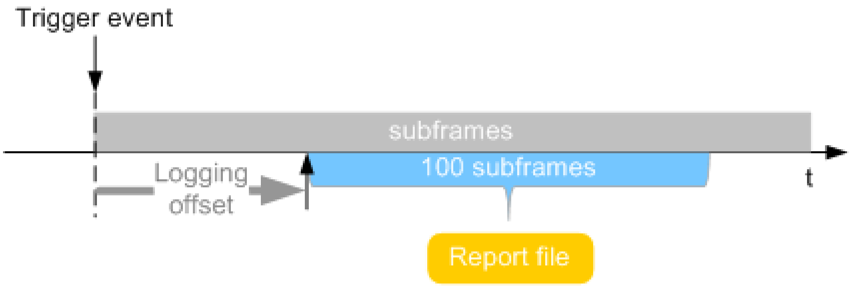
Block error rate for the statistical insertion of block errors.

The block error rate is defined as the ratio from the number of NACKs to the sum of the number of NACKs plus the number of ACKs.

As no external HARQ feedback is considered if Block Error Insertion is used, it is expected that the DUT does not send false ACK or NACK (ACK after erroneous and NACK after non-erroneous packet). Also it is expected that no further impairments like fading or AWGN are applied to the generated uplink signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BERate on page 936

Logging Offset
Per default, the generation of the debug report files starts with receiving a trigger event. To delay the start time and log other 100 subframes, enable a "Logging Offset".



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:RTFB:LOFFset on page 940

6 Generating eMTC/NB-IoT signals

eMTC/NB-IoT configuration requires R&S SMW-K115.

The introduction of mobile communications extended the variety and the requirements on the way machines communicate with each other. The machine communication is known as machine type communication (MTC), the machine to machine communication (M2M) or the Internet of things (IoT).

Related 3GPP specifications

Because LTE was primarily optimized for the mobile broadband market, the specifications had to be extended to cover possible MTC solution. The following specifications specify IoT related features:

- 3GPP **LTE Rel. 12 (MTC)**
  First MTC specification, based on the existing LTE standard. Introduces new type CAT0 devices
- 3GPP **LTE Rel. 13 (eMTC or LTE-M)**
  Further development of MTC to eMTC (enhanced MTC). Introduces new type CAT-M1 devices.
- 3GPP **LTE Rel. 13 (NB-IoT)**
  First dedicated IoT specification, regarded as new radio access technology. Introduces new type CAT-NB1 devices.
- 3GPP **LTE Rel. 14 (eMTC and NB-IoT)**
  Introduces eMTC widebands and new types CAT-M2 and CAT-NB2 devices.
- 3GPP **LTE Rel. 15 (NB-IoT)**
  Introduces NB-IoT TDD mode in UL, FDD NPRACH formats, early data transmission, NB-IoT wake up signal and scheduling request in uplink for NPUSCH F2.
- 3GPP **GERAN (EC-GSM)**
  Extension in the GSM standard

Overview of the main characteristics

	eMTC (LTE-M)	NB-IoT
Based on	existing LTE standard	new radio access technology
UE category	CAT0 CAT-M1 CAT-M2	CAT-NB1 CAT-NB2
Channel bandwidth	1.4 MHz	180 KHz
Number of RB	6	1
Coverage extension (CE)	CE mode A and CE mode B	CE level 0, CE level 1 and CE level 2

LTE features not supported by eMTC or NB-IoT

Consider the following differences between eMTC and LTE/LTE-A.

- eMTC does not support:
  - Spatial multiplexing
  - Simultaneous PUCCH/PUSCH
  - Higher-order modulation schemes
  - CSI feedback
  - Transmission modes 3, 4, 8 and 10
  - PUCCH format 3, 4 and 5
  - ACK/NACK bundling multiplexing in TDD
- eMTC supports:
  - 2 HARQ processes
  - Contiguous resource allocations for UL and DL
- Among other, NB-IoT does not support:
  - Carrier aggregation
  - Home eNB, closed subscriber group (CSG)
  - Relaying
  - Dual connectivity
  - MBMS/eMBMS

Scope of this description

This section gives a brief description of the LTE Rel. 13 and somer Rel. 14 features that are related to the eMTC and NB-IoT technology. The following section list the subset of features that are covered by the software option R&S SMW-K115/-K143:

- Chapter 6.1, "About eMTC", on page 364
- Chapter 6.2, "About NB-IoT", on page 381

For an insight description of the NB-IoT features, refer to:

- White Paper 1MA266 "Narrowband Internet of Things"
- Application Note 1MA296 "Narrowband Internet of Things Measurements"

6.1 About eMTC

Short summary

eMTC is an extension of the LTE standard.

eMTC main characteristics are:

- Channel bandwidth splitting into narrowbands
  Min channel bandwidth is a narrowband with 1.4 MHz or 6 RBs. 16 narrowbands can be allocated within the 20 MHz channel bandwidth.

- Four non-overlapping consequent narrowbands can be grouped into wideband with 5 MHz carrier bandwidth or 24 RBs
- Two coverage extension (CE) modes: CEModeA and CEModeB

Coverage extension modes

CE mode	CE level	Description	Optional/mandatory
CEModeA	0, 1	Supports small number of PUSCH or PUCCH repetitions	Mandatory in eMTC Rel. 13
CEModeB	2, 3	Enables large number of PUSCH or PUCCH repetitions	Optional in eMTC Rel. 13

Overview of the physical signals and channels

Because eMTC is an extension of the LTE standard, it reuses the LTE concept, including reference signals and channels. eMTC, however, does not support MIMO and MBFSN.

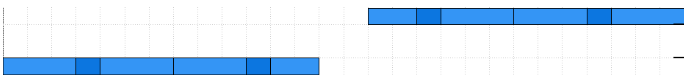
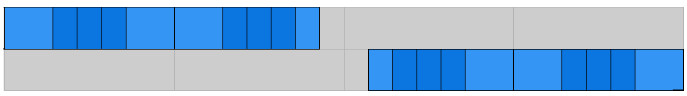
eMTC uses the following signals and channels:

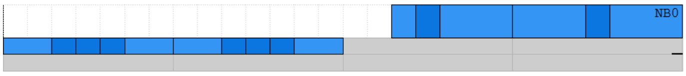
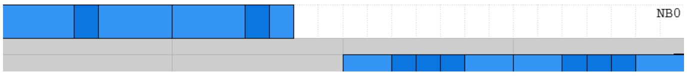
- UL reference signals: SRS, DMRS
- DL physical channels:
  PDSCH, PBCH, PDCCH, and the new MPDCCH (MTC physical downlink control channel)
- UL physical channels:
  PUSCH (modulation QPSK, 16QAM, 64QAM), PUCCH, PRACH
  See:
  - Chapter 6.1.5, "PUSCH", on page 375
  - Chapter 6.1.6, "PUCCH", on page 378
  - Chapter 6.1.7, "PRACH", on page 380

Guard period for narrowband and wideband retunning

According to TS 36.211, an eMTC transmission cannot switch the used narrowband/ wideband immediately but it needs time to **retune** to the new frequency. This retuning time is referred as guard time and is defined as number of unused symbols depending on the channel type and the link direction. In any of the combinations, two symbols are left unused, see the illustrations in Table 6-1.

Table 6-1: Symbols used as guard period for retuning

Link direction	Transition	Visualization on the "Time Plan"
UL	PUSCH-to-PUSCH	
	PUCCH-to-PUCCH	

Link direction	Transition	Visualization on the "Time Plan"
	PUCCH-to-PUSCH	
	PUSCH-to-PUCCH	

Related settings

- "Retuning Symbols" on page 244

6.1.1 Physical layer

Narrowbands

In eMTC, a narrowband is defined as a set of six non-overlapping consecutive physical resource blocks in the frequency domain. The number of narrowbands N_{NB} is calculated as follows:

$N_{NB} = N_{RB} / 6$, where N_{RB} is the number of the available resource blocks.

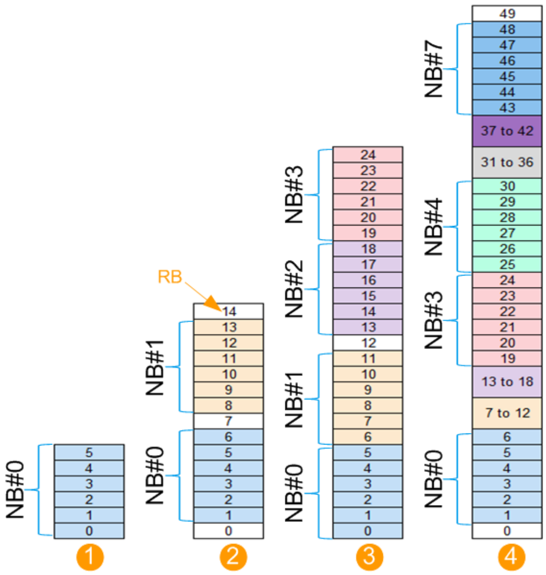


Figure 6-1: eMTC narrowbands

NB# = Narrowband number
RB = Resource block number
1 = "Channel Bandwidth = 1.4 MHz", $N_{RB} = 6$, $N_{NB} = 1$
2 = "Channel Bandwidth = 3 MHz", $N_{RB} = 15$, $N_{NB} = 2$
3 = "Channel Bandwidth = 5 MHz", $N_{RB} = 25$, $N_{NB} = 4$
4 = "Channel Bandwidth = 10 MHz", $N_{RB} = 50$, $N_{NB} = 8$
White RB = Not allocated RBs

eMTC transmission is always subframe-wise. That is, the smallest resource that can be allocated is 1 RB and one subframe.

Related settings

- Chapter 6.3.7.1, "eMTC DL valid subframes and frequency hopping", on page 463
- "Number of eMTC Narrowbands" on page 239
- "Valid Subframes" on page 244

Widebands

Four non-overlapping consequent narrowbands can be grouped into wideband with 5 MHz carrier bandwidth or 24 RBs. If the number of narrowband $N_{NB} \geq 4$, the number of widebands N_{WB} is calculated as follows:

$N_{WB} = N_{NB} / 4$, where N_{RB} is the number of the available resource blocks.

If the number of narrowband $N_{NB} < 4$, all available resource blocks are allocated to the same wideband.

Related settings

- "Wideband Config" on page 240
- "Number of eMTC Widebands" on page 240

6.1.2 PBCH

eMTC reuses the PBCH structure of LTE and is hence backward compatible. The PBCH in eMTC supports merely additional repetitions for enhanced frequency tracking. A further difference is the PBCH content (i.e. MIB), that is extended with a information regarding the scheduling of the SIB1-BR paging message.

If enabled, PBCH is repeated in subframe#0 and one additional subframe in all subframes in every 40ms cycle. The additional subframe is subframe#9 for FDD or subframe#5 for TDD.

PBCH repetition is not supported if the occupied bandwidth is 1.4 MHz.

Related settings

- Chapter 6.3.7.5, "PBCH channel coding and SIB-BR configuration", on page 484

6.1.3 PDSCH

A block of N_{acc} subframes is scrambled with the PDSCH scrambling sequence. The scrambling sequence is function of the $N_{Cell}ID$ and the $N_{PDSCH,abs}$.

Where:

- $N_{PDSCH,abs}$ is the number of consecutive subframes that the PDSCH transmission spans, including the invalid subframes.

- Invalid are subframes in that the PDSCH transmission is postponed.

According to TS 36.211, N_{acc} depends on the CE mode and the frame type as listed in Table 6-2.

Table 6-2: N_{acc} depending on the CE level and frame type

CE mode	CE level	Frame type 1	Frame type 2
CEModeA	0, 1	1	1
CEModeB	2, 3	4	10

For example on the $N_{PDSCH,abs}$ calculation, see Example"Calculation of $N_{PUSCH,abs}$" on page 376. $N_{PDSCH,abs}$ is calculated similar to $N_{PUSCH,abs}$.

PDSCH start subframe

The PDSCH transmission starts two valid subframes after the end of the last repetition of the scheduling MPDCCH, see Figure 6-4.

Repetition of PDSCH not carrying SIB1-BR

The PDSCH repetition is defined as combination of cell-specific higher-level parameters `pdsch-maxNumRepetitionCEmodeA`/`pdsch-maxNumRepetitionCEmodeB` and the UE-specific parameter PDSCH repetition number. The latter is part of the DCI formats 6-1A/B or 6-2.

TS 36.211 specifies the PDSCH repetition levels for all three DCI format. Table 6-3 show an example of the DCI format 6-1A case.

Table 6-3: PDSCH repetition levels, defined with DCI format 6-1A [TS 36.211]

Higher-level parameter **pdsch-maxNumRepetitionCEmodeA** **(cell-specific)**	**PDSCH Repetition Number n1 to n4** **(UE-specific)**
Not configured	1, 2, 4, 8
16	1, 4, 8, 16
32	1, 4, 16, 32

For information on the PDSCH repetitions, if PDSCH carries SIB1-BR, see "System information MIB" on page 370.

PDSCH hopping

PDSCH hopping is the process where the PDSCH changes the occupied narrowband on a per subframe basis. The occupied physical resource blocks (PRB) within the narrowband are maintained, merely changed is the narrowband.

Two hopping rules are defined depending on whether the PDSCH carries or not system information SIB1-BR:

- PDSCH **not carrying SIB1-BR**
  Information on the PRB within a narrowband on that the PDSCH is mapped in the first subframe is transmitted by the DCI.

The hopping pattern is defined as a function of the absolute subframe number i_0 and the cell-specific higher-layer parameters $N_{NB}^{ch,DL}$, $N_{NB,hop}^{ch,DL}$ and $f_{NB,hop}^{DL}$, where:

– $N_{NB}^{ch,DL}$ is the number of consecutive subframes during which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband
– $N_{NB,hop}^{ch,DL}$ is the number of narrowbands over which MPDCCH or PDSCH hops
– $f_{NB,hop}^{DL}$ is the hopping offset, i.e. number of narrowbands between two consecutive MPDCCH or PDSCH hops

See Example"PDSCH not carrying SIB1-BR hopping" on page 370.

- PDSCH **carrying SIB1-BR**
  PDSCH transmission is repeated periodically, every 8 radio frames. If n_f is the system frame number (SFN), a period starts at frames for that $n_f$mod8 = 0.

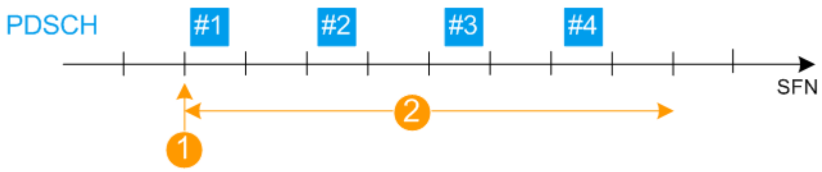


Figure 6-2: PDSCH carrying SIB1-BR transmission (Channel Bandwidth = 10 MHz)

SFN = System frame number
1 = PDSCH period starts at frames for that $n_f$mod8 = 0
2 = Period of 8 radio frames
PDSCH #1 to #4 = 4 PDSCH repetitions, configured with the parameter "eMTC > Bitmap > Schedulung Info SIB1-BR = 1", see Table 6-5.

Within each period, the PDSCH is repeated $N_{PDSCH}^{SIB1-BR}$ times, where the set of used frames and subframes n_{sf} depends on the channel bandwidth, the cell ID N_{ID}^{cell} and the frame structure type, see Table 6-4.

Table 6-4: Set of frames and subframes n_{sf} for SIB1-BR [TS 36.211]

Channel bandwidth	$N_{PDSCH}^{SIB1bis}$	N_{ID}^{cell} mod 2	Frame structure 1 n_f mod 2	Frame structure 1 n_{sf}	Frame structure 2 n_f mod 2	Frame structure 2 n_{sf}
$N_{RB}^{DL} \le 15$	4	0	0	4	1	5
	4	1	1	4	1	5
$N_{RB}^{DL} > 15$	4	0	0	4	1	5
	4	1	1	4	1	0
	8	0	0, 1	4	0, 1	5
	8	1	0, 1	9	0, 1	0
	16	0	0, 1	4, 9	0, 1	0, 5
	16	1	0, 1	0, 9	0, 1	0, 5

System information MIB

PDSCH carries the system information SIB1-BR (`SystemInformationBlockType1-BR`). The PDSCH allocation that carries the SIB1-BR block comprises of six contiguous localized RB within a narrowband and is repeated as defined with the parameter `schedulingInfoSIB1-BR-r13`.

See:
- Table 6-5
- Figure 6-2

Table 6-5: Number of repetitions for PDSCH carrying SIB1-BR [TS 36.213]

Value of `schedulingInfoSIB1-BR-r13`	Number of PDSCH repetitions
0	SIB1-BR is not scheduled
1, 4, 7, 10, 13, 16	4
2, 5, 8, 11, 14, 17	8
3, 6, 9, 12, 15, 18	16
19 to 31	Reserved

Example: PDSCH not carrying SIB1-BR hopping

Configure for example:
- "User 1 > 3GPP Release = eMTC CE: A"
- "Channel Bandwidth = 10 MHz" or "Number of Narrowbands = 8".
- "eMTC > Narrowband > Number of Narrowbands for Hopping $N_{NB,hop}^{ch,DL}$ = 4"
- "eMTC > Narrowband > Hopping Offset $f_{NB,hop}^{DL}$ = 2"
- "eMTC > Narrowband > Hopping Interval for CE Mode A $N_{NB}^{ch,DL}$ = 4"
- "eMTC > Bitmap > Bitmap Subframes = 10" and "SF#0 to SF#9 = On".
- "eMTC > Search Space > Max. Repetition of PDSCH for CE Mode A = 32"
- "eMTC > DCI Configuration > User 1 > DCI format 6-1A > Config > PDSCH Frequency Hopping > On", "Repetition Number = 2" and "Ressource Block Assigment = 32".
  Hence, the n3 value from Table 6-3 is used and "Repetitions of PDSCH = 16".
  In this configuration, the first used narrowband is NB#1.
- "eMTC > Allocations > PDSCH > Num. Abs. SF $N_{PDSCH,abs}$ = 16", i.e. one PDSCH transmission last 16 subframes
- "eMTC > Allocations > PDSCH > Start Subframe = 3"

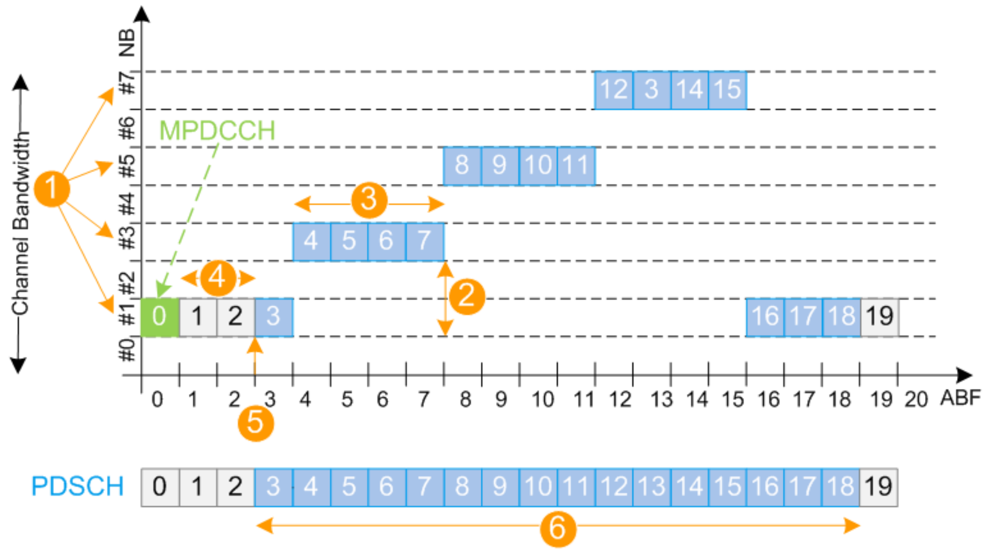


Figure 6-3: Example of PDSCH hopping

ABF = Absolute subframe number, counted from the first subframe in SFN = 0.
NB = Narrowband
#0 to #7 = Narrowband number, calculated automatically for the selected channel bandwidth
MPDCCH = One single repetition and "Start Subframe = 0"
NB#1 = "Start NB = 1", as set with the DCI field "Ressource Block Assigment".
1 = $N_{NB,hop}^{ch,DL} = 4$
2 = $f_{NB,hop}^{DL} = 2$
3 = $N_{NB}^{ch,DL} = 4$
4 = PDSCH always starts 2 subframes after the last repetition of the MPDCCH the shared channel is scheduled
5 = "PDSCH Start Subframe = 3" i.e. 2 subframes after the MPDCCH transmission
6 = $N_{PDSCH,abs} = 16$

Related settings

- "Narrowbands" on page 465
- "Max. Repetitions of PDSCH for CE Mode A/B" on page 468
- "DCI Format 6-1A/6-1B" on page 473
- Chapter 6.3.7.6, "PDSCH channel coding and scrambling", on page 487
- Chapter 6.3.7.4, "eMTC allocations (PBCH, MPDCCH, PDSCH)", on page 480

6.1.4 MPDCCH

The eMTC physical downlink shared channel MPDCCH in eMTC is similar to the LTE EPDCCH in terms of structure and purpose. In both cases, this control channel carries scheduling assignments. It is transmitted in an MPDCCH set, mapped to group of resource elements called ECCEs (enhanced control channel elements) and it can use localized or distributed transmission scheme. EPDCCH is user-specific but MPDCCH also includes common search spaces (Type1 and Type2).

Other than in LTE, in eMTC the MPDCCH set consists of 2, 4, or 6 physical resource block (PRB) pairs. There is also the additional MPDCCH format 5, see Table 6-6.

Table 6-6: MPDCCH formats and number of ECCEs for one MPDCCH N^{MPDCCH}_{ECCE} [TS 36.211]

MPDCCH format	Case A	Case B
0	2	1
1	4	2
2	8	4
3	16	8
4	32*	16*
5	24	12

*) MPDCCH format 4 is supported if distributed transmission is used.

The MPDCCH is transmitted over N_{rep}^{MPDCCH} consecutive valid downlink subframes and spans $N_{MPDCCH,abs}$ consecutive subframes, including the invalid subframes where the transmission is postponed.

MPDCCH hopping

If frequency hopping is enabled, the narrowband for the MPDCCH transmission (NB_{start}) in the first subframe is given by higher-layer; it can be different per MPDCCH set. The hopping pattern is defined as a function of the absolute subframe number i_0 and the cell-specific higher-layer parameters $N_{NB}^{ch,DL}$ (`interval-DLHoppingConfigCommon`), $N_{NB,hop}^{ch,DL}$ (`mpdcch-pdsch-HoppingNB-r13`) and $f_{NB,hop}^{DL}$ (`mpdcch-pdsch-HoppingOffset-r13`), where $N_{NB,hop}^{ch,DL}$ = 2 or 4 narrowbands.

See Example"PDSCH not carrying SIB1-BR hopping" on page 370.

Search spaces

eMTC UE monitors the following MPDCCH search spaces:

- Type 0 common search space, if configured with CE Mode A
- Type 1 common search space, used for paging
- Type 2 common search space, used for random access (RA)
- UE-specific search space

The search space defines the MPDCCH candidates that the UE has to monitor. The UE is expected to decode only the control information on an MPDCCH that is transmitted over ECCEs within the search space the UE monitors.

MPDCCH starting subframe

The MPDCCH starting subframe depends on the used search space and is calculated similar to the NPDCCH starting subframe, see "Calculating the NPDCCH starting subframe" on page 389.

MPDCCH repetition number

The number of times the MPDCCH is repeated N_{rep}^{MPDCCH} is defined as a function of the R_{max} value and the repetition level r1 to r4, where:

- R_{max} gives the maximum number of MPDCCH repetitions and is defiend per search space, see Table 6-8 and Table 6-9.
- Repetition level is set by the DCI field "Subframe Repetition Number" of the corresponding DCI format, see Table 6-7.

Table 6-7: Repetition level r1 to r4 as function of the DCI subframe repetition number field

R	r1	r2	r3	r4
"DCI Subframe Repetition Number"	0	1	2	3

Table 6-8: MPDCCH repetition number for Search Space = UE-specific or Type 0/Type 2 Common

R_{max}	r1	r2	r3	r4
1	1			
2	1	2		
4	1	2	4	
≥ 8	$R_{max}/8$	$R_{max}/4$	$R_{max}/2$	R_{max}

Table 6-9: MPDCCH repetition number for Search Space = Type 1 Common

R_{max}	r1	r2	r3	r4
1	1			
2	1	2		
4	1	2	4	
8	1	2	4	8
16	1	4	8	16
32	1	4	16	32
64	2	8	32	64
128	2	16	64	128
256	2	16	64	256

Example: MPDCCH repetitions (UE-specific search space)

Configure for example:

- "eMTC > Bitmap > Bitmap Subframes = 10" and "SF#0 to SF#9 = On".
- "eMTC > Search Space > Max. Repetition of MPDCCH Rmax (Type 2 Common) = 4".
- "User Configuration > User 1 > 3GPP Release = eMTC CE: A".
- "User Configuration > User 1 > MPDCCH Config:": "Max. Repetition of MPDCCH Rmax (User-Specific search space) = 4", "MPDCCH Hopping > On" and "Search Space Start Subframe = 1".
- "eMTC > DCI Configuration > User 1 > DCI format 6-1A > Search Space = UE-Specific" and "DCI format 6-1A > Config > DCI Subframe Repetition Number = 2". Hence the r3 value from Table 6-8 is used and "MPDCCH Repetitions = 4".
- "eMTC > Allocations > MPDCCH > Start Subframe = 1"

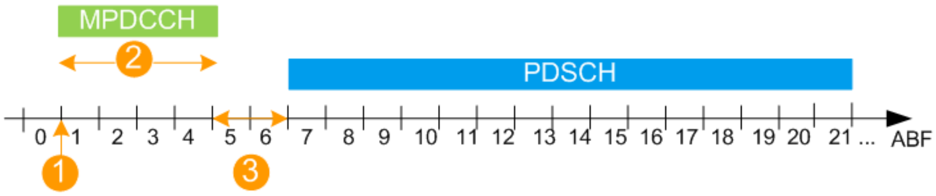


Figure 6-4: Example of MPDCCH repetitions and PDSCH cross-scheduling (UE-specific search space)

1 = MPDCCH start subframe
2 = MPDCCH Repetitions
3 = PDSCH always starts 2 subframes after the last repetition of the MPDCCH the shared channel is scheduled

DCI formats, decoding and content

Table 6-10 gives an overview of the defined DCI formats.

Table 6-10: DCI formats

DCI format	Purpose	CE Mode	"User x"/ P-RNTI/ RA-RNTI	Search space
3 3A	As in LTE Transmission of TPC Commands for MPUCCH and MPUSCH 2 bits and 1-bit power adjustment respectively	CE Mode A	"User x"	UE-specific Type 2 common
6-0A	Scheduling of PUSCH in one UL cell Resource allocation type 0	CE Mode A	"User x"	UE-specific Type 0 common
6-0B	Scheduling of PUSCH in one UL cell Resource allocation type 2, without TPC and CSI request	CE Mode B	"User x"	UE-specific
6-1A	Scheduling of one PUSCH codeword in one cell Random access procedure initiated by a PDSCH order Resource allocation type 2	CE Mode A	"User x" RA-RNTI	UE-specific Type 0 common Type 2 common

DCI format	Purpose	CE Mode	"User x"/ P-RNTI/ RA-RNTI	Search space
6-1B	Scheduling of one PUSCH codeword in one cell Random access procedure initiated by a PDSCH order Resource allocation with 1 bit	CE Mode B	"User x" RA-RNTI	UE-specific Type 2 common
6-2	Paging and direct indication	-	P-RNTI	Type 1 common

Table 6-11 gives the DCI formats **decoding** for MPDCCH and PDSCH.

Table 6-11: DCI decoding [TS 36.213]

MPDCCH and PDSCH configured with:	Transmission Mode	DCI format	Search space	PDSCH transmission scheme, corresponding to MPDCCH
P-RNTI	-	6-2	Type 1 common	• If number of PBCH antenna ports = 1, Single-antenna port, port 0 • Otherwise, Transmit diversity
RA-RNTI	-	6-1A 6-1B	Type 2 common	• If number of PBCH antenna ports = 1, Single-antenna port, port 0 • Otherwise, Transmit diversity
C-RNTI	Mode 1	• 6-1A • 6-1A or 6-1B	• Type 0 common • UE-specific	Single-antenna port, port 0
	Mode 2	• 6-1A • 6-1A or 6-1B	• Type 0 common • UE-specific	Transmit diversity
	Mode 6	6-1A	• Type 0 common • UE-specific	• Transmit diversity • Closed-loop spatial multiplexing, single layer transmission
	Mode 9	• 6-1A • 6-1A or 6-1B	• Type 0 common • UE-specific	• Single-antenna port, port 0 or transmitt diversity • Single-antenna port, port 7 or 8

Related settings

- Chapter 6.3.7.2, "Search space settings", on page 466
- Chapter 6.3.7.3, "eMTC DCI configuration", on page 468
- Chapter 6.3.7.4, "eMTC allocations (PBCH, MPDCCH, PDSCH)", on page 480

6.1.5 PUSCH

A block of N_{acc} subframes is scrambled with the PUSCH scrambling sequence. The scrambling sequence is function of the $N_{Cell}ID$ and the $N_{PUSCH,abs}$.

Where:

- $N_{PUSCH,abs}$ is the number of consecutive subframes that the PUSCH transmission spans, including the invalid subframes.

- Invalid are subframes in that the PUSCH transmission is postponed.

According to TS 36.211, N_{acc} depends on the CE mode and the frame type as listed in Table 6-12.

Table 6-12: N_{acc} depending on the CE level and frame type

CE mode	CE level	Frame type 1	Frame type 2
CEModeA	0, 1	1	1
CEModeB	2, 3	4	5

Example: Calculation of $N_{PUSCH,abs}$

If:

- ValidSF = 0, 2, 3, 4, 5
- $n_{invalidSF}$ = 1

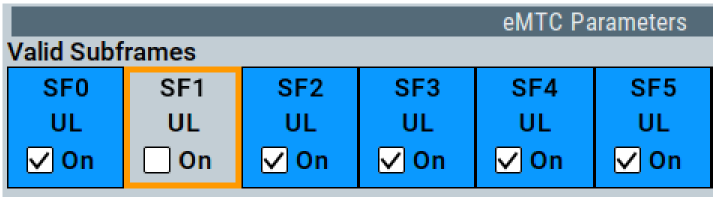


Figure 6-5: Valid subframes configuration ("General UL Settings > Cell > eMTC Parameters")

- StartSF = 0
- n_{Rep}^{PUSCH} = 4

Then $N_{PUSCH,abs}$ = 4 +1 = 5

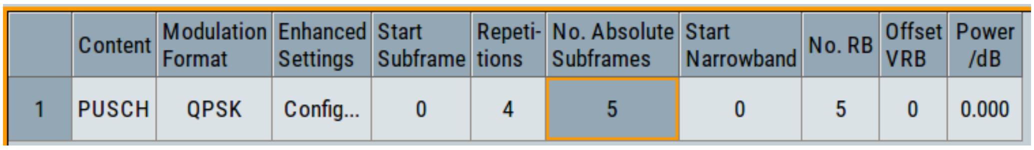


Figure 6-6: No. absolute subframes ("UL Frame Configuration > UE x > eMTC Allocation")

PUSCH frequency hopping

PUSCH can utilize frequency hopping.

- If hopping is disabled, the PUSCH repetitions are located in the same resource block at the same narrowband.
- If hopping is enabled, then PUSCH is transmitted in a given NB for a selected number of consecutive subframes ($N_{PUSCH,abs}$)

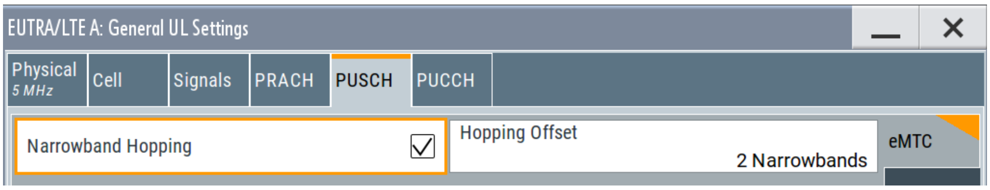
  The frequency-hopping pattern is calculated depending on the following:
  - Absolute subframe number (ASF) of the first UL subframe in that the PSUCH is scheduled
  - The cell-specific higher-level parameter $f_{NB,hop}$ that defines the hopping offset between the current and the subsequent narrowband

– The cell-specific higher-level parameter $N_{NB,ch}$ that set the number of subframes the hopping pattern remains in the same narrowband
– Number of absolute subframes $N_{PUSCH,abs}$

Example: PUSCH hopping

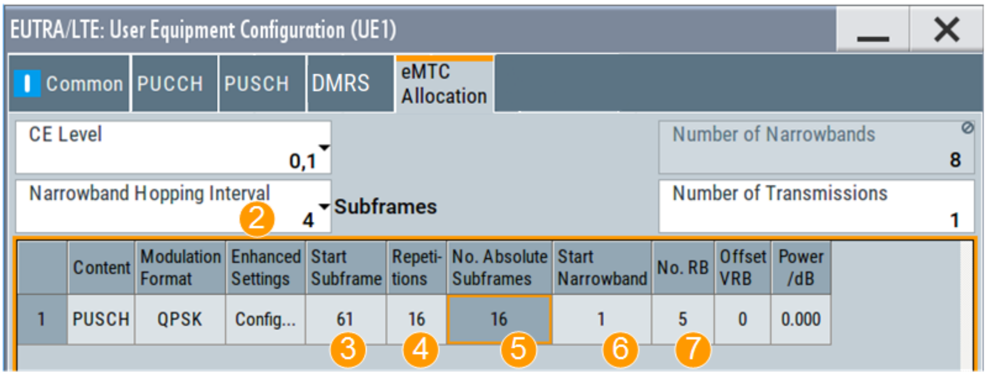
Configure, for example, the following settings:

- "ARB > Sequence Length = 10 Frames"
- In the "General UL Settings" dialog:
  – "Cell > eMTC Parameters > Valid Subframes > SF x UL > On" (all UL subframes)
  – "PUSCH Narrowband Hopping > On" and "Hopping Offset = 2" ($f_{NB,hop}$ = 2)



- "UL Frame Configuration > UE 1 > 3GPP Release > eMTC" and "UE 1 > State > On"
- In the "UE 1 > User Configuration > eMTC Allocation" dialog, configure one PUSCH transmission:
  – "Narrowband Hopping Interval = 4" ($N_{NB,ch}$ = 4)
  – "Start Subframe = 61" ("Frame = 60", "Subframe = 1"), "Repetitions = 16", "Start Narrowband = 1"

  The calculated number of absolute subframes is $N_{PUSCH,abs}$ = 16



2, 3, 4, 5, 6, 7 = The effect on the settings is illustrated on Figure 6-7

- In the "Time Plan", select "1st Subframe = 60" and "Subframes = 20".

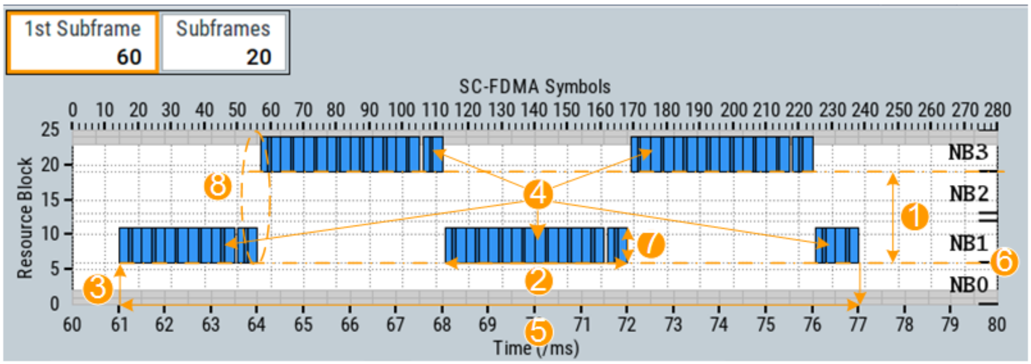


Figure 6-7: PUSCH hopping: understanding the displayed information

1 = $f_{NB,hop}$ = 2 (the offset between the start of two subsequent narrowbands is 2)
2 = $N_{NB,ch}$ = 4 (PUSCH remains in the same narrowband for four subframes)
3 = StartSF = 61 (start subframe number)
4 = n_{Rep}^{PUSCH} = 16 (PUSCH is repeated a total number of 16 times)
5 = $N_{PUSCH,abs}$ = 16 (number of absolute subframes)
6 = Start narrowband = NB1
7 = Number of RB per narrowband
6 = Guard period for retuning, see Figure 6-7

- To observe the unused slots at each narrowband hop at greater detail, select "1st Subframe = 61" and "Subframes = 7".

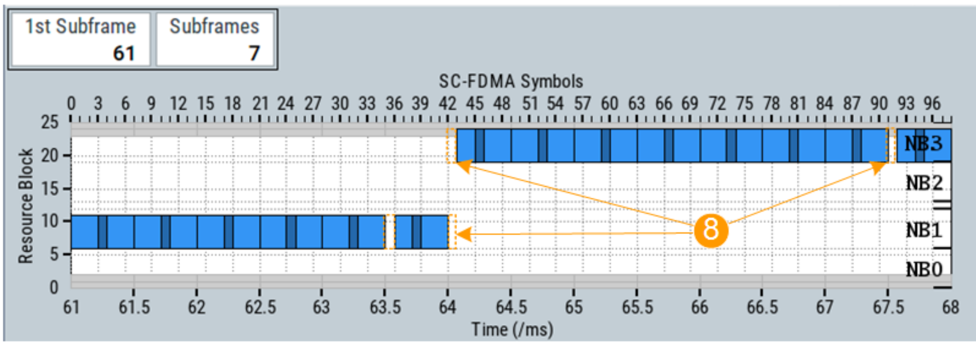


Figure 6-8: Narrowband hop with PUSCH-to-PUSCH transition

8 = The last and the first symbols are unused at each narrowband hop in a PUSCH-to-PUSCH transition (see also "Guard period for narrowband and wideband retunning" on page 365)

6.1.6 PUCCH

PUCCH can be transmitted once or repeated defined number of times. It is transmitted during defined number of consecutive subframes and is postponed during the invalid subframes.

PUCCH allocation in terms of resource blocks is calculated depending on the:

- Absolute subframe number (ASF) of the first UL subframe in that the PSUCH is scheduled
- The cell-specific higher-level parameter $N_{NB,ch}$ that set the number of subframes the hopping pattern remains in the same narrowband.

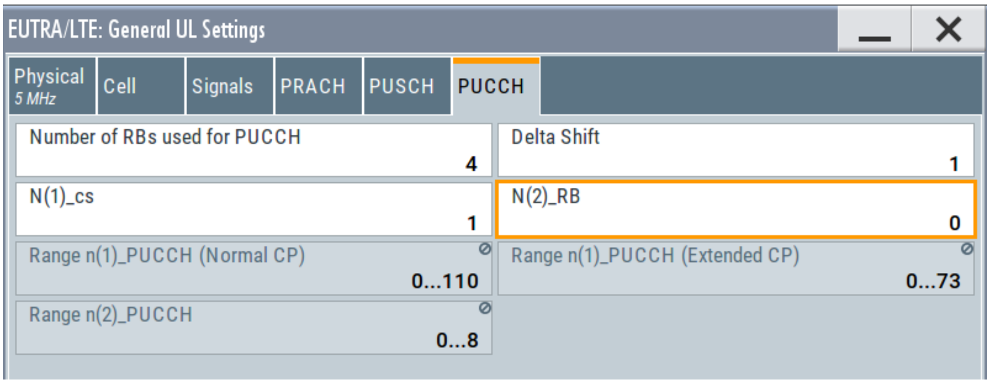
- Number of absolute subframes $N_{PUCCH,abs}$

For more information on the $N_{NB,ch}$, $N_{PUCCH,abs}$ and the term invalid subframes, see Chapter 6.1.5, "PUSCH", on page 375.

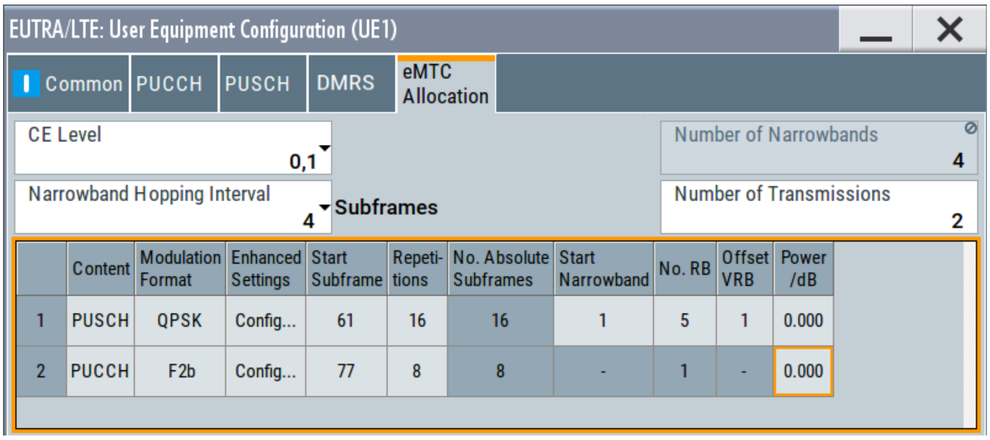
Example: PUCCH configuration

This example extends the configuration used in Example"PUSCH hopping" on page 377.

- In the "General UL Settings > PUCCH" dialog, select "Number of RBs used for PUCCH = 4" and "Delta Shift = 1".



- In the "UE 1 > User Configuration > eMTC Allocation" dialog, add one PUCCH transmission with "Repetitions = 8" ($n_{Rep}^{PUCCH} = 8$)
  The start subframe is set automatically.



- Observe the "Time Plan".

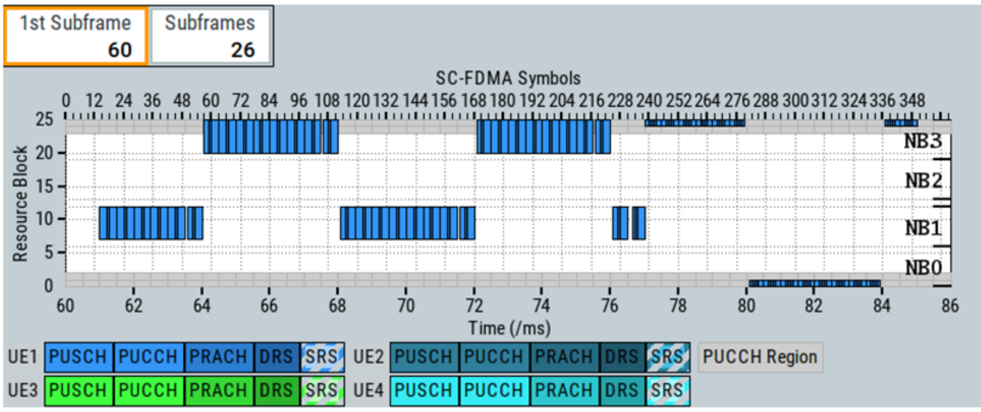


Figure 6-9: PUCCH hopping: understanding the displayed information

1 = "PUCCH Region = 4 RBs" (two RBs at each channel bandwidth end)
2 = $N_{NB,ch}$ = 4 (PUCCH remains in the same RB four subframes)
3 = StartSF = 77 (start subframe number)
4 = n_{Rep}^{PUCCH} = 8 (PUCCH is repeated eight times)
5 = $N_{PUCCH,abs}$ = 8 (number of absolute subframes)

6.1.7 PRACH

As in LTE, eMTC PRACH configuration comprises cell-specific and UE-specific parameters. Different than in LTE that defines one single PRACH configuration, in eMTC there are four eMTC PRACH configurations, one per CE level.

The following cell-specific parameters define the eMTC PRACH configurations:

- PRACH hopping offset $f_{PRB,hop}^{PRACH}$ (`prach-HoppingOffset`) in terms of RBs and common for all PRACH allocations
- One PRACH configuration per CE level, configured with:
  – PRACH configuration index (`prach_ConfigurationIndex`) that selects the predefined PRACH distribution pattern
  – PRACH frequency offset ($n_{PRBoffset}^{RA}$) (`prach_FrequencyOffset`) in terms of RBs that shift the PRACH allocation in the frequency domain
  The physical RBs used for the PRACH allocation ($n_{PRBoffset}^{RA}$) depend also on the system frame number (SFN). If frequency hopping is used for frame type 2, also on the UL/DL configuration.
  – PRACH frequency hopping (`prach_HoppingConfig`)
  – Number of PRACH repetitions per attempt (N_{rep}^{PRACH}) (`numRepetitionPerPreambleAttempt`)
  See Table 6-13
  – Optionally, PRACH starting subframe periodicity N_{start}^{PRACH} (`prach_StartingSubframe`)

Table 6-13: Number of PRACH repetitions per attempt depending on the PRACH format

PRACH configuration index		PRACH format	N_{rep}^{PRACH}
(Frame type 1)	(Frame type 2)		
0 to 15	0 to 19	0	≥ 1
16 to 31	20 to 29	1	≥ 1
32 to 47	30 to 39	2	≥ 1
48 to 63	40 to 47	3	≥ 1
-	48 to 57	4	1

A UE can start up to 40 preamble attempts, where each subsequent of them has to use a PRACH configuration that corresponds to a higher CE level. The frequency allocation of each preamble is retrieved from the cell-specific PRACH configuration of the selected CE level. UEs can merely postpone the preamble in time by defining the first subframe it appears. Preamble attempts do not overlap; any subsequent preamble attempt starts after the previous one is completed.

Each preamble occupies 6 consecutive resource blocks. Preambles are generated from Zadoff-Chu sequences.

6.2 About NB-IoT

Short summary

NB-IoT addresses the low-cost requirement of the IoT market. It does not support complex LTE features like carrier aggregation.

NB-IoT is new air interface with the following main characteristics:

- 180kHz carrier bandwidth (or 200 KHz channel bandwidth) in both uplink and downlink.
  This bandwidth corresponds to one resource block in LTE transmission
- Three different operating modes, see "Operating modes" on page 382
- Three kinds of coverage extension (CE) levels: CE level 0, CE level 1 and CE level 2
  Where the CE level 2 indicates the worst coverage situation
- UE that support NB-IoT are tagged with the category CAT-NB1
- NB-IoT is defined for FDD and half duplexing mode

Overview of the physical signals and channels

Defined are:

- DL narrowband primary and secondary synchronization signals (NPSS and NSSS)
  See Chapter 6.2.2, "NPSS and NSSS", on page 385.
- DL narrowband reference signals (NRS)

See Chapter 6.2.3, "NRS", on page 386

- DL physical channels:
  NPBSCH (narrowband physical broadcast channel), NPDSCH (narrowband physical downlink shared channel), NPDCCH (narrowband physical downlink control channel)

  See:
  - Chapter 6.2.4, "NPBCH", on page 387
  - Chapter 6.2.6, "NPDSCH", on page 392
  - Chapter 6.2.5, "NPDCCH", on page 388
- UL narrowband demodulation reference signals (NDRS)
  See Chapter 6.2.7, "NDRS", on page 394.
- UL physical channels:
  NPUSCH (narrowband physical uplink shared channel), NPRACH (narrowband physical uplink random access channel)

  See:
  - Chapter 6.2.8, "NPUSCH", on page 395
  - Chapter 6.2.9, "NPRACH", on page 398

6.2.1 Physical layer

NB-IoT reuses the LTE resource grid:

- The time domain structure of LTE is reused. There are 7 OFDM symbols within a slot, as it is in the normal CP case.
- Per OFDM DL symbol, there are 12 subcarriers spaced at 15 KHz and hence occupying 180 kHz bandwidth.
- In UL, the eNB decides which of the two allowed subcarrier spacings to apply (see Table 6-14)
  For the spacing of 3.75 KHz, for instance, there are 48 subcarriers available within a resource block of 180 kHz.
- One subcarrier in one OFDM symbol is referred as a resource element.

Table 6-14: Number of subcarriers in downlink N_{SC}^{DL} and uplink N_{SC}^{UL}

Subcarrier spacing	N_{SC}^{DL}	N_{SC}^{UL}	Slot duration, ms
Δf = 3.75 KHz	-	48	2
Δf = 15 KHz	12	12	0.5

In DL, NB-IoT supports transmission over up to two antenna ports (AP2000 and AP2001), where the same transmission scheme applies for all DL physical channels

Operating modes

Figure 6-10 illustrates the three different NB-IoT operating modes.

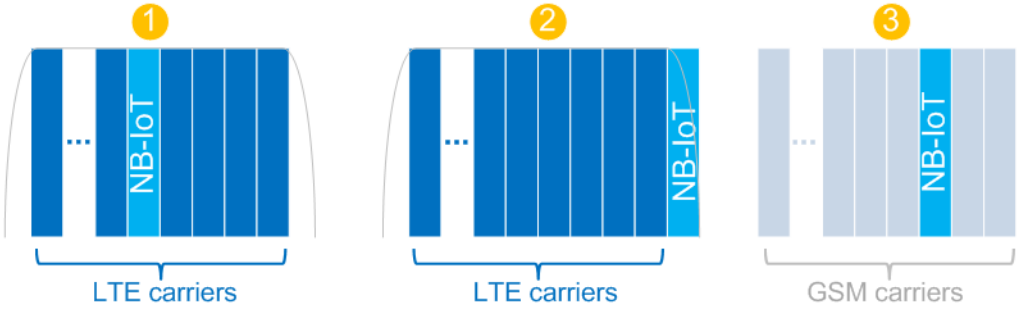


Figure 6-10: NB-IoT operating modes

1 = In-band operation by reusing free LTE resource blocks (supported in LTE bandwidths larger than 200 kHz)*
2 = Guard band operation by using the spectrum between neighboring LTE carriers (unused LTE guard band resource blocks)
3 = Standalone operation in free GSM spectrum
* = In-band operation in DL is not supported in the 1.4 MHz bandwidth

NCell ID N^{Ncell}_{ID}

NB-IoT maintains the concept of up to 504 physical cell IDs (PCI). It is refereed as NCell ID or N^{Ncell}_{ID}.

Regarding the PCI, the specification defines two modes:

- **In-band operation with same PCI (N^{NCell}_{ID} = PCI)**
  Where N^{NCell}_{ID} is the NB-IoT cell ID and PCI is the physical cell ID of the LTE cell.
  In this mode, NB-IoT and LTE share the same PCI and use the same number of CRS and NRS ports:
  There can be a maximum number of two CRS ports, because the number of narrowband reference signals $N_{NRS} \leq 2$.
  (see NRS)
- **In-band different PCI operation ($N^{NCell}_{ID} \neq$ PCI)**
  The LTE cell and the NB-IoT cell operate in the same band but have a different PCI.
  The number of CRS ports could be different than the N_{NRS}

Examples

Example: Configuring an NB-IoT allocation in standalone operating mode

Standalone NB-IoT operation is the default and the only one possible mode when the channel bandwidth is set to 200 kHz.

In DL:

- Select "General DL Settings > Physical > Channel Bandwidth = 200 kHz".
- Select "NB-IoT Carrier Allocation".
  The parameter "Mode = Standalone" confirms that in the selected channel bandwidth, only NB-IoT standalone operation in possible.

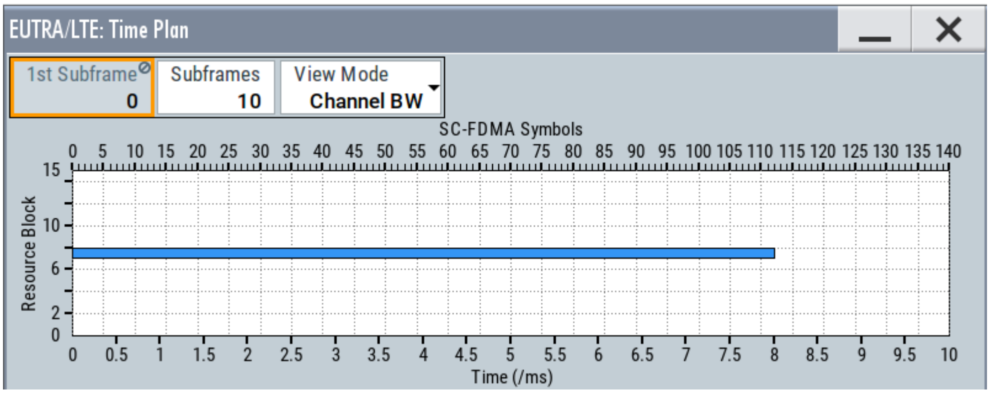
In UL:

- Select "General UL Settings > Physical > Channel Bandwidth = 200 kHz".
- Select "UL Frame Configuration > UEx > 3GPP Release = NB-IoT".
- Select "UEx > User Equipment Configuration > NB-IoT Allocation".
  The parameter "Mode = Standalone" confirms that in the selected channel bandwidth, only NB-IoT standalone operation is possible.

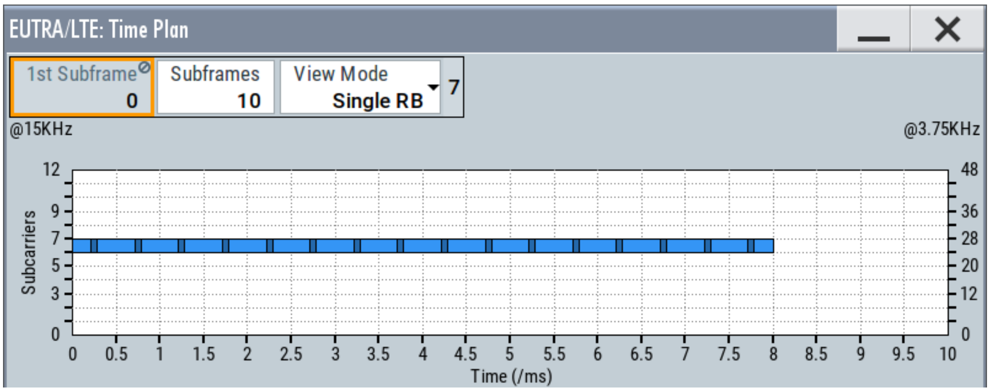
Example: Enabling an NB-IoT UL in-band operation

An NB-IoT in-band or guard-band operation requires channel bandwidth wider than 200 kHz, 1.4 MHz or wider for UL (and 3MHz or wider for DL). The following example shows you how to allocate the NB-IoT transmission around the DC carrier.

1. Select a channel bandwidth wider than 200 kHz and containing even number of resource blocks.
   For example "General UL Settings > Physical > Channel Bandwidth = 3 MHz".
   The 3 MHz channel bandwidth consists of 15 resource blocks.
2. Select "UL Frame Configuration > UEx > 3GPP Release = NB-IoT".
3. Select "UEx > User Equipment Configuration > NB-IoT Allocation".
4. Select "Mode = In-band".
5. Select "Resource Block Index = 7".
6. Observe the "Time Plan".
   Use the "View Mode > Channel BW".



7. To shift the default NPUSCH allocation within the resource block, select "NB-IoT Allocation > NPUSCH#1 > Subcarrier Indication = 6".
8. In the "Time Plan", set the "View Mode = Single RB".



Example: Enabling mixed LTE and NB-IoT configuration

Extend the configuration in Example"Enabling an NB-IoT UL in-band operation" on page 384 with the following:

- Select "General > LTE/IoT Standard > LTE/eMTC/NB-IoT".
- In the "UL Frame Configuration > General" dialog, enable second UE with "3GPP Release = LTE/LTE-A".
- In the "UL Frame Configuration > Subframe" dialog, enable at least the PUSCH allocation of the LTE UE.
- Set for example:
  – "PUCCH/PUSCH > State > On"
  – "PUSCH > Set 1 No. RB = 12" to allocate the entire channel bandwidth
- Observe the time plan in both view modes.

6.2.2 NPSS and NSSS

As in the LTE, the DL primary and secondary synchronization signals (NPSS and NSSS) are used for cell search, time and frequency synchronization, and obtaining the cell ID.

The carrier on which the UE detects the NPSS/NSSS/NPBCH/SIB-NB is referred as **anchor carrier**.

The NPSS and NSSS have the following transmission patterns:

- NPSS is transmitted in the sixth subframe (SF#5) of every frame.
  It spans 11 subcarriers and uses one fixed 11-bit log Zhadof-Chu sequence.
- NSSS is transmitted in the tenth subframe (SF#9) in the even-numbered frames, that fulfill the following condition:
  n_f mod 2 = 0, where n_f is the frame number.

NSSS spans 12 subcarriers and is generated form a 131-bit length Zhadof-Chu sequence, that is scrambled and cyclically shifted also with the NCell ID, see "NCell ID N^{Ncell}_{ID}" on page 383.

No other signals can be scheduled during the subframes NPSS or NSSS are transmitted.

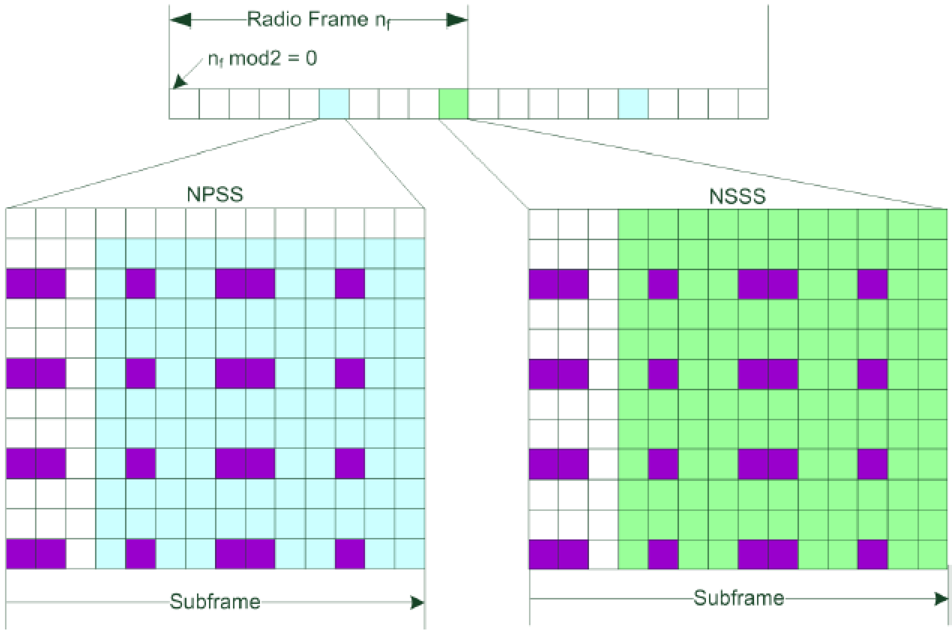


Figure 6-11: NPSS and NSSS allocation with 4 antenna port LTE CRS transmission [1MA266]*

Blue = NPSS
Green = NSSS
White = First three OFDM symbols are reserved for the LTE PDCCH and hence omitted by NB-IoT
Violet = LTE CRS; in in-band mode, all possible LTE CRS resource elements are omitted by NB-IoT
* = NRS is not transmitted in the NPSS and NSSS subframes

6.2.3 NRS

- NRS is transmitted in the last two OFDM symbols of each slot, if these slots are not used for NPSS or NSSS.
- Can be transmitted on one or two antenna ports (AP2000/AP2001), depending on the transmission scheme.
- NRS is mapped on a similar way as the RS in LTE, see Figure 6-12.
- NRS is cyclically shifted by the NCell ID

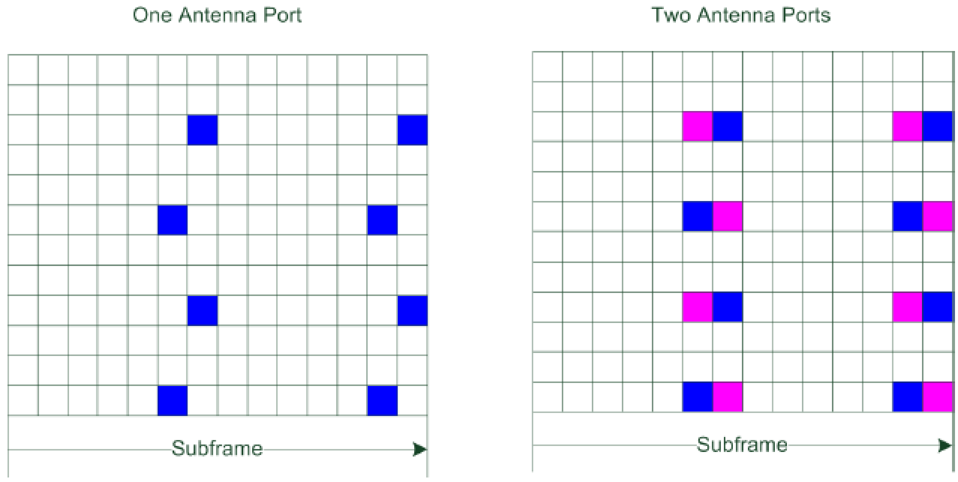


Figure 6-12: NRS mapping to the resource elements (one and two antenna ports) [1MA266]

With this structure, there is no overlap between the NRS and the LTE CRS.

The NRS position depends on the duplexing mode; in TDD mode, it depends on the special subframe configuration. Observe the timeplan for current allocation.

6.2.4 NPBCH

The narrowband physical broadcast channel (NPBCH) is QPSK modulated and carries narrowband master information block MIB-NB information.

MIB-NB

MIB-NB is scrambled with the N^{Ncell}_{ID}. It contains 34 bits and is transmitted over 64 frames. The MIB-NB is split into 8 blocks, where each block is transmitted on the first subframe (SF#0) in a frame and is repeated in the subsequent 7 frames.

MIB-NB carries important information and among other, it indicates the starting frame of SIB1-NB and repetitions, see "SIB1-NB" on page 393.

Figure 6-13 shows the subframe structure of the NPBCH.

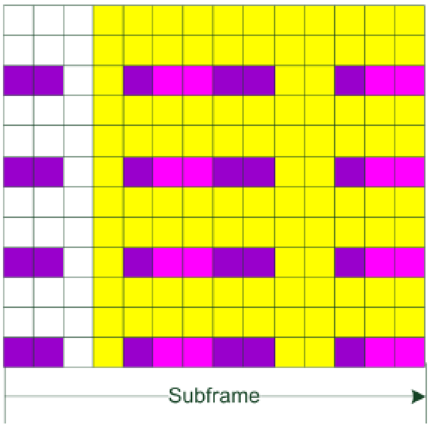


Figure 6-13: NPBCH mapping on the resource elements in SF#0 [1MA266]

Yellow = NPBCH resource elements = 100, excluding the LTE CRS and NRS symbols and the symbols in the PDCCH region
Violet = LTE CRS
Magenta = NRS
White = First three OFDM symbols are reserved for the LTE PDCCH

6.2.5 NPDCCH

The narrowband physical downlink control channel (NPDCCH) controls the data transfer between UE and eNB. It indicates the UE for that the NPDSCH carries data, the data allocation and the number of times it is repeated. NPDCCH is QPSK modulated.

NPDCCH is transmitted on an aggregation of one or two consecutive narrowband control channel elements (NCCE), distinguished by their NCCE index. Each NCCE is defined as a set of 6 subcarriers and occupies two slots. NPDCCH can occupy one or two NCCEs, where the first case is referred to as NPCCH format 0 and the later as NPDCCH format 1.

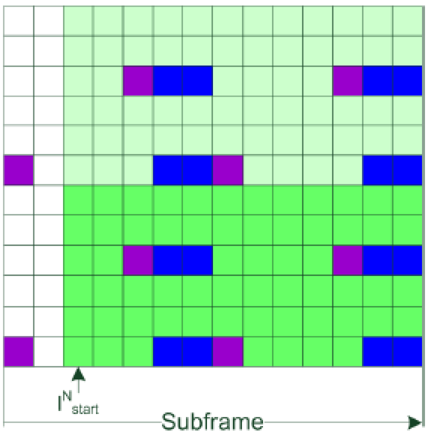


Figure 6-14: NPDCCH mapping [1MA266]

Green = NPDCCH resource elements (NCCE#0 and NCCE#1), excluding the LTE CRS and NRS symbols and the symbols in the PDCCH region
Violet = LTE CRS
Blue = NRS
White = OFDM symbols are reserved for the LTE PDCCH
$l_{NDPCCHStart}$ = Start Symbol

Search spaces

NPDCCH is grouped into three search spaces:

- Type 1 common search space, used for paging
- Type 2 common search space, used for random access
- UE-specific search space

The search space defines the NPDCCH candidates that the UE has to monitor. The UE can decode only the control information on an NPDCCH that is transmitted over NCCEs within the search space the UE monitors.

An NPDCCH search space is defined at aggregation level (L) and as a set of NPDCCH candidates. Each candidate is repeated R times over consecutive NB-IoT downlink subframes, where:

- SFs used for the transmission of system messages are omitted.
- The starting subframe is calculated to fulfill the conditions listed in "Calculating the NPDCCH starting subframe" on page 389.
- The aggregation level L = {0, 1} defines the number of NCCEs allocated for the NPDCCH (see also Figure 6-14)
- The repetition R is selected per search space type from:
  – Table 6-15 and
  – Table 6-16

Calculating the NPDCCH starting subframe

Possible values are calculated automatically to fulfill the:

- Validity of the subframes, see "Valid Subframes" on page 408
- Configured NB-IoT allocations, see Chapter 6.3.2, "NPBCH, NPDCCH and NPDSCH settings", on page 409
- NPDCCH condition, per search space type, as defined in :
  – Type 1 common
    Determined form locations of NB-IoT paging opportunity subframe
  – Type 2 common and UE-Specific
    $(10n_f + floor(n_s/2))modT = alpha_{offset}.T$
    $T = G.R_{max} \geq 4$

  Where:
  – n_f is the system frame number SFN
  – n_s is the slot number
  – G is search space start subframe
  – R_{Max} is max number of NPDCCH repetitions

– $alpha_{offset}$ is the search space offset

G, R_{Max} and $alpha_{offset}$ are search space-specific value, set with the following settings:

– UE-Specific, see "UE-Specific Search Space" on page 413
– Type 2 common, see "Common Search Space" on page 412

Table 6-15: Type 1 common search space NPDCCH candidates [TS 36.213]

R_{Max}	R								NCCE indices of monitored NPDCCH candidates L = 2
"Repetitions of DCI"	000	001	010	011	100	101	110	111	
1	1								{0,1}
2	1	2							{0, 1}
4	1	2	4						{0, 1}
8	1	2	4	8					{0, 1}
16	1	2	4	8	16				{0, 1}
32	1	2	4	8	16	32			{0, 1}
64	1	2	4	8	16	32	64		{0, 1}
128	1	2	4	8	16	32	64	128	{0, 1}
256	1	4	8	16	32	64	128	256	{0, 1}
512	1	4	16	32	64	128	256	512	{0, 1}
1024	1	8	32	64	128	256	512	1024	{0, 1}
2048	1	8	64	128	256	512	1024	2048	{0, 1}

Table 6-16: UE-specific and Type 2 common search space NPDCCH candidates

R_{Max}	R	"Repetitions of DCI"	NCCE indices of monitored NPDCCH candidates L = 2	UE-specific search space only NCCE indices of monitored NPDCCH candidates L = 1
1	1	00	{0,1}	{0}, {1}
2	1	00	{0, 1}	{0}, {1}
2	2	01	{0, 1}	-
4	1	00	{0, 1}	-
4	2	01	{0, 1}	-
4	4	10	{0, 1}	-
≥8	$R_{Max}/8$	00	{0, 1}	-
≥8	$R_{Max}/4$	01	{0, 1}	-
≥8	$R_{Max}/2$	10	{0, 1}	-
≥8	R_{Max}	11	{0, 1}	-

DCI formats, decoding and content

Table 6-17 gives an overview of the defined DCI formats.

Table 6-17: DCI formats

DCI format	Size, bits	Purpose	User / RNTI	Search space
N0	23	Scheduling of NPUSCH in one UL cell	User x (C-RNTI)	UE-specific Type 2 common
N1	23	Scheduling of one NPUSCH codeword in one cell Random access procedure initiated by an NPUSCH order	User x (C-RNTI) RA-RNTI	UE-specific Type 2 common
N2	15	Paging and direct indication	P-RNTI	Type 1 common

The DCI formats decoding is as follows:

- Scrambling with P-RNTI: DCI format N2
- Scrambling with RA-RNTI: DCI format N1
- Scrambling with C-RNTI: evaluated is the first bit called flag for format N0/format N1 differentiation:
  – First bit = 0: N0
  – First bit = 1: N1

Among other, the DCIs carry information on scheduling delay I_{Delay}, where scheduling delay is the time between the NPDCCH end and the NPDSCH or NPUSCH start.

When signaled over DCI format N0 and N1:

- $I_{Delay}^{NPDSCH} \geq 5$ SFs
- $I_{Delay}^{NPUSCH} \geq 8$ SFs

In DCI format N2, $I_{Delay}^{NPDSCH} = 5$ SFs

Example: NPDCCH candidates calculation

- Current frame $n_f = 16$ and subframe = 0 (16, 0)
- $R_{Max} = 4$
- $G = 4$
- $\alpha_{offset} = 1/8$
- $T = G{*}R_{Max} = 16$
- $(10n_f + \lfloor n_s/2 \rfloor) \mathrm{mod}\ T = \alpha_{offset}.T = 2$

The following starting subframes fullfill the condition:

- For R = 1: (16, 2), (16, 3), (16, 4) and (16, 6)
- For R = 2: (16, 2), (16, 4)
- For R = 4: (16, 2)

Example: NPDCCH scheduling based on DCI format N1

- "Search Space = UE-specific"
  - $R_{max} = 4$
  - $G = 1.5$
  - $\alpha_{offset} = 1/8$
- "Repetitions of DCI Subframes = 2" and therefore R = 4
- NPDCCH "Start Subframe = 2"
  (See also Example"NPDCCH candidates calculation" on page 391)

NPDCCH is transmitted in four subframes, where the first subframe is subframe 2.

Figure 6-15 shows this configuration as observed on the "Timeplan".

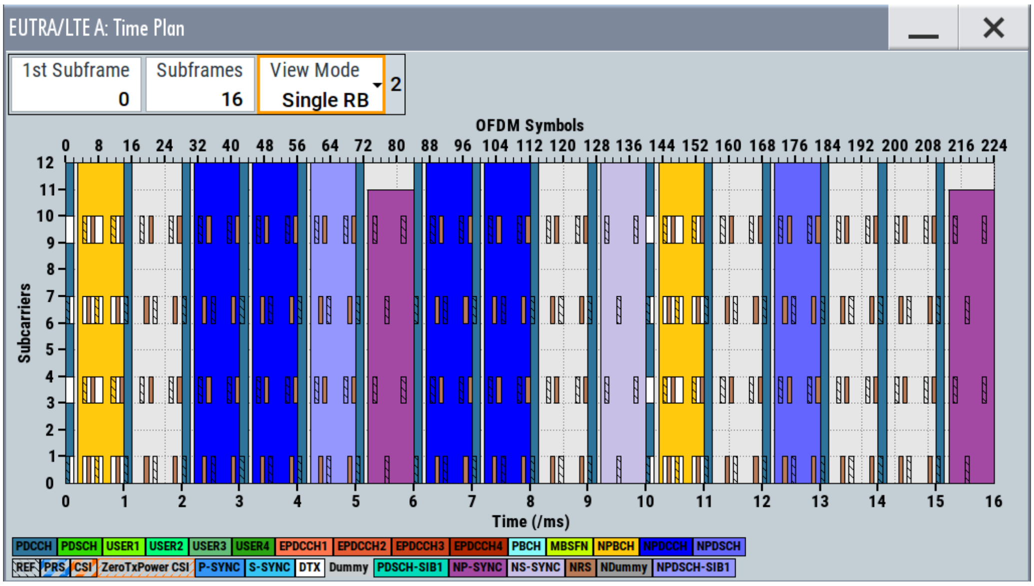


Figure 6-15: NPDCCH scheduling based on DCI format N1

NPDCCH is not allocated in subframe#4 because this subframe is reserved for the SIB1-NB transmission over NPDSCH.

For details, observe the NB-IoT allocation information in NB-IoT Allocation dialog.

6.2.6 NPDSCH

The narrowband physical downlink shared channel (NPDSCH) transmits signal information other than MIB. The channel is QPSK modulated, has the same structure as the NPDCCH (see Figure 6-14) and the same conditions apply for the $l_{NDPSCHStart}$.

NPDSCH is mapped to N_{SF}^{NPDSCH} number of subframes, where each mapped subframe is repeated N_{Rep}^{NPDSCH} times. One NPDSCH transmission lasts $N_{SF}^{NPDSCH}*N_{Rep}^{NPDSCH}$ subframes. NPDSCH transmission starts at least 5 subframes after the NPDCCH and can be additionally delayed by number of subframes k_0, where k_0 is referred as scheduling delay. The maximum transport block size TBS is 680 bits.

SIB1-NB

NPDSCH carries the system information SIB1-NB. The message is repeated 4, 8 or 16 times, has a period of 256 frames and predefined TBS of up to 680 bits. It is transmitted on subframe SF#4 of every second frame in a number of consecutive frames, depending on the selected repetition interval.

SIB1-NB can be modified at each modification period of 4096 frames, where the modification is indicated in DCI format N2.

NPDSCH scheduling

Scheduling and TBS depend on whether the NPDSCH carries SIB1-NB message or not:

- No SIB1-NB
  The N_{SF}, N_{Rep} and k_0 values are defined with the "Resource Assignment I_{SF}", "Repetition Number I_{Rep}" and "Scheduling Delay I_{Delay}" fields in the DCI format.
  See Table 6-26, Table 6-27 and Table 6-25 for the corresponding mapping.
- SIB1-NB
  - NPDSCH number of repetitions N_{Rep}^{NPDSCH} is set with the `schedulingInfoSIB1` parameter of MIB-NB.
  - The starting frame in that the SIB1-NB (i.e. NDPSCH) is transmitted is defined as function of the N_{Rep}^{NPDSCH} and the NCell ID N_{ID}^{Cell}.

Example: NPDSCH scheduling based on DCI format N1

This example extends the configuration described in Example"NPDCCH scheduling based on DCI format N1" on page 392.

- "Search Space = UE-specific" with R_{max} = 4
- DCI format N1 configuration:
  - I_{SF}^{NPDSCH} = 2 therefore N_{SF} = 3
  - I_{Rep}^{NPDSCH} = 2 therefore N_{Rep} = 4
  - I_{Delay} = 2 therefore k_0 = 8

NPDSCH is transmitted over $N_{SF}^{NPDSCH}*N_{Rep}^{NPDSCH}$ = 12 consecutive subframes, where the first NPDSCH subframe is 5 + 8 = 13 subframes after the NPDCCH transmission.

Figure 6-16 shows this configuration as observed on the "Timeplan".

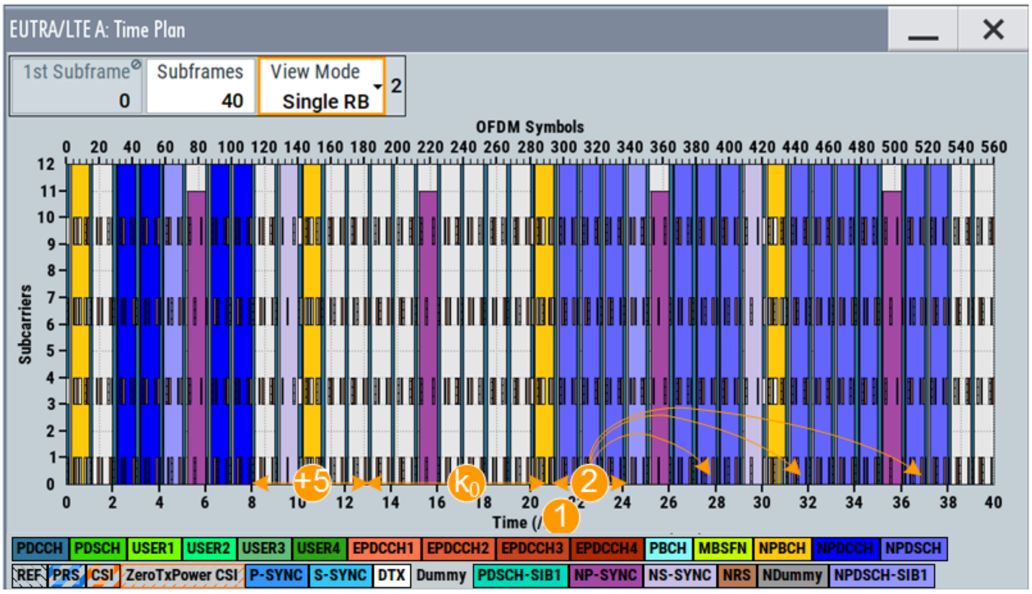


Figure 6-16: NPDSCH scheduling based on DCI format N1

+5 = NPDSCH starts at least five subframes after NPDCCH
k_0 = Eight subframes additional delay (because I_{Delay} = 2)
1 = NPDSCH start subframe = 21 (5 + 8 = 13 SFs after NPDCCH); SF#20 is used for NPSS
2 = NPDSCH is transmitted over three consecutive subframes, that in turn are repeated four times

In TDD duplexing mode, NPDSCH is transmitted in the downlink or in the DwPTS symbols. Observe the timeplan for current allocation.

6.2.7 NDRS

The narrowband demodulation reference signals (NDRS) are transmitted in the resources units containing data transmission. NDRS uses the same modulation as the associated data. All transmissions use a single antenna port, because MIMO is not defined for the UL direction.

The NDRS allocation, both as slot assignment and duration, depends on the used NPUSCH format and subcarrier spacing, see Table 6-18.

Table 6-18: NDRS duration and symbol assignment depending on the NPUSCH format and subcarrier spacing [TS 36.211]

NPUSCH format	NDRS duration (symbol per slot)	Symbol assignment for subcarrier spacing Δf = 3.75 KHz	Symbol assignment for subcarrier spacing Δf = 15 KHz	Number of subcarriers
F1	1	4	3	1 (@3.75kHz) 1, 3, 6, 12 (@15kHz)
F2	3	0, 1, 2	2, 3, 4	1

The NDRS is generated form a base sequence that is frequency shifted by a phase factor. If NDRS is transmitted with NPUSCH format F2, the NDRS is spread with the sequence known from LTE PUCCH formats 1, 1 and 1b.

6.2.8 NPUSCH

Other that in LTE, the NPUSCH carries the UL data, including UL control information (UCI). There is no channel like the LTE PUCCH channel defined in NB-IoT .

Resource units (RU)

In NB-IoT , the resource units (RU) are used to describe the mapping of the NPUSCH to resource element.

NPUSCH formats

TS 36.211 specifies two NPUSCH formats, each transporting the following information:

- F1: UL channel data over UL-SCH
- F2: UL control information UCI, restricted to acknowledgment of a DL transmission

For overview information of the NPUSCH formats and the number of used UL carriers per resource unit (RU), see Table 6-19.

Table 6-19: NPUSCH formats [TS 36.211]

NPUSCH format	Subcarrier spacing Δf	Number of subcarriers N_{SC}^{RU}	Number of slots N_{slots}^{UL}	RU duration, ms	Modulation	Resource elements per RU	Bits per RU
F1	3.75 KHz	1	16	32	π/2-BPSK π/4-QPSK	96	96 192
	15 KHz	1	16	8	QPSK	96	96 192
		3	8	4	QPSK, 16QAM	144	288
		6	4	2	QPSK, 16QAM	144	288
		12	2	1	QPSK, 16QAM	144	288
F2	3.75 KHz	1	4	8	π/2-BPSK	16	16
	15 KHz	1	4	2	π/2-BPSK	16	16

In the time domain, the NPUSCH transmission is defined as NPUSCH format, number of RU (N_{RU}), number of repetitions (N_{rep}^{NPUSCH}), and scheduling delay. An NPUSCH allocation is then $N_{rep}^{NPUSCH} N_{RU} N_{slots}^{UL}$ long. After the transmission of 256 ms, the NPUSCH transmission is postponed for 40 ms, see Table 6-20.

Table 6-20: NPUSCH gap duration expressed as number of slots

Subcarrier spacing	Slot length, ms	256 ms expressed as number of slots	40 ms expressed as number of slots
3.75 kHz	2	128	20
15 kHz	0.5	512	80

The RU size is not constant (Table 6-19). It is signaled with the DCI format N0, that carries also information on the NPUSCH start time, number of NPUSCH repetitions N_{Rep}^{PUSCH} and subcarrier indication field (I_{SC}).

See:

- "DCI formats, decoding and content" on page 391
- "DCI Format N0" on page 417

Physical dimension of the NPUSCH allocation

Table 6-19 lists also the resource elements and the resulting physical bits per RU, depending on the modulation. This information is required for the calculation of the total physical bits per NPUSCH allocation.

The following applies:

- Resource elements per RU = Resource elements per slot per subcarrier * N_{slots}^{UL} * N_{SC}^{RU}

  Where:

  – For F1: Resource elements per slot per subcarrier = 6

  – For F2: Resource elements per slot per subcarrier = 4
- Number of bits per RU = {Resource elements per RU (for BPSK); 2 * Resource elements per RU (for QPSK)}
- Total number of physical bits per NPUSCH allocation = N_{RU} * Number of bits per RU

  Where N_{RU} is set with the parameter "NB-IoT Allocation > Allocation# > Resource Units" and displayed with the parameter "Enchanced Settings > Config > Number of RU".

Example: NPUSCH configuration

The following is a simple example, intended to explain the parameters interdependency. It does not represent a meaningful configuration.

1. Select "Channel Bandwidth = 3 MHz".
2. Configure two UEs with the following settings:

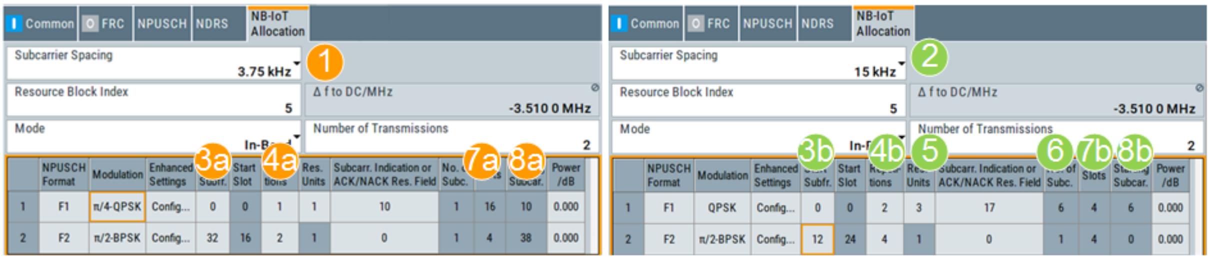


Figure 6-17: Example: NB-IoT allocations of two UEs with carrier spacing of 3.75 kHz and 15 kHz in the same resource block (Resource Block Index = 5)

1 = UE1: Δf = 3.75 kHz, two NPUSCH transmissions with F1 and F2, "Resource Block Index = 5"
2 = UE2: Δf = 15 kHz, two NPUSCH transmissions with F1 and F2, "Resource Block Index = 5"
3a, 3b = "Start Subframe" - offsets the allocation start in the time domain
4a, 4b = Repetitions (different values per NPUSCH format and UE)
5 = Number of resource units (for NPUSCH F2 RU = 1; for NPUSCH F1 variable)
6 = "Number of Subcarriers" (for NPUSCH F2 N_{SC}^{RU} = 1; for NPUSCH F1 N_{SC}^{RU} depends on the "Subcarrier Indication"
7a, 7b = NPUSCH duration as number of slots (calculated)
8a, 8b = "Starting Subcarrier" - offsets the allocation in the frequency domain

3. Use the "Adjust Length" function to set the "ARB Sequence Length = 4 Frames"
4. Observe the NPUSCH and NDRS allocations in the "Time Plan":
   a) Display subframes in the range "1st Subframe = 0" and "Subframes = 40".
   b) Select "View Mode = Single RB".
   c) Select "RB = Resource Block Index = 5".

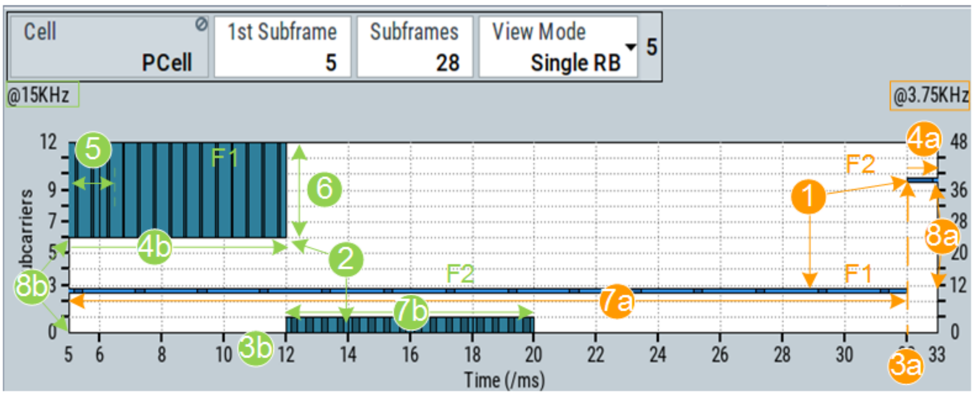


Figure 6-18: Time plan: understanding the displayed information

1 = NPUSCH transmissions of UE1
2 = NPUSCH transmissions of UE2
3a = NPUSCH F2 transmission of UE1 with "Start Subframe = 32"
3b = NPUSCH F2 transmission of UE2 with "Start Subframe = 12"
4a, 4b = UE1 NPUSCH F2 and UE2 NPUSCH F1 with "Repetitions = 2" (the repetitions are not shown completely)
5 = Resource unit RU = 3 (all other transmissions use RU = 1)
6 = NPUSCH F1 with N_{SC}^{RU} = 6; all other use N_{SC}^{RU} = 1
7a, 7b = NPUSCH F1 allocations of UE1 an UE2, both are 16 slots long; compare the time duration
7a = UE1 NPUSCH F1 duration = 16 slots*1 repetition*Slot duration = 16*2 ms = 32 ms

7b = UE2 NPUSCH F2 duration = 4 slots*4 repetitions*Slot duration = 16*0.5 ms = 8 ms
8a = "Starting Subcarrier = 10 and 38" (observe subcarrier numbering at the right y-axis ("@3.75kHz")
8b = "Starting Subcarrier = 6 and 0" (observe subcarrier numbering at the left y-axis ("@15kHz")

6.2.9 NPRACH

The NPRACH channel is used during the random access procedure. One random access channel spans one subcarrier within a symbol group.

Symbol group

The term symbol group describes the set of subcarriers reserved for the narrowband random access preamble. A symbol group comprises of a cyclic prefix and five identical symbols. Four consecutive symbol groups that are repeated defined number of times (N_{rep}^{NPRACH}) build a preamble.

CP*	Symbol	Symbol	Symbol	Symbol	Symbol

Figure 6-19: Random access symbol group

CP = Cyclic prefix (variable length)
Symbol = Sequence of five identical symbols

NPRACH configuration

The NPRACH configuration `NPRACH-ConfigSIB-NB-r13` is signaled by higher levels with the SIB2-NB.

NPRACH is configured per coverage level and is based on the following parameters:

- NPRACH configuration index: indicates the coverage level
- NPRACH preamble format: two formats with different cyclic prefix length, where the second is four times longer than the first one.
- $N_{periodicity}^{NPRACH}$: NPRACH resource periodicity (`mprach-periodicity-r13`)
- NPRACH starting time (`nprach-StartTime-r13`)
- N_{rep}^{NPRACH}: number of NPRACH repetitions per preamble attempt (`maxNumPreambleAttemptCE-r13`)
- Number of NPRACH subcarriers N_{sc}^{NPRACH} (`nprach-NumSubcarrierres-r13`)
- $N_{scoffset}^{NPRACH}$: frequency location of the first NPRACH subcarrier (`nprach-SubcarrierrOffset-r13`)

NPRACH allocation

Depending on the preamble format, the symbol group duration is as follows:

- Preamble format 0: 1.4 ms

- Preamble format 1: 1.6 ms

The signaled parameters are sufficient to calculate the location of the first symbol group. Locations of the subsequent symbol groups are frequency hopped (shifted) versions of the first one. Their location is derived according to a predefined algorithm, that assures that hopping patterns do not overlap. The frequency hopping is applied within 12 subcarriers ($N_{SC}^{RA} = 12$).

The location of the first symbol group is given by the NPRACH starting time and the parameter n_{start}, calculated from the subcarrier index n_{int}. The subcarrier index is the resource block index for the 3.75 KHz subcarrier spacing case.

The frequency allocation of the group is calculated as follows:

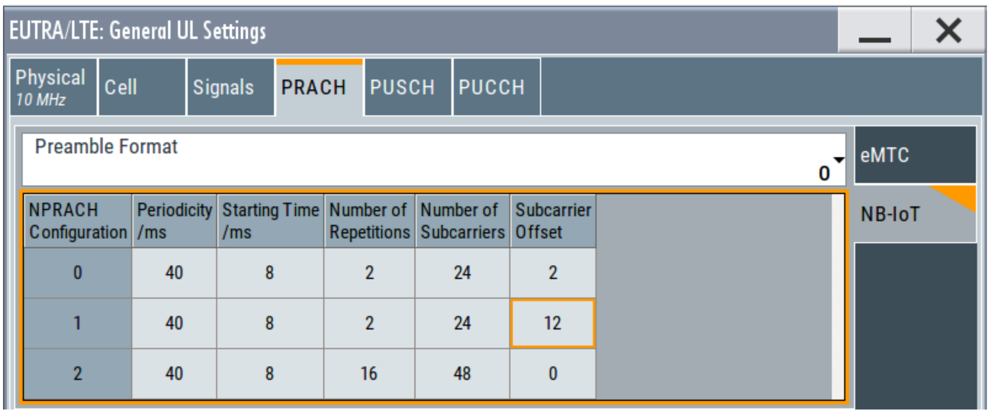
- $n_{sc}^{RA}(i) = n_{start} + \tilde{n}_{SC}^{RA}(i)$

  Where:
  - $n_{start} = N_{scoffset}^{NPRACH} + [n_{int}/N_{sc}^{RA}].N_{SC}^{RA}$
  - $\tilde{n}_{SC}^{RA}(0) = n_{int} mod N_{sc}^{RA}$
  - $\tilde{n}_{SC}^{RA}(i) = f(\tilde{n}_{SC}^{RA}(i-1); k_h)$
    Where k_h = { +1, -1, +6, -6} is a hopping index that describes the frequency hopping pattern.
    For details, see TS 36.211.

Example: NPRACH configuration

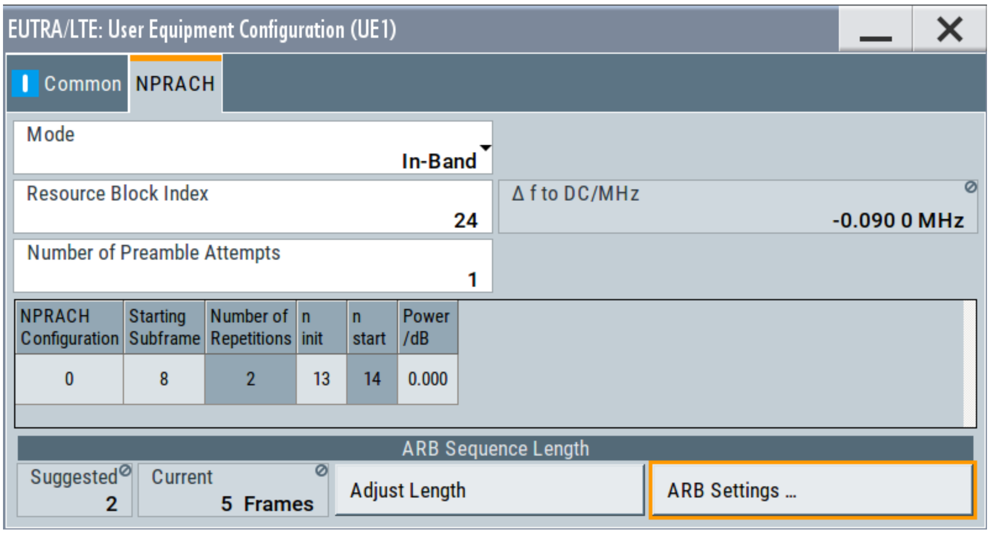
The following is an example on the NPRACH allocation calculation.

1. Select "UL General Settings > PRACH" and configure:
   - NPRACH "Preamble Format = 0"
   - NPRACH "Starting Time = 8 ms"
   - "NPRACH Configuration = 0" with:
     - $N_{rep}^{NPRACH} = 2$
     - $N_{sc}^{NPRACH} = 24$
     - $N_{scoffset}^{NPRACH} = 2$
   - $N_{SC}^{RA} = 12$



2. Select "UL Frame Configuration > UE1 > 3GPP Release = NB-IoT".

3. Select "UE1 Settings > Common > Mode = PRACH".
4. In the "NPRACH" dialog, select n_{int} = 13.



5. Open the "UL Frame Configuration > Time Plan".

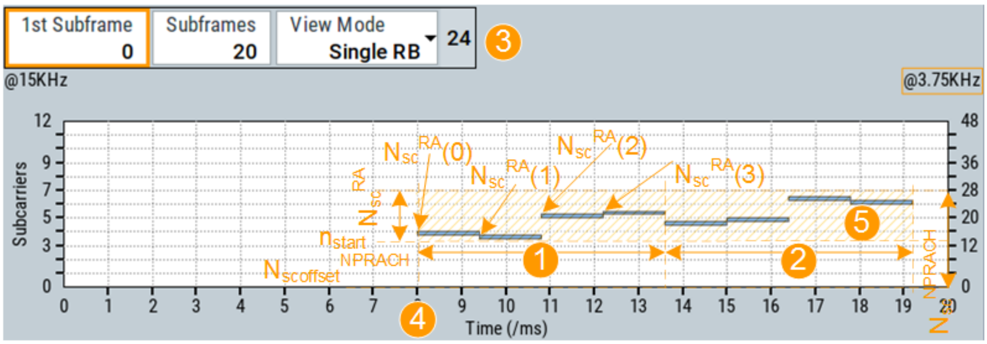


Figure 6-20: NPRACH configuration visualized in the Time Plan

1	= First repetition
2	= Second repetition
3	= "Time Plan > View Mode = Single RB", "RB# = 24" (zooms in the NPRACH allocation)
4	= Starting time = 8 ms
5	= NPRACH transmission area: spans N_{SC}^{RA} = 12 subcarriers starting from start subcarrier n_{start} = 14 (observe the subcarrier numbering on the right y-axis"@3.75kHz")
$N_{scoffset}^{NPRACH}$	= 2
N_{sc}^{NPRACH}	= 24

The NPRACH configuration calculation in the first repetition is as follows:

- First symbol group (i = 0):
  - $\tilde{n}_{sc}^{RA}(0)$ = 13mod12 = 1
  - n_{start} = 2 + [13/12].12 = 2 + 12 = 14
  - $n_{sc}^{RA}(0)$ = 14 + 1 = 15
- Second symbol group (i = 1):
  - $\tilde{n}_{sc}^{RA}(1)$ = 1 - k_h = 1 - 1 = 0 (for details, see TS 36.211)

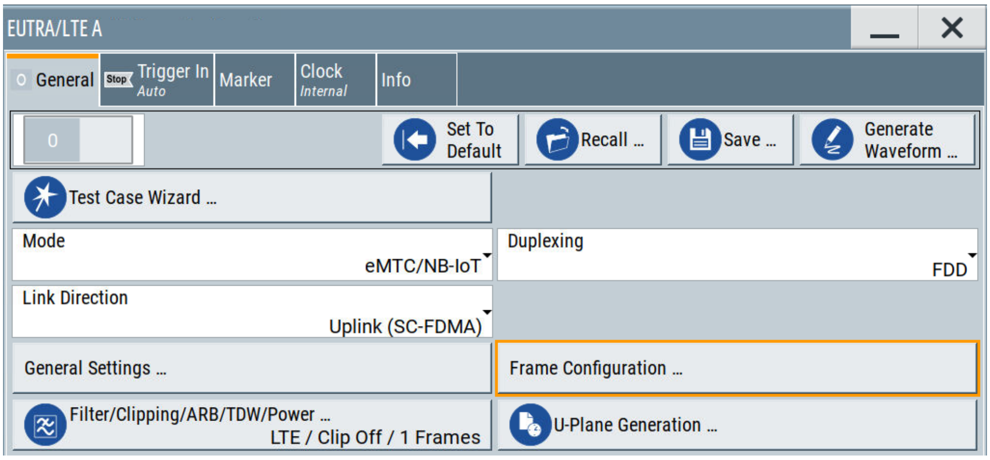
  - $n_{sc}^{RA}(1) = 14 + 0 = 14$
- Third symbol group (i = 2):
  - $\tilde{n}_{sc}^{RA}(2) = 0 + 6 = 0$
  - $n_{sc}^{RA}(2) = 14 + 6 = 20$
- Fourth symbol group (i = 3):
  - $\tilde{n}_{sc}^{RA}(3) = 6 + 1 = 7$
  - $n_{sc}^{RA}(3) = 14 + 7 = 21$

Set the "UL General Settings > PRACH > Preamble Format = 1" and observe the changed symbol length in the "Time Plan".

6.3 eMTC/NB-IoT-specific configuration and settings

Access:

1. In the "EUTRA/LTE > General" dialog, select **"Mode > eMTC/NB-IoT"**.

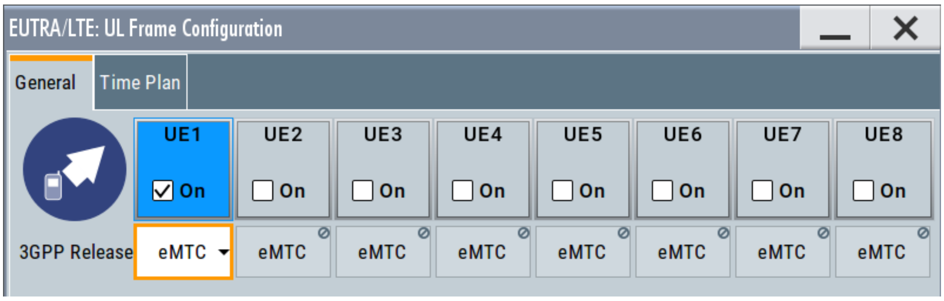


2. **To access the physical and cell-related DL settings**:
   a) Select "Link Direction > Downlink"
   b) Select "General Settings"
3. **To access the DL User-specific settings**:
   a) Select "Link Direction > Downlink"
   b) Select "Frame Configuration > General".
   c) To access the configure the allocation of the NB-IoT DL channels, **select the "NB-IoT DCI Config" and "NB-IoT Allocation"**.

   Other than in LTE, the NB-IoT allocations are not defined on a per subframe basis. The settings in the "Subframe" tab apply to LTE channels and are required only if you generate mixed LTE and IoT signals.
4. **To access the physical and cell-related UL settings**:
   a) Select "Link Direction > Uplink"

b) Select "General Settings"

5. **To access the UL UE-specific settings**:
   a) Select "Link Direction > Uplink"
   b) Select "Frame Configuration > General".



   c) To access the settings of the individual UEs, **click the "UE x" block**.

   You can enable up to 4 UEs, where each UE can work in a different mode, as set with the parameter 3GPP Release.
   Other than in LTE, the eMTC/NB-IoT allocations are dedicated UE-specific settings. They are not defined on a per subframe basis.
   If you are familiar with the LTE implementation or generate mixed LTE and IoT signals, you may find it useful to accesses the settings also from the "Subframe" tab.

   This section lists the **eMTC/NB-IoT-specific settings**. The settings that eMTC/NB-IoT reuse from LTE are described in:
   Chapter 4, "EUTRA/LTE configuration and settings", on page 63

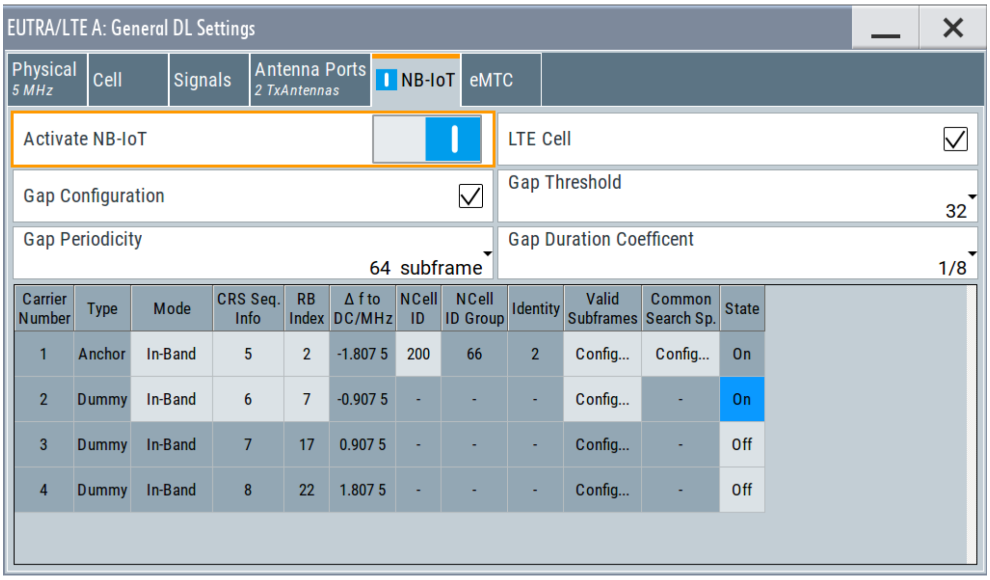
The remote commands required to define the eMTC/NB-IoT settings are described in Chapter 11.28, "eMTC/NB-IoT commands", on page 940.

6.3.1 NB-IoT carrier allocation

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "General > Duplexing > FDD".
3. Select "General DL Settings > NB-IoT".

With these settings, you configure the **anchor carrier** used by all NB-IoT channels.



4. Define the anchor carrier in terms of operating mode, allocated resource block, used NB-IoT cell ID and valid subframes.
5. To configure the subframes that are enabled for NB-IoT transmission:
   a) Select "Valid Subframes > Config"
   b) For in-band operation, select, for example "Bitmap Subframes = 40"
   c) Select a subframe (SF) to enable it for NB-IoT transmission.

   Suframes in that the NPBCH, NPSS or NSSS are transmitted can not be used for other NB-IoT DL channels.
   NB-IoT transmission is postponed during invalid subframes.
6. Set the "State = On" to enable each of the up to 3 **secondary carriers**.
7. Set **"Activate NB-IoT = On"** to activate the configuration.
8. To observe the NB-IoT carrier allocations, open the "Time Plan".

   In standalone and in-band modes, the "Time Plan" indicates the anchor carrier.
   In in-band mode, activated secondary carriers and the LTE synchronization signals PSS/SSS are also indicated.
9. To observe the anchor carrier in greater detail, set "View Mode = Single RB".
   See for example Figure 7-3.

Settings:

Activate NB-IoT

For "Physical > Channel Bandwidth ≥ 3 MHz", enables the NB-IoT anchor carrier and generally the NB-IoT channels.

If disabled, all downlink NB-IoT allocations are deactivated.

Option: R&S SMW-K146

To enable NB-IoT in TDD mode, select TDD UL/DL Configuration = "1 to 5"

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:STATe` on page 979

LTE Cell

In "General DL Settings > NB-IoT > Mode > In-Band" operation, defines how the LTE channels are handled.

If enabled, all LTE channels are deactivated. However, LTE reference signals are still transmitted.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:LTECell:STATe` on page 973

Gap Configuration

If activated, a gap between the NPDCCH and NPDSCH with the specified duration is applied.

The gap (`DL-GapConfig`) is applied to all NPDCCH and NPDSCH transmission but BCCH, as defined in TS 36.331.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:CONFig:STATe` on page 974

Gap Threshold

If Gap Configuration > "On", sets the gap threshold, as defined in TS 36.331.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:THReshold` on page 974

Gap Periodicity

If Gap Configuration > "On", sets the number of subframes after that the configured gap is repeated.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:PERiodicity` on page 974

Gap Duration Coefficient

If Gap Configuration > "On", sets the gap duration coefficient, as defined in TS 36.331.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:DURation:COEFficent` on page 974

Puncture LTE at Inband Carriers

In mixed LTE and IoT mode ("LTE > Mode > LTE/eMTC/NB-IoT") and in in-band or guard band operation ("General DL Settings > NB-IoT > Mode > In-Band/Guard Band"), punctures the LTE signal at the NB-IoT carriers.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PUNCture` on page 973

Carrier Number

Indicates the NB-IoT carrier.

Remote command:
n.a.

Type

The first carrier is the anchor carrier.

Anchor carrier is the carrier where the UE assumes that NPSS/NSSS, NPBCH and SIB1-NB are transmitted.

In in-band and guard band operation, you can enable and configure up to 3 secondary carriers. The secondary carriers are filled in with dummy data.

DL NB-IoT carriers span one resource block. To observe their allocation, use the "Time Plan" with "View Mode = Single RB".

Remote command:
n.a.

Mode

Selects the operating mode, see Figure 6-10.

See also Example"Configuring an NB-IoT allocation in standalone operating mode" on page 384.

"Standalone"	Available if "Physical > Channel Bandwidth = 200 kHz". All LTE allocations are automatically disabled.
"In-band/ Guardband"	Available if "Physical > Channel Bandwidth ≥ 3MHz".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:MODE` on page 975

CRS Sequence Info

For "Mode > In-Band/Guardband", sets the `eutra-CRS-SequenceInfo` parameter of the MIB-NB message.

It indicates the carrier containing NPSS/NSSS/NPBCH, where the value gives the LTE RB index.

The parameters CRS Sequence Info and RB Index are interdependent. Their values are calculated automatically according to TS 36.213.

Example: CRS sequence info and RB index values for 5MHz channel bandwidth

The following applies for example for "Physical > Channel Bandwitth = 5 MHz".

"CRS Sequence Info"	"RB Index"
5	2
6	7
7	17
8	22

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CRSSeq` on page 975

RB Index

Sets the resource block number in that the NB-IoT transmissions are allocated.

The available resource blocks depend on the used "Channel Bandwidth" (or "Number of Available Resource Blocks") and the operating "Mode".

Table 6-21: Resource block index value ranges

Operation mode	Resource block allocation	Value range
In-band	Within the "Channel Bandwidth"	See Table 6-22
Guard band	Left guard band	< 0
	Right guard band	> "Number of Available Resource Blocks"

Table 6-22: RB indexes allowed for NB-IoT synchronization in in-band operation

LTE system band-width	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
RB index	2, 12	2, 7, 17, 22	4, 9, 14, 19, 30, 35, 40, 45	2, 7, 12, 17, 22, 27, 32, 42, 47, 52, 57, 62, 67, 72	4, 9, 14, 19, 24, 29, 34, 39, 44, 55, 60, 65, 70, 75, 80, 85, 90, 95

The parameters CRS Sequence Info and RB Index are interdependent. Their values are calculated automatically according to TS 36.213.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:RBIDx` on page 975

`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:GBRBidx` on page 977

Delta Frequency to DC, MHz
In "Mode > In-band/Guard Band", indicates the delta frequency with that the NB-IoT carrier is offset form the LTE center frequency.

The value depends on "RB Index" and in in-band mode and per default in the guard-band mode it is calculated as follows:

"Delta Frequency to DC" = $\Delta f_{NB\text{-}IoT}$*("RB Index"*N_{SC}^{RB} - floor(N_{RB}^{DL}*N_{SC}^{RB}/2) + N_{SC}^{RB}/2) ± 7500

Where:
- $\Delta f_{NB\text{-}IoT}$ = 15 kHz is the NB-IoT subcarrier spacing
- N_{RB}^{DL} is the "Number of Resource Blocks per Slot"
- N_{SC}^{RB} = 12 is the number of subcarrier per RB
- ± 7500 is a frequency shift of half subcarrier bandwidth to avoid the center frequency

Thus, the possible values for the center frequencies of the NB-IoT channels are at 180 kHz offset to each other. In guard band mode, the you can change this spacing and set different "Delta Frequency to DC". If the set value does not correspond to a valid RB index, than the "RB Index = User".

According to the specification, the center frequencies of the NB-IoT channels in guard band mode must satisfy the following conditions:
- The first allocated NB-IoT RB must be orthogonal to the LTE RBs, whereas the following NB-IoT can be at 180 kHz or 15 kHz offset.
- The center frequencies of the NB-IoT carriers must satisfy the EARFCN conditions and hence be an integer multiple of 100 kHz; a raster of ±2.5 kHz and ±7.5 kHz is allowed, too.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:DFReq` on page 975

NCell ID
Sets the narrowband physical cell identifier, N^{NCell}_{ID}.

Defined are 504 unique physical layer cell identities (NCell ID), where the NSSS carries the N^{NCell}_{ID} value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CELL` on page 976

NCell ID Group
Indicates the physical cell identity group.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CIDGroup` on page 976

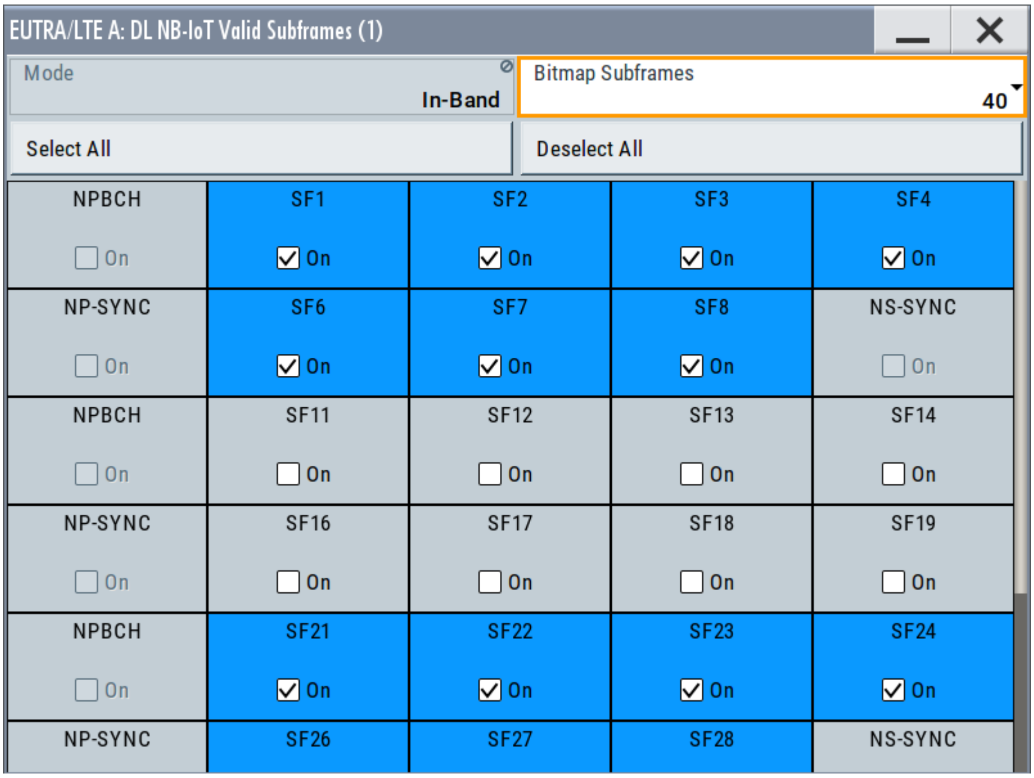
Identity
Indicates the identity of the physical layer within the "NCell ID Group".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ID?` on page 976

Valid Subframes
Sets the subframes bitmap carried by SIB1-NB (`downlinkBitmap-r13`) and defines the valid subframes (SF) that can be used for NB-IoT transmission.

If an SF is set to invalid or it contains NPSS, NSSS, NPBCH, or SIB1-NB, the NB-IoT transmission is postponed during this SF.

The selected subframes influence the scheduling of the NB-IoT transmissions.



According to TS 36.213, the valid SF in the secondary carriers (`DL-CarrierConfigDedicated-NB-r13`) can be defined in one of the following ways:

- No bitmap defined means that all DL subframes are valid
- To apply the bitmap of the anchor carrier
- To define an explicit bitmap configuration per secondary carrier.

In this implementation, the valid subframes in the secondary carriers are set individually.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF` on page 976
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SF<st0>:VALSf`
on page 977

Mode ← Valid Subframes
Indicates the operation mode of the selected carrier.

Bitmap Subframes ← Valid Subframes
Sets the valid subframes configuration over 10ms or 40ms (`subframePattern10-r13, subframePattern40-r13`), where 40ms configuration is available in the in-band mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF` on page 976

Select All/Deselect All ← Valid Subframes
Sets all SFs to valid or invalid SFs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFALl` on page 977
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFNN` on page 977

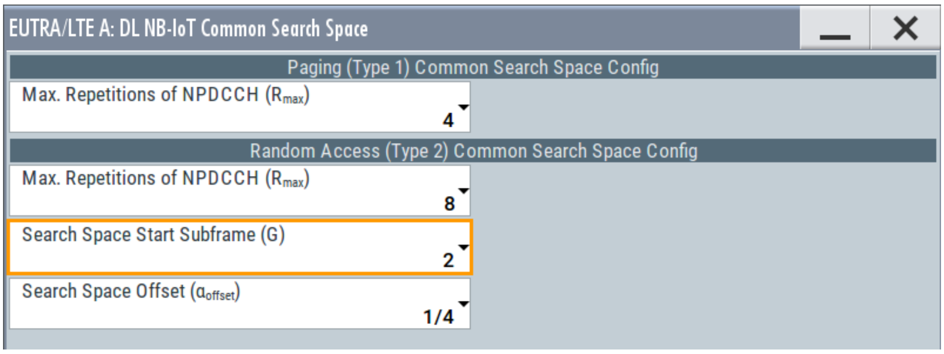
State
Enables secondary NB-IoT carrier.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:STATe` on page 979

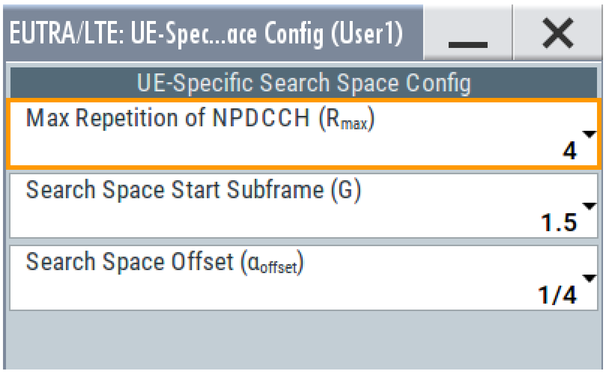
6.3.2 NPBCH, NPDCCH and NPDSCH settings

Access:

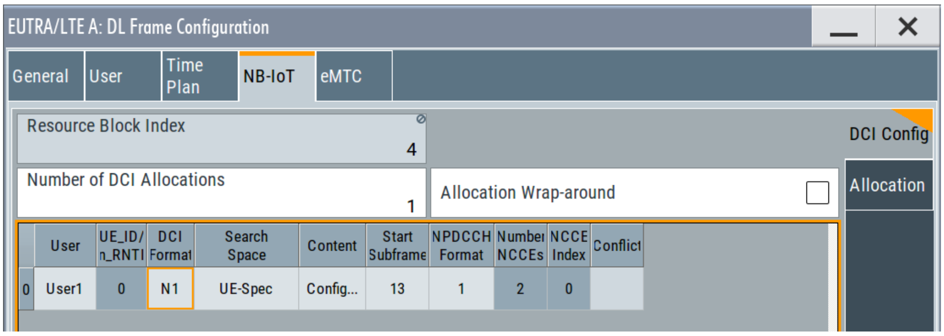
1. Select "General > Link Direction > Downlink".
2. To configure the **common and UE-specific search spaces**:
   a) Select "General DL Settings > NB-IoT Carrier Allocation > Common Search Space".



b) Select "Frame Configuration > General > User Configuration > UEx > Search Space > Config".

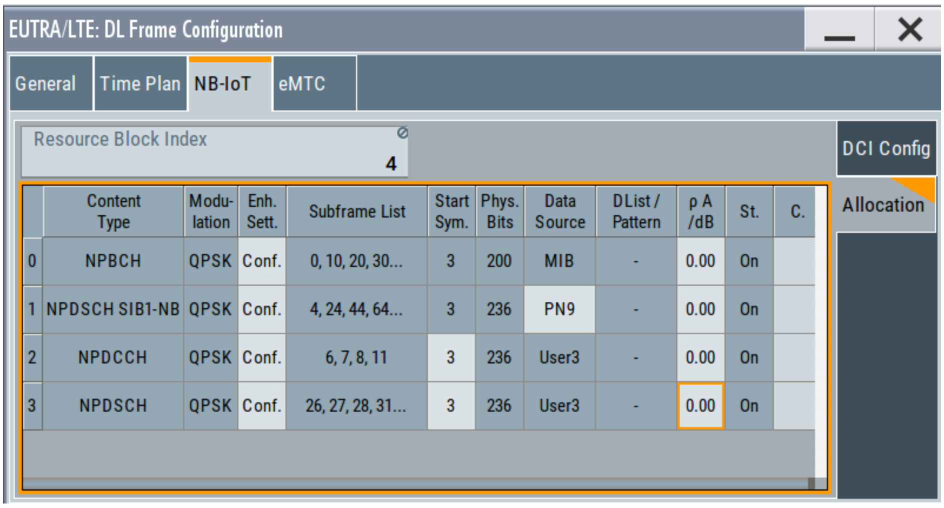


3. Enable at least one NB-IoT UE, i.e. select "Frame Configuration > General > User > User 3" > **"3GPP Release = NB-IoT"**.
4. To adjust the **DCI content** for example to configure the **NPDSCH and NPDCCH scheduling**:
   a) Select "Frame Configuration > NB-IoT > DCI Configuration".
   b) Select "Number of DCI Allocations = 1".
   c) Configure the DCI allocations, for example the DCI of one of the NB-IoT UEs: "User > User 3", "DCI Format = N1", "Search Space = UE-Specific".



   d) Select "Content > Config".
   e) In the "DCI Format Configuration" dialog, set "Repetitions of DCI Subframe = 2", I_{SF}^{NPDSCH} = 2, I_{Rep}^{NPDSCH} = 2 and I_{Delay} = 2
   f) Observe the information on the resulting configuration:
   "Repetitions of NPDCCH (R) = 4", "Repetitions of NPDSCH (N_{Rep}) = 4", "Number of NPDSCH Subframes (N_{SF}) = 4"
   g) In the "NB-IoT > DCI Configuration" dialog, set a "Start Subframe".
5. To display the automatically configured **NPBCH, NPDCCH and NPDSCH allocations in the anchor carrier** according to the current DCI configuration:

a) Select "Frame Configuration > NB-IoT > Allocation".

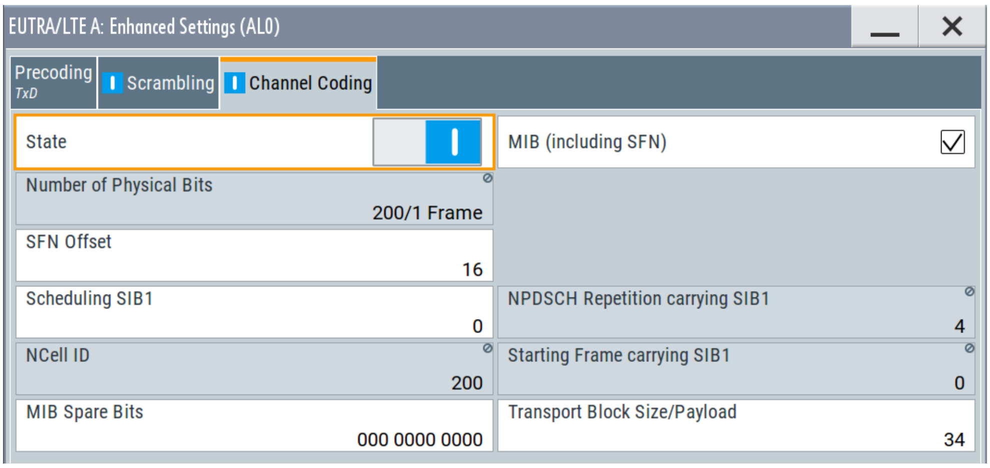


b) For the NPDCCH and NPDSCH allocations, observe the subframes displayed in the "Subframe List".

6. Observe the NB-IoT channels and signals on the "Time Plan".

   See the example on Figure 6-16.
   The time plan confirms the NPDCCH start subframe and the subframes in that NPDCCH is transmitted.
   It also confirms the that the NPDSCH allocation starts with the defined sheduling delay after the NPDCCH allocation and spans the configured number of sub-frames.

7. To change information in the **MIB-NB**, like for example the **SIB1-NB scheduling**, select "NPBCH > Enchanced Settings > Config".



See Chapter 6.3.2.4, "NPBCH channel coding and MIB-NB configuration", on page 433.

Settings:

6.3.2.1 Search space settings

Access:

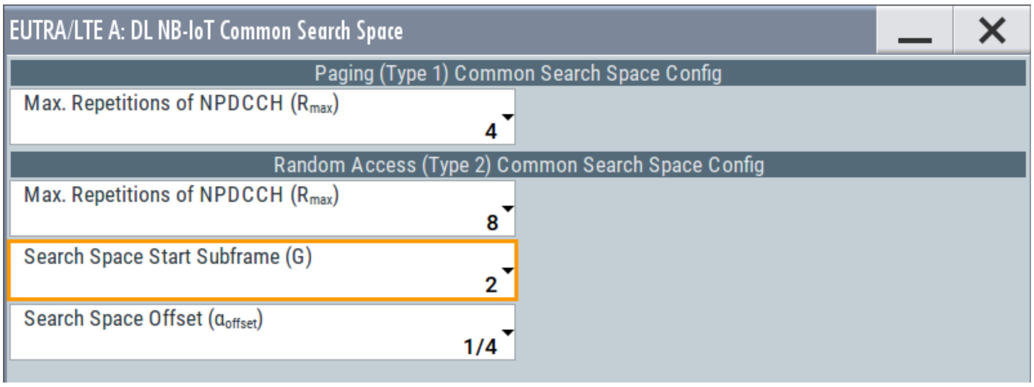
1. Select "General > Link Direction > Downlink".
2. Select "General DL Settings > NB-IoT Carrier Allocation > Common Search Space".
3. Select "Frame Configuration > General > User Configuration > UEx > Search Space > Config"

Settings:

Common Search Space

Configures the Type 1 (paging) and Type 2 (random access) common search space.

The common search space defines the NPDCCH candidates that the UE has to monitor, see "Search spaces" on page 389.



Max. Repetitions of NPDCCH (Rmax) for Type 1 common search space ← Common Search Space

Sets the maximum number NPDCCH is repeated R_{Max} (`npdcch-NumRepetitionPaging-r13`).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PAG:RMAX on page 978

Max. Repetitions of NPDCCH (Rmax) for Type 2 common search space ← Common Search Space

Sets the maximum number NPDCCH is repeated R_{Max} (`npdcch-NumRepetitions-RA-r13`).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:RMAX on page 978

Search Space Start Subframe (G) ← Common Search Space

Sets the start SF for the random access common search space (`npdcch-StartSF-CSS-RA-r13`).

The following applies:

$G*R_{Max} \geq 4$

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:STSFrame on page 979

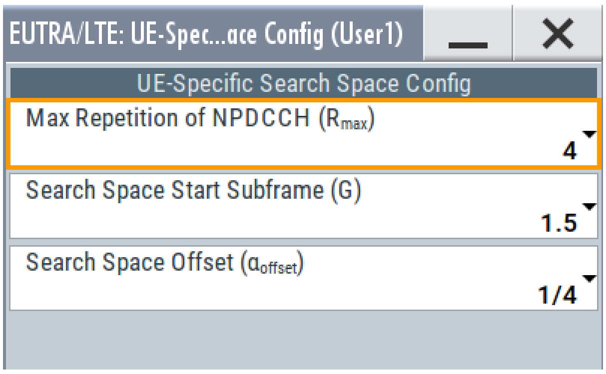
Search Space Offset (α_{offset}) ← Common Search Space

Shifts the search space start (`npdcch-Offset-RA-r13`).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:SSOFfset on page 979

UE-Specific Search Space

Configures the user-specific search space.



Max. Repetitions of NPDCCH (Rmax) (UE-specific search space) ← UE-Specific Search Space

Sets the maximum number NPDCCH is repeated R_{Max} (`npdcch-NumRepetitions-r13`).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:RMAX on page 1005

Search Space Start Subframe (G) ← UE-Specific Search Space
Sets the start SF for the random access common search space (npdcch-StartSF-USS-r13).

The following applies:

$G*R_{Max} \geq 4$

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:STSFrame on page 1005

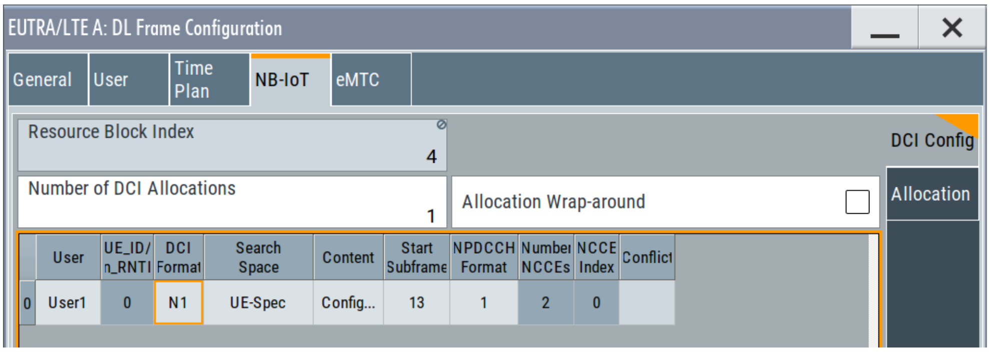
Search Space Offset (α_{offset}) ← UE-Specific Search Space
Shifts the search space start (npdcch-Offset-USS-r13).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:SSOFfset on page 1005

6.3.2.2 NB-IoT DCI configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Enable at least one NB-IoT UE, i.e. select "Frame Configuration > General > User > User 3" > **"3GPP Release = NB-IoT"**.
3. Select "Frame Configuration > NB-IoT > DCI Configuration".



4. Select "Number of DCI Allocations = 1".
5. Configure the DCI allocations, e.g. select "User > User 3" and select "Start Subframe = 6"
6. For each DCI, select "Content > Config".

Settings:

Resource Block Index

Indicates the resource block number of the anchor NB-IoT carrier.

The value is set with the parameter RB Index.

Number of DCI Allocations

Sets up to 100 configurable DCIs.

There is one table row per DCI in the DCI table.

The default "Number of DCI Allocations" value depends on the availability of NB-IoT users:

- 0: if all "User" are set to eMTC.
  Changing the value to "Number of DCI Allocations = 1", enables you to configure P-RNTI or RA-RNTI DCIs.
- 1: if there is at least one "User" with "3GPP Release = NB-IoT".

Set "Number of DCI Allocations = 0" to disable the DCI-based NB-IoT configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:NALLoc on page 985

Allocation Wrap-around

An NPDCCH can schedule a NPDSCH outside of the selected "ARB Sequence Length".

Enable this parameter to ensure a consistent signal, where the NPDSCH allocations are relocated at the beginning of the ARB sequence.

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:AWARound on page 985

User
Selects the user the DCI is dedicated to. The available DCI formats depend on the value of this parameter.

Other than in LTE, there is no NPDCCH indication of the system information (SI-RNTI).

"User x" Selects one of the four users with "3GPP Release = NB-IoT", as configured in the "Frame Configuration > General > User" dialog.

"P-RNTI/RA-RNTI"
A group of users is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:USER on page 985

UE_ID/n_RNTI
Displays the UE_ID of the "User x" or the n_RNTI for the selected DCI.

The UE_ID is set with the parameter "Frame Configuration > General > User Configuration > User x" > UE ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:UEID? on page 986

DCI Format
Sets the DCI format for the selected allocation.

The downlink control information (DCI) is a message used to control the physical layer resource allocation in the UL and DL direction. It carries scheduling information and uplink power control commands.

Depending on the DCI message usage, they are categorized into three different formats: N0, N1 and N2.

See "DCI formats, decoding and content" on page 391.

To configure the parameters per DCI format, select "Content > Config".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:FMT on page 986

Search Space
Defines the search space for the selected DCI.

The search space defines the NPDCCH candidates that the UE has to monitor. The UE can decode only the control information on an NPDCCH that is transmitted over NCCEs within the search space the UE monitors.

Table 6-23 lists different scheduling situations and the required configuration of "Search Space" and DCI Format.

Table 6-23: Scheduling situation

Situation	"DCI Format"	"Search Space"
NPDCCH and NPDSCH configured by P-RNTI	N2	Type 1 common
NPDCCH and NPDSCH configured by RA-RNTI	N1	Type 2 common
NPDCCH and NPDSCH configured by C-RNTI	N1	UE-specific by C-RNTI

Situation	"DCI Format"	"Search Space"
NPDCCH and NPDSCH configured by temporary C-RNTI and/or C-RNTI during random access procedure	N1	Type 2 common
NPDCCH and NPUSCH configured by C-RNTI	N0	UE-specific by C-RNTI
NPDCCH configured as "PDCCH order" to initiate random access procedure	N1	UE-specific by C-RNTI
NPDCCH and NPUSCH configured by temporary C-RNTI and/or C-RNTI during random access procedure	N0	Type 2 common

"UE-spec" Non-common DCIs are mapped to the UE-specific search space. Each UE has multiple UE-specific search spaces, determined as a function of the UE ID and the subframe.

"Type 1 Common/Type 2 Common"
The DCI is mapped to the common search space, where Type 1 common search space is used for paging and Type 2 for random access. A common search space is used to address all or a group of UEs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SSP` on page 986

DCI Content Configuration

Configure the parameters per DCI format.

The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification.

The resulting "Bit Data", N_{SF}, N_{Rep} and R values are displayed.

Bit Data ← DCI Content Configuration

Displays the resulting bit data as selected with the DCI format parameters.

The first bit in DCI formats N0 and N1 is used as flag to distinguish between the two formats. It is set as follows:

- DCI format N0: First bit = 0
- DCI format N1: First bit = 1

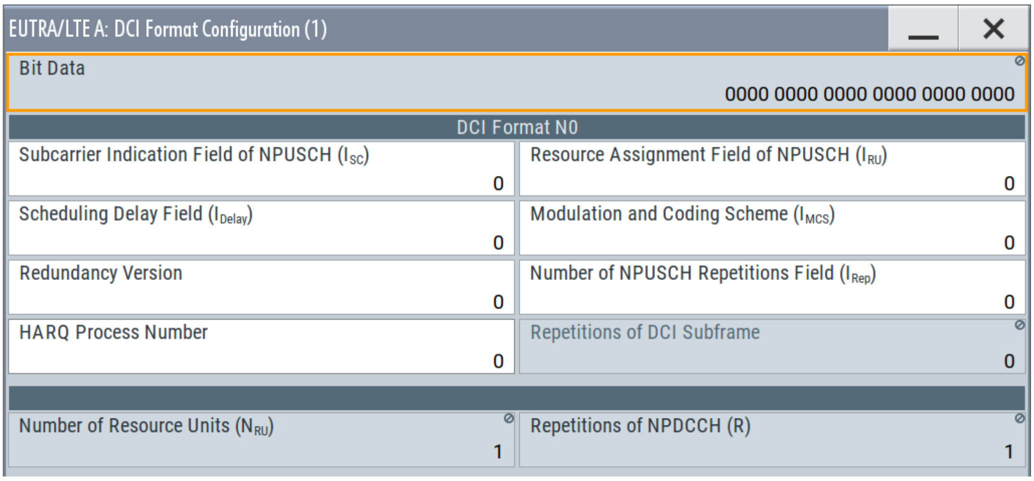
Mapping of the information bits is according to TS 36.212.

See also "DCI formats, decoding and content" on page 391.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:BITS?` on page 988

DCI Format N0 ← DCI Content Configuration

The DCI format N0 is 23-bits long and used for scheduling of NPUSCH in one UL cell.



DCI format N0 and transmits the following information.

"Subcarrier Identification Field of NPUSCH (I_{SC})"

6 bits

Define the starting frequency and resource unit of the NPUSCH allocation, see Table 6-37.

Remote command:

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SCINd on page 994

"Resource Assignment Field of NPUSCH (I_{RU})"

3 bits

The resulting number of resource units for NPUSCH N_{RU}^{NPUSCH} is indicated by the parameter Number of Resource Units (N_{RU}).

I_{RU}	0	1	2	3	4	5	6	7
N_{RU}	1	2	3	4	5	6	8	10

See also "Number of Resource Units N_{RU}" on page 451.

Remote command:

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IRU on page 988

"Scheduling Delay Field (I_{Delay})"
2 bits
Determines the number of DL subframes with that the NPDSCH is delayed after the NPDCCH transmission.

Table 6-24: Number of subframes NPDSCH is delayed (k_0 for DCI format N0)

I_{Delay}	k_0
0	8
1	16
2	32
3	64

See also Chapter 6.2.6, "NPDSCH", on page 392.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDELay on page 989

"Modulation and Coding Scheme (I_{MSC})"
4 bits
Define the modulation order Q_m and the transport block index I_{TBS}.
The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCSCheme on page 989

"Redundancy Version"
1 bit
Sets if the transmission start with RV0 or RV2.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:RVERsion on page 993

"Number of NPUSCH Repetition Fields (I_{Rep})"
3 bits
Gives number of times NPUSCH is repeated N_{Rep}^{NPUSCH}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPUSch:IREP on page 992

"New Data Indicator"
1 bit
As in LTE.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd on page 989

"Repetitions of DCI Subframes"
2 bits
Used to configure the NPDCCH mapping, see Table 6-16.
The resulting number of repetitions $N_{RepNPDCCH}$ (R) is indicated by the parameter Repetitions of NPDCCH (R).

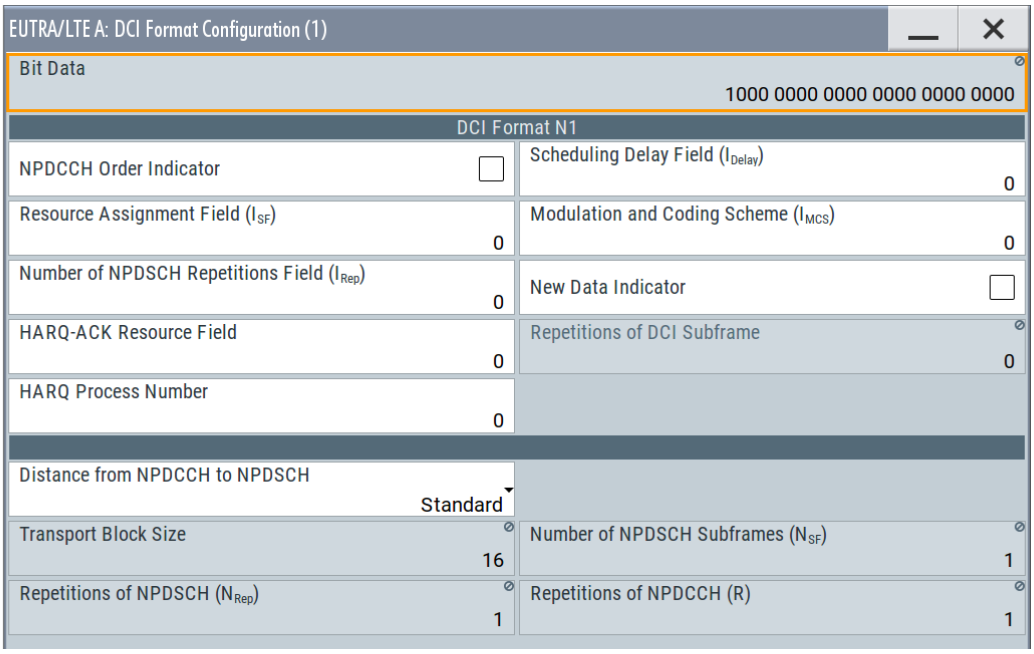
Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt` on page 994

"HARQ Process Number"
1 bit
Sets the HARQ process number, if "DL Frame Configuration > User" > Support two HARQ Processes = "On"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HPNMber` on page 993

DCI Format N1 ← DCI Content Configuration

The DCI format N1 is used for scheduling of one NPUSCH codeword in one cell and random access procedure initiated by an NPUSCH order.



DCI format N1 is 23-bits long and transmits the following information.

"NPDCCH Order Indicator"

1 bit

- 0: indicates scheduling one NPDSCH codeword in one cell
- 1: indicates random access procedure initiated by an NPDCCH order

  The remaining bits are set to 1.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:OIND` on page 989

"Starting Number of NPRACH Repetitions (I_{Rep})"

2 bits

Used if "NPDCCH Order Indicator = 1" and DCI format N1 CRC is scrambled with C-RNTI

Defines the number of NPRACH repetitions N_{Rep} following a PDCCH order.

I_{Rep}	0	1	2	3
N_{Rep}^{NPRACH}	R1	R2	R3	reserved

Where R1 < R2 < R3 and N_{Rep} = {1, 2, 4, 8, 16, 32, 64, 128}, see "Number of Repetitions" on page 460.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SNUMber` on page 992

"Subcarrier Indication Field of NPRACH (I_{SC})"

6 bits

Used if "NPDCCH Order Indicator = 1" and DCI format N1 CRC is scrambled with C-RNTI

Indicates the subcarrier allocated for NPRACH.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SCINd` on page 991

"Scheduling Delay Field (I_{Delay})"

2 bits

Determines the number of DL subframes with that the NPDSCH is delayed after the NPDCCH transmission. This delay is added to the minimum delay of 5 subframes.

Table 6-25: Number of subframes NPDSCH is delayed (k_0 for DCI format N1 depending on R_{max})

I_{Delay}	R_{max} < 128	R_{max} > 128
0	0	0
1	4	1
2	8	32
3	12	64
4	16	128
5	32	256
6	64	512
7	128	1024

See also Chapter 6.2.6, "NPDSCH", on page 392.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDELay` on page 989

"Resource Assignment Field (I_{SF})"

3 bits

Defines the number of subframes of NPDSCH (N_{SF}^{NPDSCH}). The resulting value is indicated by the parameter Number of NPDSCH Subframes (N_{SF}).

Table 6-26: Number of subframes N_{SF}^{NPDSCH} for NPDSCH

I_{SF}	0	1	2	3	4	5	6	7
N_{SF}^{NPDSCH}	1	2	3	4	5	6	8	10

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:ISF` on page 990

"Modulation and Coding Scheme (I_{MSC})"

4 bits

Define the modulation order Q_m and the transport block index I_{TBS}.

The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCScheme` on page 989

"Number of NPDSCH Repetition Fields (I_{Rep})"

4 bits

Defines the number of times NPDSCH is repeated N_{Rep}^{NPDSCH}. The resulting value is indicated by the parameter Repetitions of NPDSCH (N_{Rep}).

Table 6-27: Number of repetitions N_{Rep}^{NPDSCH} for NPDSCH

I_{Rep}	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
N_{Rep}^{NPDSCH}	1	2	4	8	16	32	64	128	192	256	284	512	768	1024	1536	2048

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:IREP` on page 990

"New Data Indicator"

1 bit; as in LTE.

Field is reserved, if DCI format N1 CRC is scrambled with RA-RNTI.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd` on page 989

"HARQ-ACK Resource Field"

4 bits

Field is reserved, if DCI format N1 CRC is scrambled with RA-RNTI.

Defines the subcarrier and the subframe number ($n+k_0-1$) used by the NPUSCH that carries the ACK/NACK acknowledgment of the NPDSCH reception.

Where:

- n is the end subframe of the NPDSCH
- k_0 is the delay selected depending on the "HARQ-ACK Resource Field" value and the UL subcarrier spacing

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HACK` on page 988

"Repetitions of DCI Subframes"

2 bits

Used to configure the NPDCCH mapping, see Table 6-16.

The resulting number of repetitions $N_{RepNPDCCH}$ (R) is indicated by the parameter Repetitions of NPDCCH (R).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt` on page 994

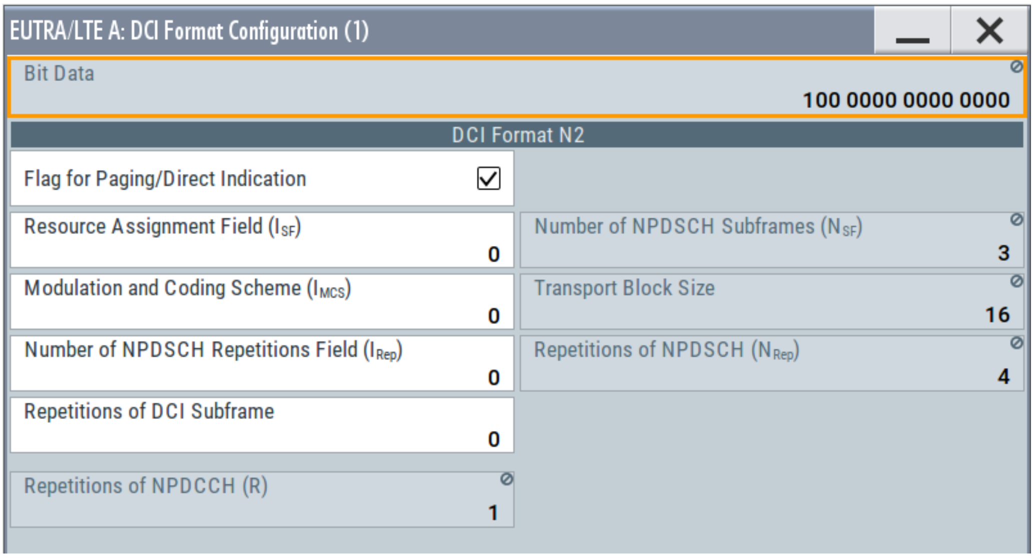
"HARQ Process Number"
1 bit
Can be set if at least 2 HARQ processes are configured.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HPNMber on page 993

"Transport Block Size"
Indicates the TBS, calculated for the selected "Modulation and Coding Scheme (I_{MSC})" and "Resource Assignment Field (I_{SF})".
The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:TBSZ? on page 995

DCI Format N2 ← DCI Content Configuration
The DCI format N2 is used for paging and direct indication. It is available for "User = P-RNTI".



DCI format N2 is 15-bits long and transmits the following information.

"Flag for Paging/Direct Indication"
1 bit
- 1: Paging
- 0: Direct indication
  8 bits that provide direct indication of system information update and other fields;
  Direct indication information is transmitted on NPDCCH using P-RNTI but without an associated paging message.

Bit **(in LSB order)**	**Field in direct indication information**
1	"System Info Modification"
2	"System Info Modification - Extended Discontinuous Reception"
3 to 8	not used

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:PAG on page 993

"System Info Modification - Extended Discontinuous Reception"
1 bit (systemInfoModification-eDRX)
Used if "Flag for Paging/Direct Indication = 1" and DCI format N2 CRC is scrambled with P-RNTI

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SIME on page 994

"System Info Modification"
1 bit (systemInfoModification)
Used if "Flag for Paging/Direct Indication = 1" and DCI format N2 CRC is scrambled with P-RNTI

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SINF on page 994

"Resource Assignment Field (I_{SF})"
3 bits
Defines the number of subframes of NPDSCH, see Table 6-26.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:ISF on page 990

"Modulation and Coding Scheme (I_{MSC})"
4 bits
Define the modulation order Q_m and the transport block index I_{TBS}.
The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCScheme on page 989

"Number of NPDSCH Repetition Fields (I_{Rep})"
4 bits
Defines the number of times NPDSCH is repeated N_{Rep}, see Table 6-27.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:IREP on page 990

"Repetitions of DCI Subframes"
2 bits
Used to configure the NPDCCH mapping, see Table 6-15.
The resulting number of repetitions $N_{RepNPDCCH}$ (R) is indicated by the parameter Repetitions of NPDCCH (R).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt on page 994

Distance from NPDCCH to NPDSCH ← DCI Content Configuration

For "DCI Format = N1", sets how the distance between the NPDCCH to NPDSCH is determined.

"Standard" NPDSCH starts at least five subframes after NPDCCH, i.e. there is a gap of 4 subframes between both channels.

"Minimum" In subframes without synchronization signals, PBCH or SIB transmissions, NPDSCH starts in the first valid subframe right after the NPDCCH.

"Zero" Disables the NPDSCH SIB1-NR and NPUCCH transmissions. The NPDSCH is transmitted immediately after the NPDCCH.
Use this value to increase the number of NPDSCH allocations.
To observe the allocated subframes, select "DL frame Configuration > NB-IoT > Allocation" > Suframe List.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:DIST on page 995

Transport Block Size ← DCI Content Configuration

Indicates the TBS, calculated for the selected "Modulation and Coding Scheme (I_{MSC})" and "Resource Assignment Field (I_{SF})".

The TBS is set automatically for Q_m = 2 according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:TBSZ? on page 995

Number of Resource Units (N_{RU}) ← DCI Content Configuration

Displays the resulting number of NPUSCH resource units N_{RU}^{NPUSCH}, retrieved from the selected "Resource Assignment Field of NPUSCH (I_{RU})".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NRUNits? on page 992

Number of NPDSCH Subframes (N_{SF}) ← DCI Content Configuration

Displays the resulting number of NPDSCH subframes (N_{SF}), see Table 6-26.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NSF?`
on page 991

Repetitions of NPDSCH (N_{Rep}) ← DCI Content Configuration

Displays the resulting number of NPDSCH repetitions (N_{Rep}), see Table 6-27.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NREP?`
on page 991

Repetitions of NPDCCH (R) ← DCI Content Configuration

Displays the resulting number of NPDCCH repetitions (R), depending on:
- "Search Space" on page 416
- R_{max}, set per search space in the dialogs Common Search Space and UE-Specific Search Space
- "Repetitions of DCI Subframes" DCI field of corresponding DCI format.

See:
- Table 6-15
- Table 6-16

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:REP?`
on page 990

Start Sufbrame

Sets the next valid starting subframe for the particular NPDCCH, see "Calculating the NPDCCH starting subframe" on page 389.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:STSFrame` on page 987

NPDCCH Format

Sets the NPDCCH format.

Table 6-28: NPDCCH formats

NPDCCH format	Number of NCCEs	Search space
0	1	UE-specific
1	2	UE-specific Type 1 common Type 2 common

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:FMT`
on page 987

Number NCCEs
NPDCCH is transmitted on an aggregation of one or two consecutive narrowband control channel elements (NCCE), see Figure 6-14.

The value is calculated from the selected "NPDCCH Format" and "NCCE Index", see Table 6-28.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CCES? on page 987

NCCE Index
For UE-specific search space, sets the NCCE start index.

NCCE index	Occupied subcarriers per subframe
0	0 to 5
1	6 to 11

See also Figure 6-14.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDCCe on page 987

Conflict
Indicates a conflict between two DCI formats, for example if they have the same NCCE index and start subframe.

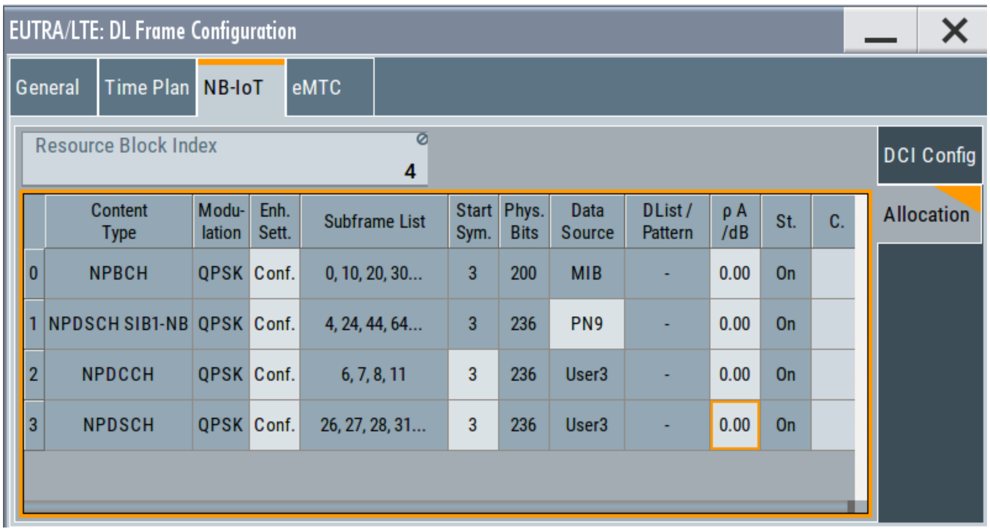
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CONFlict?
on page 988

6.3.2.3 NB-IoT allocations (NPBCH, NPDCCH, NPDSCH)

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > NB-IoT Allocation".
3. Select "ρ A" to boost the power of a particular allocation.

   The dialog displays the NB-IoT allocations in the **anchor carrier**.



The NPBCH allocation and the SIB1-NB transmissions are configured automatically, but can be changed. See Chapter 6.3.2.4, "NPBCH channel coding and MIB-NB configuration", on page 433.
The NPDSCH and NPDCCH allocations are configured according to the current DCI configuration, see Chapter 6.3.2.2, "NB-IoT DCI configuration", on page 414.

Settings:

Resource Block Index

Indicates the resource block number of the anchor NB-IoT carrier.

The value is set with the parameter RB Index.

Allocation number

Consecutive number of the allocation.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NALLoc?` on page 996

Content Type

Indicates the channel type.

Allocation number	Channel	Description
0	NPBCH	Narrowband broadcast channel
1	• NPDSCH SIB1-NB • NPDCCH • NPDSCH	• If MIB (including SFN) > "On", one NPDSCH that carries the SIB1-NB message is automatically configured If MIB (including SFN) > "Off", NPDCCH is configured • If Distance from NPDCCH to NPDSCH > "Zero", because NPDSCH SIB1-NB and NPDCCH are not transmitted
> 1	• NPDCCH • NPDCCH and NPSCH	Allocated automatically, depending on the current DCI configuration, Chapter 6.3.2.2, "NB-IoT DCI configuration", on page 414: • One narrowband DL control channel per active NB-IoT user, see "Configure User" > 3GPP Release • One pair per paging and random access RNTI

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONType?` on page 996

Modulation
All DL NB-IoT channels are QPSK modulated.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:MODulation?` on page 996

Enhanced Settings > Config
Accesses the precoding, scrambling and channel coding settings of the selected channel, see:
- Chapter 6.3.2.4, "NPBCH channel coding and MIB-NB configuration", on page 433
- Chapter 6.3.2.5, "NPDSCH and NPDCCH channel coding and scrambling", on page 437

Suframe List
Indicates the subframes in that the channel is allocated.

The subframes are calculated depending on the duplexing mode, the channel type, the number of repetitions and the valid subframes, see "Valid Subframes" on page 408.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SFList?` on page 996

Start Symbol
Indicates the first symbol (l_{Start}) in a subframe where NB-IoT channels can be allocated.

Table 6-29: Start symbol l_{Start}

Channel	Data	Start symbol $l_{NDPCCHStart}$	Mode
NPBCH	MIB	• 3 *)	• Regardless
NPDCCH	any	• 1, 2, 3 • 0	• "In-band" • "Guard Band"/ "Standalone"
NPDSCH	• SIB1-NB • other	• 3 *) • 1, 2, 3 0	• Regardless • "In-band" "Guard Band"/ "Standalone"

*) To avoid collisions with control information in the LTE system, NPBCH and NPDSCH carrying SIB-NB are allocated after the LTE PDCCH control region.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STSYmbol on page 997

Phys. Bits

Displays the allocation size in bits ($N_{PhysBits}$).

For QPSK modulation, the allocated number of bits is calculated as follows:

Number of Physical Bits = 2*Number of RE per PRB or

$N_{PhysBits} = 2*N_{RE}$

Where:
- N_{RE} are number of available resource elements RE per resource blocks PRB after the "Start Symbol" and excluding reference RE reserved for LTE CRS and NRS.
- For NPDSCH, N_{RE} is N_{RE}^{NPDSCH} is selected form Table 6-30.
- For NPDCCH format 0 with one NCCE, N_{RE} is $2*N_{RE}^{NPDCCH,0} = N_{RE}^{NPDSCH}$
- For NPDCCH format 1 with two NCCEs), N_{RE} is $N_{RE}^{NPDCCH,1} = N_{RE}^{NPDSCH}$

Table 6-30: Number of available resource elements RE per resource blocks PRB (N_{RE}) after the Start Symbol $l_{NDPCCHStart}$

Mode	Number of NB APs (NB-IoT MIMO Configuration)	Number of LTE APs ("Global MIMO Configuration")	$l_{NDPCCHStart}$ = 0	$l_{NDPCCHStart}$ = 1	$l_{NDPCCHStart}$ = 2	$l_{NDPCCHStart}$ = 3
Guard Band/ Standalone	1 2	0	160 152	-	-	-
In-band	1	1	-	142	130	118
	1	2	-	136	124	112
	1	4	-	128	120	108
	2	1	-	134	122	110
	2	2	-	128	116	104
	2	4	-	120	112	100

NPBCH carries 200 bits per frame.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits? on page 997

Data Source

Indicates the data source depending on the "Content Type".

The data source can be changed in the following cases:
- For NPDSCH allocations that are configured for "NB-IoT DCI Config > User = P-RNTI or RA-RNTI"
- If "NPBCH > Enhanced Settings > Config > Channel Coding = Off"
- For the NPDSCH SIB1-NB allocation
  Use this function to load data lists as source for the SIB messages.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DATA` on page 998
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DSELect` on page 998
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PATTern` on page 998

ρ A
Sets the power P_{NPBCH}, P_{NPDCCH} or P_{NPDSCH} (ρ A) of the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:POWer` on page 997

State
Indicates that the allocation is active.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STATe?` on page 998

Conflict
Indicates a conflict between allocations.

If conflict occurs, change used NCCE index and the change starting subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONFlict?` on page 999

6.3.2.4 NPBCH channel coding and MIB-NB configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > NB-IoT Allocation".
3. Select "NPBCH > Enchanced Settings > Config".

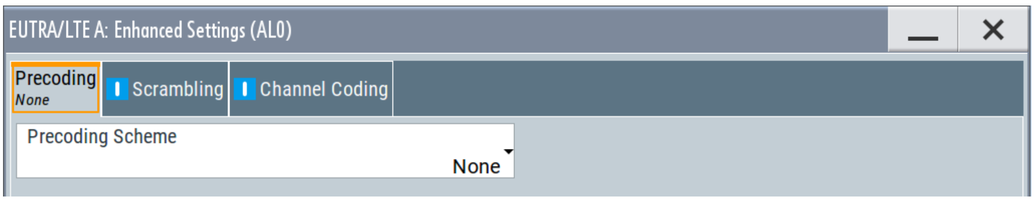
NPBCH can be generated in one of the following modes:

- Without channel coding, if "Channel Coding > State > Off"
  Dummy data or user-defined data lists are used.
- Channel coding with arbitrary transport block content
  If channel coding is activated ("Channel Coding > State > On") and parameter "MIB (including SFN) > Off"
- Channel coding with real data (MIB-NB) including SFN
  If channel coding and "MIB (including SFN)" are activated
  This mode is required for the generation of SIB1-NB message.

Settings:

Precoding settings

Access: select "Frame Configuration > NB-IoT Allocation > NPBCH > Enchanced Settings > Config > Precoding".



Precoding Scheme ← Precoding settings
Selects the precoding scheme.

"None" Disables precoding.

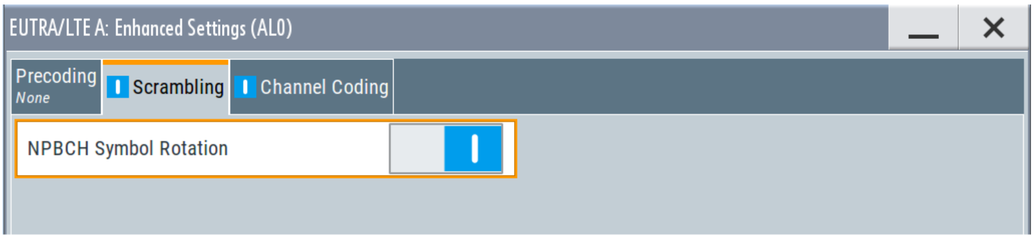
"Tx Diversity"
If NB-IoT MIMO Configuration = "2 Tx Antennas", select precoding for transmit diversity.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:SCHeme
on page 999

Number of Layers ← Precoding settings
Displays the number of layers for the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:NOLayers?
on page 1000

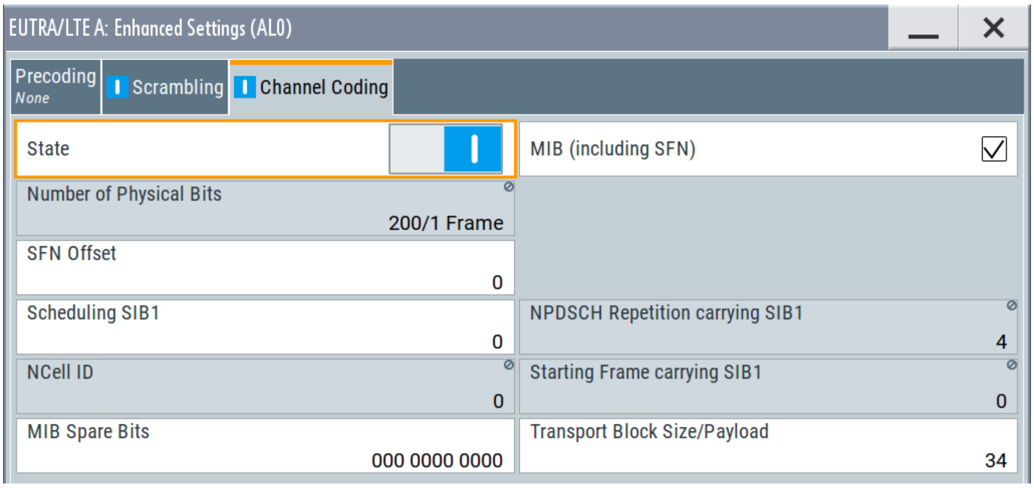
Scrambling settings
Access: select "Frame Configuration > NB-IoT Allocation > NPBCH > Enchanced Settings > Config > Scrambling".



NPBCH Symbol Rotation ← Scrambling settings
Enables NPBCH scrambling with symbol rotation, as specified in LTE Rel. 13.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:SROT
on page 1000

Channel coding settings
Access: select "Frame Configuration > NB-IoT Allocation > NPBCH > Enchanced Settings > Config > Channel Coding".



Channel Coding State ← Channel coding settings
Enables channel coding.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:STATe`
on page 1001

Number of Physical Bits ← Channel coding settings
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits?` on page 997

MIB (including SFN) ← Channel coding settings
Enables transmission of real MIB (master information block) data. The SFN (system frame number) is included as well.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MIB` on page 1003

SFN Offset ← Channel coding settings
By default, the counting of the SFN (system frame number) starts with 0. This parameter sets a different start SFN value.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SOFFset` on page 1004

Scheduling SIB1 ← Channel coding settings
Sets the parameter `schedulingInfoSIB1` that defines the NPDSCH number of repetitions N_{Rep}^{NPDSCH}, see NPDSCH repetition carrying SIB1.

Table 6-31: Number of repetitions N_{Rep}^{NPDSCH} for NPDSCH carrying SIB1-NB

schedulingInfoSIB1	0	1	2	3	4	5	6	7	8	9	10	11	12 to 15
"Duplexing = FDD" N_{Rep}^{NPDSCH}	4	8	16	4	8	16	4	8	16	4	8	16	reserved
Option: R&S SMW-146 "Duplexing = TDD" N_{Rep}^{NPDSCH}	4	8	16	4	8	16	4	8	16	4	8	16	16

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SIB on page 1004

NPDSCH repetition carrying SIB1 ← Channel coding settings
Indicates the number of NPDSCH repetitions, if this NPDSCH carries SIB1-NB (see Table 6-31).

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:RSIB? on page 1003

NCell ID ← Channel coding settings
Indicates the NCell ID N_{ID}^{Cell}, as selected with the parameter NCell ID.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:NCID? on page 1003

Starting Frame carrying SIB1 ← Channel coding settings
Indicates the first frame in that the NPDSCH transmission carrying SIB1-NB is allocated.

The value is calculated for the selected NPDSCH repetition carrying SIB1 and NCell ID.

N_{Rep}^{NPDSCH}	N_{ID}^{Cell}	Starting frame for SIB1-NB repetitions
4	N_{ID}^{Cell} mod 4 = 0	0
4	N_{ID}^{Cell} mod 4 = 1	16
4	N_{ID}^{Cell} mod 4 = 2	32
4	N_{ID}^{Cell} mod 4 = 3	48
8	N_{ID}^{Cell} mod 2 = 0	0
8	N_{ID}^{Cell} mod 2 = 1	16
16	N_{ID}^{Cell} mod 2 = 0	0
16	N_{ID}^{Cell} mod 2 = 1	1

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:STFSib1? on page 1004

MIB Spare Bits ← Channel coding settings
Sets the 11 spare bits in the NPBCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MSPare` on page 1003

Transport Block Size/Payload (DL) ← Channel coding settings
Displays the size of the transport block/payload in bits.

For NPBCH, the transport block size is always 34 bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSize?`
on page 1002

6.3.2.5 NPDSCH and NPDCCH channel coding and scrambling

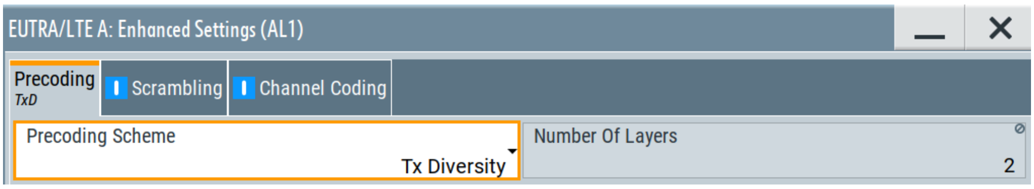
Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > NB-IoT Allocation".
3. Select "NPDSCH/NPDCCH > Enchanced Settings > Config".

   Access settings of "Precoding", "Scrambling" and "Channel Coding".

Settings:

Precoding settings
Access: select "Frame Configuration > NB-IoT Allocation > NPDSCH > Enchanced Settings > Config > Precoding".



Precoding Scheme ← Precoding settings

Selects the precoding scheme.

"None" Disables precoding.

"Tx Diversity"

If NB-IoT MIMO Configuration = "2 Tx Antennas", select precoding for transmit diversity.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:SCHeme
on page 999

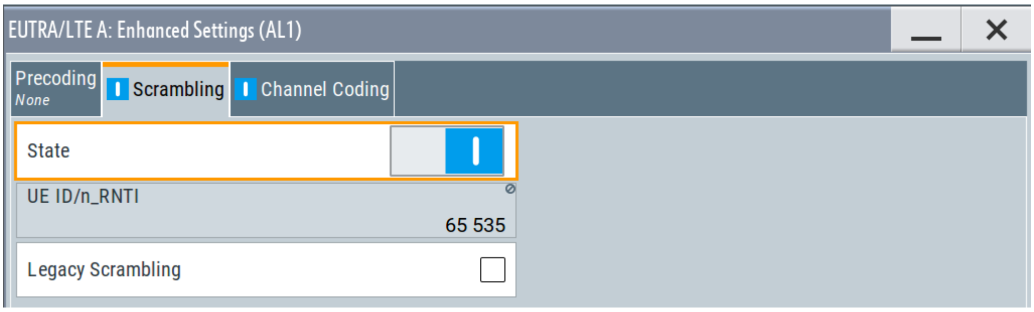
Number of Layers ← Precoding settings

Displays the number of layers for the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:NOLayers?
on page 1000

Scrambling settings

Access: select "Frame Configuration > NB-IoT Allocation > NPDSCH > Enchanced Settings > Config > Scrambling".



Scrambling State ← Scrambling settings

Enables scrambling.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:STATe
on page 1000

UE ID/n_RNTI ← Scrambling settings

Indicates the user equipment identifier (n_RNTI) or UE ID of the user to which the NPDSCH transmission is intended. The displayed "UE ID/n_RNTI" value is used to calculate the scrambling sequence.

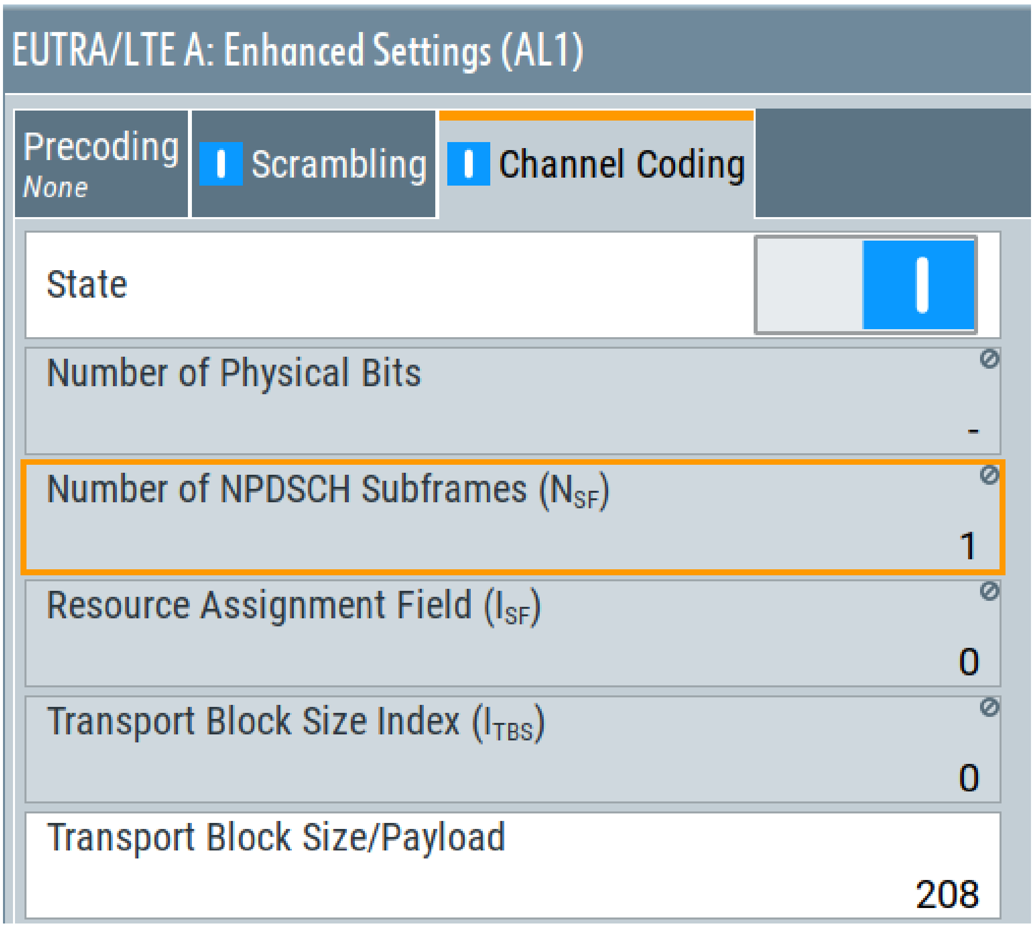
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:UEID?
on page 1001

Legacy Scrambling ← Scrambling settings
Option: R&S SMW-K143

If disabled, scrambling according to LTE Rel. 14 is applied.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:LEGacy:STATe on page 1001

Channel coding settings
Access: select "Frame Configuration > NB-IoT Allocation > NPDSCH > Enchanced Settings > Config > Channel Coding".



Channel Coding State ← Channel coding settings
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:STATe
on page 1001

Number of Physical Bits ← Channel coding settings
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits?` on page 997

Number of NPDSCH Subframes (N_{SF}) ← Channel coding settings
Indicates the value calculated from the current DCI configuration.

See:
- "NPDSCH scheduling" on page 393
- E.g. "DCI Format N1" on page 420

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:NSF?` on page 1002

Resource Assignment Field (I_{SF}) ← Channel coding settings
Indicates the value calculated from the current DCI configuration.

See:
- "NPDSCH scheduling" on page 393
- E.g. "DCI Format N1" on page 420

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:ISF?` on page 1001

Transport Block Size Index (I_{TBS}) ← Channel coding settings
Sets the transport block size index.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSI` on page 1002

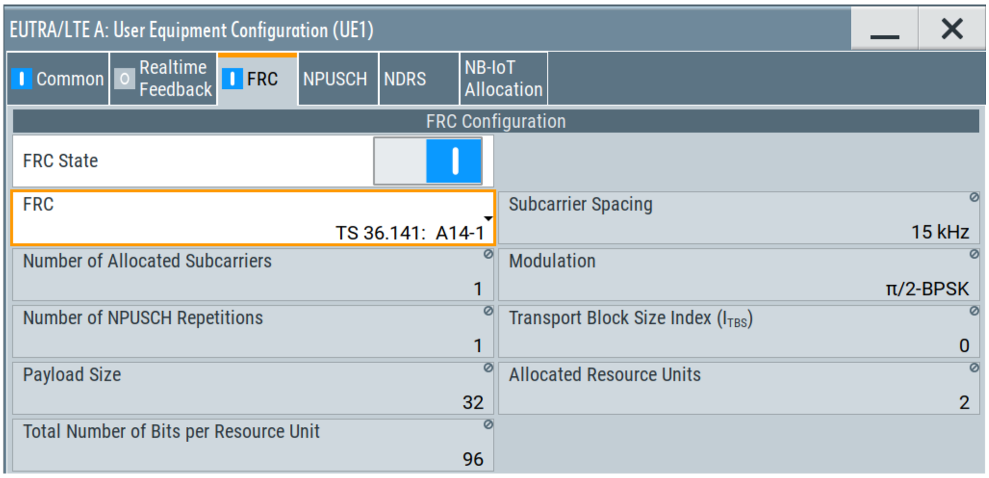
Transport Block Size/Payload (DL) ← Channel coding settings
Displays the size of the transport block/payload in bits for the current Transport Block Size Index (I_{TBS}).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSize?`
on page 1002

6.3.3 FRC settings

Access:

1. Select "General > UL Frame Configuration > UE x > 3GPP Release = NB-IoT".
2. Select "UE x > FRC".



This dialog provides a quick configuration of the predefined fixed reference channels (FRC) according to:

- TS 36.141, Annex A "Reference measurement channels"
- TS 36.521, Annex A "Measurement channels".

If "FRC" is enabled, several parameters are predefined and their values are displayed as read-only values.

Settings:

FRC State

Enables FRC configuration.

If "FRC" is enabled, several parameters are predefined and their values are displayed as read-only values. To reconfigure any of these parameters, disable the FRC configuration.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:STATe on page 1053

FRC

Selects a predefined fixed reference channel according to TS 36.141 or to TS 36.521.

3GPP specifies the FRCs for a specific channel bandwidth (i.e. number of resource blocks). Depending on the current configuration, some FRCs are not listed.

Table 6-32: Supported FRCs from 3GPP TS 36.141

FRC	Description
A14-1 to A14-4	FRC for NB-IOT reference sensitivity (π/2 BPSK, R=1/3)
A15-1 to A15-2	FRC for NB-IoT dynamic range (π/4 QPSK, R=2/3)
A16-1 to A16-5	FRC for NB-IoT NPUSCH format 1

Table 6-33: Supported FRCs from 3GPP TS 36.521-1

FRC (Duplexing = FDD)	FRC (Duplexing = TDD)	Description
A.2.4-1 to A2.4-7	-	Reference channels for category NB1

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TYPE on page 1053

Subcarriers Spacing
Displays the subcarrier spacing.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:SCSPacing? on page 1055

Number of Allocated Subcarriers
Displays the number of the allocated subcarriers.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NOSCarriers? on page 1055

Modulation
Displays the modulation for the selected FRC.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:MODulation? on page 1054

Number of NPUSCH Repetitions
Displays the number of NPUSCH repetitions.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NNPRep on page 1055

Transport Block Size Index I_{TBS}
Displays the transport block size index I_{TBS}.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TBSSindex? on page 1056

Payload Size
Displays the payload size for the selected FRC.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:PASize? on page 1055

Allocated Resource Units
Displays the total number of physical bits available for the NPUSCH allocation per resource unit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:ALResunits? on page 1054

Total Number of Bits per Resource Unit
Displays the total number of physical bits available for the NPUSCH allocation per resource unit.

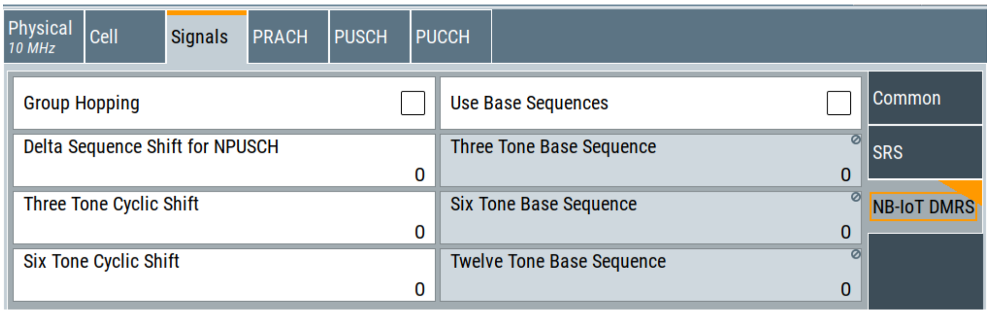
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:BPResunit? on page 1054

6.3.4 NDMRS settings

Access:

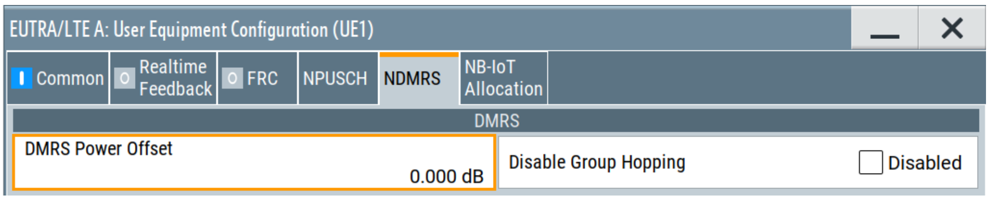
1. Select "General > General UL Settings > Signals".

   The NDMRS settings are grouped in the "NB-IoT DMRS" section.



2. To configure the NDMRS setting per UE, select "EUTRA/LTE > Frame Configuration > General > UE1".
3. Select "User Equipment Configuration > NDMRS".

   You can boost the NDMRS signal compared to the NPUSCH allocation and disable the NPUSCH group hopping for a particular UE.



The NDMRS allocation, both as slot assignment and duration, depends on the NPUSCH allocation of the particular UE. In particular, it depends on the NPUSCH format per allocation and the subcarrier spacing.

- To configure the NPUSCH allocation, select "User Equipment Configuration > NB-IoT Allocation".

- To observe the NDMRS allocation, including duration and slot assignment, select "EUTRA/LTE > Frame Configuration > Time Plan".
  Select "View Mode = Single RB" and select the resource block index used in the "NB-IoT Allocation" dialog.
  For example, see Example"NPUSCH configuration" on page 396.

NDMRS settings:

NB-IoT DMRS general settings

The following are the NDRM settings, common to all UEs. They are related to NDMRS generation and hopping.

Group Hopping ← NB-IoT DMRS general settings

Enables group hopping (`groupHoppingEnabled`) for the uplink demodulation reference signal (DMRS).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:GHOPping` on page 1037

Delta Sequence Shift for NPUSCH ← NB-IoT DMRS general settings

Sets the delta sequence shift α for NPUSCH required for the calculation of the group hopping pattern.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:DSEQshift` on page 1037

Three/Six-Tone Cyclic Shift ← NB-IoT DMRS general settings

Sets the higher layer parameters `threeTone-CyclicShift` and `sixTone-CyclicShift`.

In combination with the base sequence, these parameters define the sequence with which the demodulation reference signal (NDMRS) is transmitted.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTCShift` on page 1038
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STCShift` on page 1038

Use Base Sequences ← NB-IoT DMRS general settings

Enables using base sequences for the generation of the NB-IoT DMRS sequence hopping pattern.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:USEBase` on page 1038

Three/Six/Twelve-Tone Base Sequence ← NB-IoT DMRS general settings
Sets the higher layer parameters `threeTone-BaseSequence`, `sixTone-BaseSequence`, and `twelveTone-BaseSequence`. They define the base sequence with which the demodulation reference signal (NDMRS) is transmitted.

Each of the three sequences is used in case the signal is modulated onto three, six or 12 carriers.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTBSequence` on page 1038
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STBSequence` on page 1039
`[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TWBSequence` on page 1039

UE-specific NDMRS settings
With the provided settings, you can boost the NDMRS signal compared to the NPUSCH allocation or disable the NPUSCH group hopping for the particular UE.

Disable Group Hopping ← UE-specific NDMRS settings
NDMRS group hopping is not applied for the selected UE.

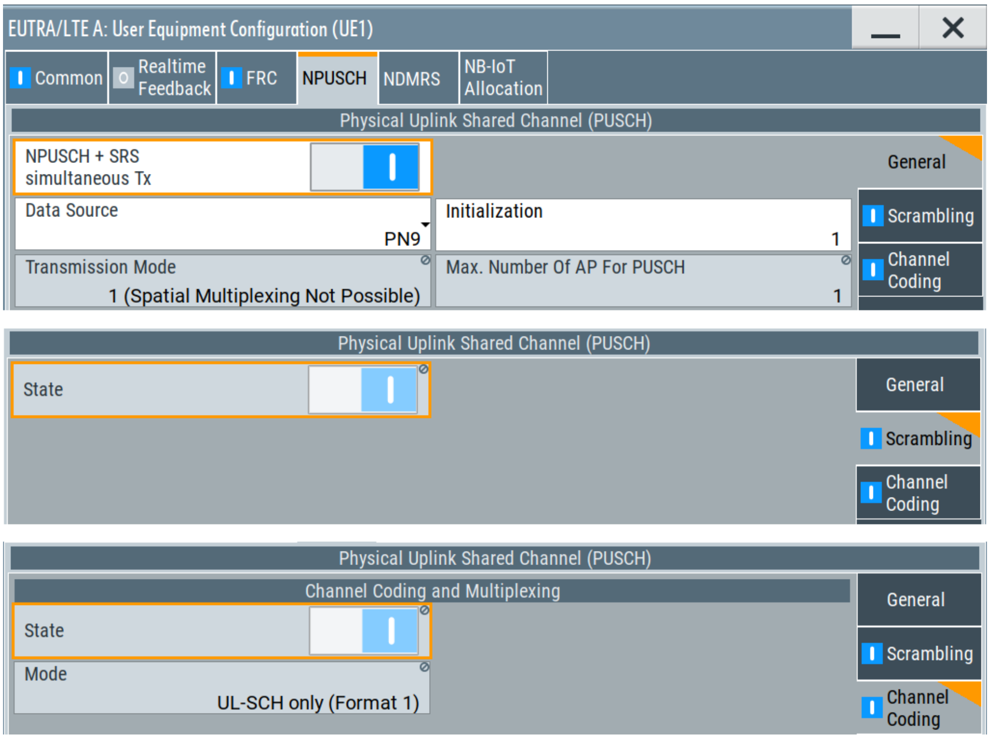
This parameter works like sending the higher-level parameter `groupHoppingDisabled`.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:GHDisable` on page 1045

6.3.5 NPUSCH settings

Access:

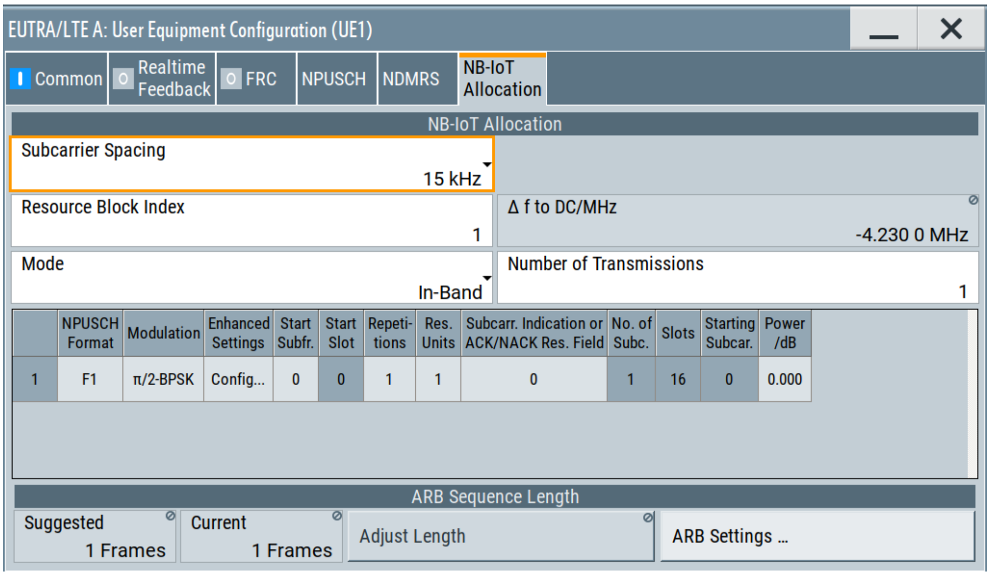
1. Select "General > UL Frame Configuration > UE x > 3GPP Release = NB-IoT".
2. Select "UE x > NPUSCH".



The provided settings are the same as for LTE, expect that NB-IoT does not support MIMO.
Hence, the "Transmission Mode = TM 1" and "Max. Number of AP for PUSCH = 1".
You can enable NPUSCH scrambling and channel coding and multiplexing, where the multiplexing mode is selected automatically, depending on the NPUSCH format. (See "NPUSCH formats" on page 395).

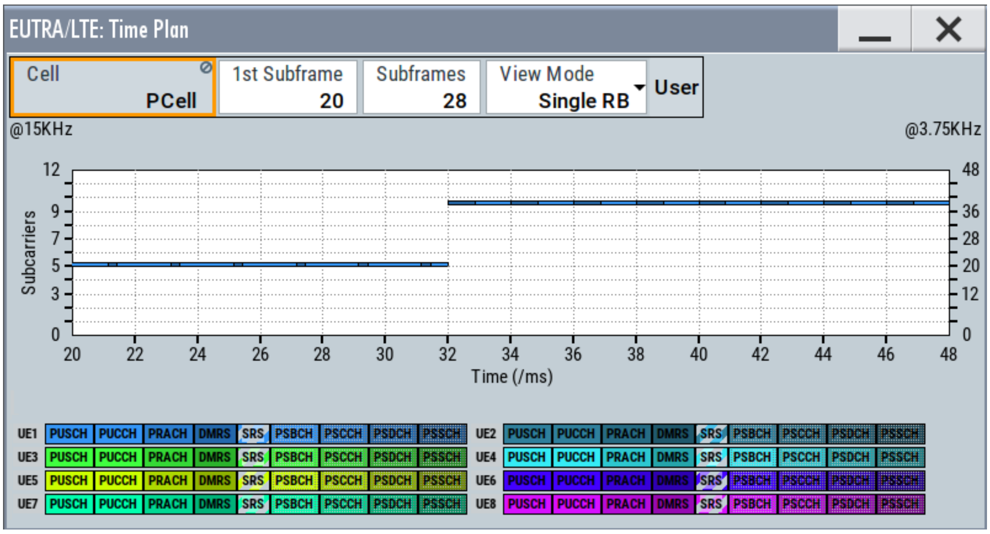
3. To configure the **NPUSCH transmission per UE**, select "Frame Configuration > UE x > NB-IoT Allocation"

   Other than in LTE, in NB-IoT the NB-IoT allocations (NPUSCH and NDMRS) are configured per UE.



The NB-IoT allocation is individual per UE, in terms of subcarrier spacing, operating mode and used resource block. There can be up to 10 NPUSCH transmissions per UE, each of them using different NPUSCH format and occupying different resources in the time and in the frequency domain.

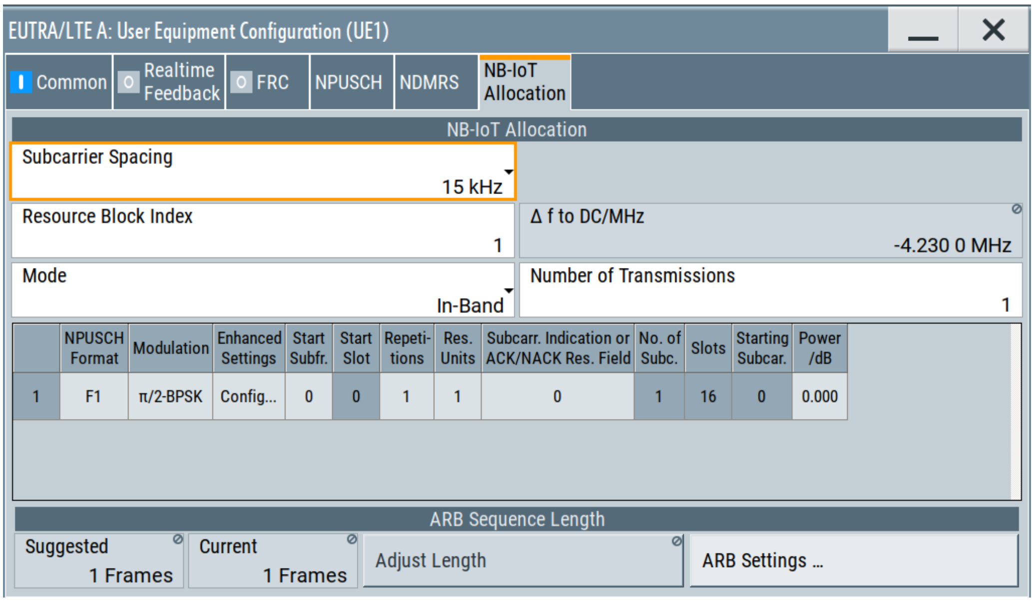
4. In the "NB-IoT Allocation" table, select "Transmission # > Enhanced Settings > Config" to configure the channel coding and multiplexing of an NB-IoT allocation. See Chapter 6.3.5.2, "NPUSCH enhanced settings", on page 453.
5. To observe the NPUSCH allocations, select "EUTRA/LTE > Frame Configuration > Time Plan".
   To zoom in and display a particular resource block, select "View Mode = Single RB".
   Select the resource block index used in the "NB-IoT Allocation" dialog.



Settings:

6.3.5.1 NB-IoT allocation settings

Access: see Chapter 6.3.5, "NPUSCH settings", on page 445.



Settings:

Subcarrier Spacing

Sets the subcarrier spacing Δf per UE.

See also Table 6-14.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:SCSPacing` on page 1045

Resource Block Index

Sets the resource block number in that the NB-IoT transmissions are allocated.

The available resource blocks depend on the used "Channel Bandwidth" (or "Number of Available Resource Blocks") and the operating "Mode".

Table 6-34: Resource block index value ranges

Operation mode	Resource block allocation	Value range
In-band	Within the "Channel Bandwidth"	0 to "Number of Available Resource Blocks"
Guard band	Left guard band	< 0
	Right guard band	> "Number of Available Resource Blocks"

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:RBINdex` on page 1045

Delta Frequency to DC, MHz

In "Mode > In-band/Guardband", indicates the delta frequency with that the NB-IoT carrier is offset form the LTE center frequency.

The value depends on "Resource Block Index" and in in-band mode and per default in the guardband mode it is calculated as follows:

"Delta Frequency" = $\Delta f_{NB\text{-}IoT}$*("RB Index"*N_{SC}^{RB} - floor(N_{RB}^{UL}*N_{SC}^{RB}/2) + N_{SC}^{RB}/2)

Where:

- $\Delta f_{NB\text{-}IoT}$ = "Subcarrier Spacing" = 15 kHz or 3.75 kHz is the NB-IoT subcarrier spacing
- N_{RB}^{UL} is the "Number of Resource Blocks per Slot"
- N_{SC}^{RB} = 12 is the number of subcarriers per RB

Thus, the possible values for the center frequencies of the NB-IoT channels are at 180 kHz offset to each other. In guard band mode, the you can change this spacing and set different "Delta Frequency to DC". If the set value does not correspond to a valid RB index, than the "RB Index = User".

According to the specification, the center frequencies of the NB-IoT channels in guard band mode must satisfy the following conditions:

- The first allocated NB-IoT RB must be orthogonal to the LTE RBs, whereas the following NB-IoT can be at 180 kHz or 15 kHz offset.
- The center frequencies of the NB-IoT carriers must satisfy the EARFCN conditions and hence be an integer multiple of 100 kHz; a raster of ±2.5 kHz and ±7.5 kHz is allowed, too.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:DFReq on page 1045

Mode
Selects the operating mode, see Figure 6-10.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:MODE on page 1046

Number of Transmissions
Enables up to 20 individual NPUSCH transmissions, where each transmission is configured in a separate row in the NPUSCH allocation table.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NTRansmiss on page 1046

NPUSCH Format
Sets the NPUSCH transmission format.

See "NPUSCH formats" on page 395.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:FORMat on page 1046

Modulation
Selects the modulation scheme for the NPUSCH transmission.

The available modulation schemes depend on the NPUSCH format, see Table 6-19.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:MODulation
on page 1046

Enhanced Setting > Config
Access dialogs with further channel coding and multiplexing settings.

The displayed settings depend on the selected NPUSCH format, see Chapter 6.3.5.2, "NPUSCH enhanced settings", on page 453

Starting Subframe (SF)
Sets the first subframe in that the NPUSCH transmission occurs and defines the NPUSCH position in the time domain.

Per default, each subsequent NPUSCH transmission of the same UE is allocated in the first possible SF following the end of the previous transmission. The following applies:

$StartSF_{NPUSCH,i+1} = StartSF_{NPUSCH,i} + (N_{Rep}^{NPUSCH,i} * N_{RU}^{NPUSCH,i} * N_{slot}^{RU}) + 1$

Use the "Time Plan" to observe the NPUSCH allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSFrame
on page 1047

Starting Slot

Indicates the starting slot of the first subframe in that the NPUSCH transmission occurs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSLot?
on page 1048

Repetitions

Sets how many times an NPUSCH transmission is repeated (N_{Rep}^{NPUSCH}).

N_{Rep}^{NPUSCH} = {1, 2, 4, 8, 16, 32, 64, 128}

The value is set automatically, if an FRC is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:REPetitions
on page 1047

Number of Resource Units N_{RU}

Sets the number of allocated resource units (N_{RU}^{NPUSCH}):

- For "NPUSCH Format = F1", N_{RU}^{NPUSCH} = {1, 2, 3, 4, 5, 6, 8, 10}
- For "NPUSCH Format = F2", N_{RU}^{NPUSCH} = 1

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NRUNits
on page 1047

Subcarrier Indication or ACK/NACK Resource Field

Sets the parameter that defines the NPUSCH position in the frequency domain, see Table 6-35.

Table 6-35: Parameters (without FRC) as function of NPUSCH format and subcarrier spacing

NPUSCH format	Parameter	Δf = 3.75 kHz	Δf = 15 kHz
F1	Subcarrier indication field I_{SC}	0 to 47	0 to 18
F2	ACK/NACK resource field	0 to 15	0 to 15

If a fixed reference channel (FRC) for NB-IoT is enabled, the values of subcarrier indication field depend on the selected FRC as follows. (See also Chapter 6.3.3, "FRC settings", on page 440).

Table 6-36: Subcarrier indication field I_{SC} values for FPC

FRC	A14-1	A14-2	A14-3	A14-4	A15-1	A15-2
I_{SC}	0 to 11	0 to 47	0 to 11	0 to 47	0 to 11	0 to 47

FRC	A16-1	A16-2	A16-3	A16-4	A16-5	A2.4-1
I_{SC}	0 to 47	0 to 11	12 to 15	16 to 17	18	0 to 47

FRC	A2.4-2	A2.4-3	A2.4-4	A2.4-5	A2.4-6	A2.4-7
I_{SC}	0 to 47	0 to 11	0 to 11	12 to 15	16 to 17	18

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:SIRF on page 1047

Number of Subcarriers
Display the allocated number of subcarriers (N_{SC}^{RU}).

- For "NPUSCH Format = F2" and for "NPUSCH Format = F1" with Δf = 3.75 kHz, n_{SC} = 1
- For "NPUSCH Format = F1" with Δf = 15 kHz, n_{SC} is calculated from the Subcarrier Indication Field I_{SC}.
  See Table 6-37

Table 6-37: Number of subcarriers (N_{SC}^{RU}) [TS 36.211]

Subcarrier indication field I_{SC}	Set of allocated subcarriers n_{SC}
0 to 11	I_{SC}
12	{0, 1, 2}
13	{3, 4, 5}
14	{6, 7, 8}
15	{9, 10, 11}
16	{0, 1, 2, 3, 4, 5}
17	{6, 7, 8, 9, 10, 11}
18	{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}
19 to 63	reserved

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSCarriers?
on page 1048

Slots
Indicates the allocated number of slots per RU N_{slot}^{RU}.

See Table 6-19.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSLTs? on page 1048

Starting Subcarrier
Indicates the subcarrier number of the first subcarrier in the NPUSCH transmission.

The value is calculated automatically for the allocated "Number of Subcarriers" and according to Table 6-37.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSCarrier?
on page 1048

Power, dB
Sets the power of the NPUSCH transmission P_{NPUSCH} relative to the UE power.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:POWer on page 1049

ARB Sequence Length
Comprises setting for automatic adjustment of the ARB sequence length.

Suggested ← ARB Sequence Length
- NB-IoT allocations:
  Indicates the ARB sequence length that is required for the selected NPUSCH transmissions.
- eMTC allocations:
  Number of frames required for the one complete transmission.
  The value is calculated as the sum of the Start_SF and n_{abs_SF}.

Use the "Adjust Length" function to apply the suggested value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:ARB:SUGGested? on page 1049
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:ARB:SUGGested? on page 1066

Current ← ARB Sequence Length
Indicates the current ARB sequence length.

Adjust Length ← ARB Sequence Length
Sets the ARB sequence length to the suggested value.

ARB Settings ← ARB Sequence Length
Opens the ARB dialog.

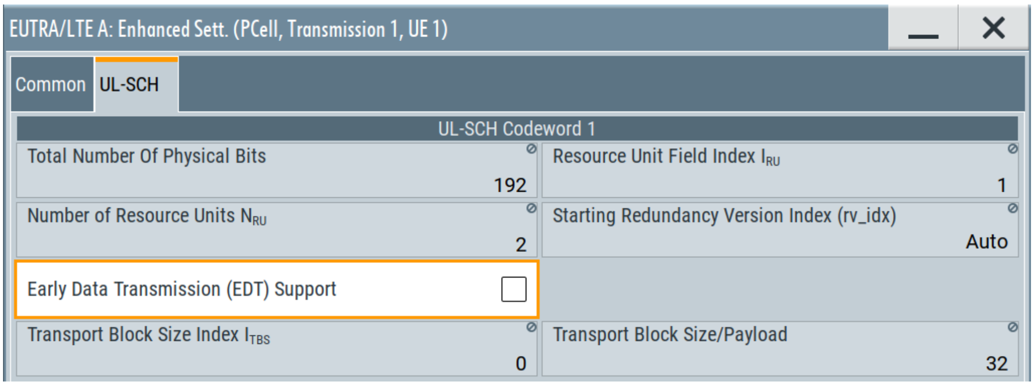
6.3.5.2 NPUSCH enhanced settings

Common

The "Common" settings dialog indicates the type of the selected channel and allows you to set the NPUSCH format, see "NPUSCH Format" on page 450.

UL-SCH

For "NPUSCH Format = F1", the "UL-SCH" dialog comprises settings concerning the transport block size.



Total Number of Physical Bits ← UL-SCH

Indicates the number of physical bits of the selected NPUSCH transmission.

The value is calculated as described in "Physical dimension of the NPUSCH allocation" on page 396.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:PHYSbits?`
on page 1052

Resource Unit Field Index I_{RU} ← UL-SCH

Indicates the resource unit (RU) field index I_{RU} selected depending on the used Number of RU N_{RU}^{NPUSCH}, see Table 6-38.

Table 6-38: RU field index [TS 36.213]

I_{RU}	N_{RU}^{NPUSCH}
0	1
1	2
2	3
3	4
4	5
5	6
6	8
7	10

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RUINdex?
on page 1052

Number of Resource Units N_{RU} ← UL-SCH

Sets the number of allocated resource units (N_{RU}^{NPUSCH}):

- For "NPUSCH Format = F1", N_{RU}^{NPUSCH} = {1, 2, 3, 4, 5, 6, 8, 10}
- For "NPUSCH Format = F2", N_{RU}^{NPUSCH} = 1

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NRUNits
on page 1047

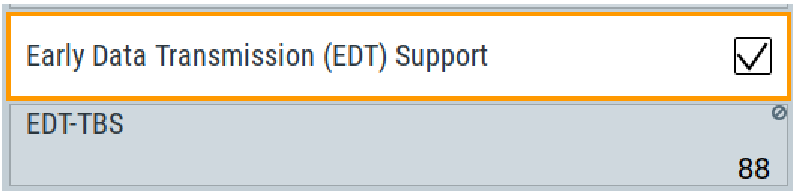
Starting Redundancy Version Idex (rv_ix) ← UL-SCH

Sets the starting redundancy version index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RVINdex
on page 1052

Early Data Transmission (EDT) Support ← UL-SCH

Enables or disables early data transmission.



Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ESUPport
on page 1051

EDT-TBS ← Early Data Transmission (EDT) Support ← UL-SCH

Sets the transport block size for early data transmission in UL.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETBS
on page 1051
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETRSize
on page 1051

Transport Block Size Index I_{TBS} ← UL-SCH

Sets the transport block size index I_{TBS}.

The value is used to retrieve the Transport Block Size/Payload.

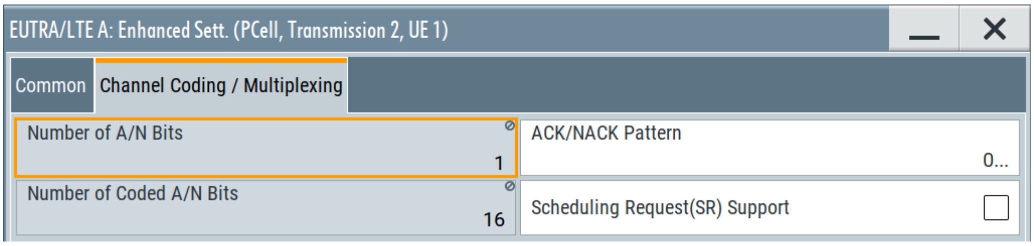
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBINdex
on page 1053

Transport Block Size/Payload ← UL-SCH
Indicates the transport block size.

The value is retrieved form the selected I_{RU} (Resource Unit Field Index I_{RU}) and I_{TBS} (Transport Block Size Index I_{TBS}), as defined in TS 36.211.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBSize?
on page 1053

Channel Coding / Multiplexing
For "NPUSCH Format = F2", the "Channel Coding / Multiplexing" dialog displays the predefined ACK/NACK configuration.



Number of A/N Bits ← Channel Coding / Multiplexing
NPUSCH format F2 uses 1 ACK/NACK bit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:BITS?
on page 1050

ACK/NACK Pattern ← Channel Coding / Multiplexing
Set the ACK/ANCK pattern as a sequence of 0 and 1.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:PATTern
on page 1050

Number of Coded A/N Bits ← Channel Coding / Multiplexing
For NPUSCH format F2, the number of coded bits is 16.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:CBITs?
on page 1050

Scheduling Request (SR) Support ← Channel Coding / Multiplexing
Option: R&S SMW-K146

If enabled, the SR symbols are multiplied with the C_{SR} sequence. The multilication is perfomed block-wise and according to TS 36.211.

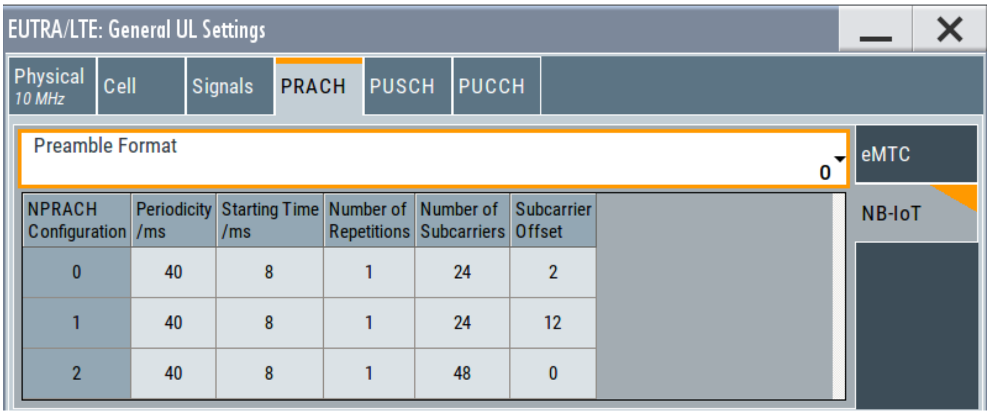
Enabled "Scheduling Request (SR) Support" corresponds transmission of the sr-WithHRAQ-ACK-Config field in the ScheduligRequenst Config-NB information element, according to TS 36.213.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:SR
on page 1051

6.3.6 NPRACH settings

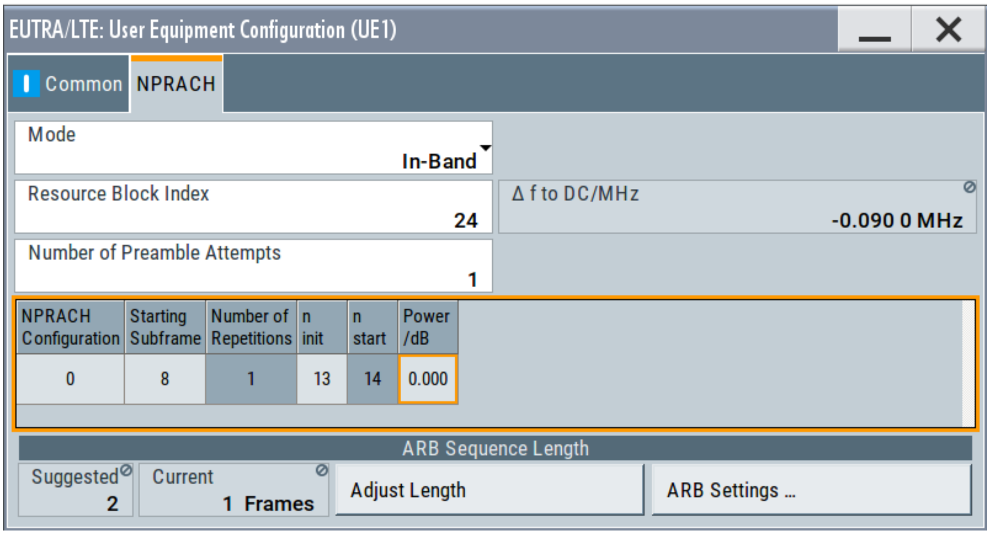
Access:

1. In the "General" dialog, select "Mode > eMTC/NB-IoT".
2. Select "Link Direction > Uplink (SC-FDMA)".
3. Select "General > General UL Settings > PRACH > NB-IoT".



With the provided settings, you can configure three NPRACH configurations for the different coverage levels.
For description of the related settings, see "NB-IoT NPRACH configurations" on page 459.

4. To allocate the NPRACH for a specific UE, use the following parameters:
   a) Select "UL Frame Configuration > UE1 > 3GPP Release = NB-IoT".
   b) Select "UE1 > Settings > Common > Mode = PRACH".
   c) Select "NPRACH".



You can change the number of preamble attempts, select one of the three NPRACH configurations and set the parameter n_{int} to define the start of the first symbol group.

For description of the related settings, see "NB-IoT NPRACH allocation per UE" on page 460.

5. If necessary, use the "Adjust Length" function to enable larger number of frames automatically so that the NPRACH frequency hopping pattern is completed.
6. Open the "Time Plan" to visualize the NPRACH allocation:
   a) Select "UL Frame Configuration > Time Plan".
   b) Select "View Mode > Single RB".
   c) Select the resource block index as configured in the "NPRACH" dialog.
      For example, select "RB = 24".
   d) Configure the subframes to be displayed, for example "1st Subframe = 0" and "Subframes = 20".

   The "Time Plan" shows the NPRACH.
   For example, see Figure 6-20.

NPRACH settings:

NB-IoT NPRACH configurations

Use the provided settings to configure three NPRACH configurations for the different coverage levels (CE).

See also:

- "NPRACH configuration" on page 398
- Example"NPRACH configuration" on page 399

The following parameters are specified in TS 36.211 as part of the SIB2-NB message:

Preamble Format ← NB-IoT NPRACH configurations

Select the preamble format.

The preamble formats use different cyclic prefix length, which results in different symbol group lengths.

Option: R&S SMW-K146

- To enable format 2, select "Duplexing = FDD"
- To enable formats 0-A and 1-A, select "Duplexing = TDD" and "TDD UL/DL Configuration = 1 to 5".

To observe the influence of this parameter, use the "Time Plan".

See also Figure 6-20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:PFMT` on page 1039

NPRACH configuration ← NB-IoT NPRACH configurations

Displays the NPRACH configuration number.

There are three NPRACH configurations, one per CE level. Each configuration is described with its time and frequency allocation and periodicity of occupancy.

Periodicity, ms ← NB-IoT NPRACH configurations

Sets the parameter $N_{periodicity}^{NPRACH}$ (`mprach-periodicity`).

It defines how often the NPRACH is scheduled. Available are periodicities between 40 ms and 2.56 s

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:PERD` on page 1039

Starting Time, ms ← NB-IoT NPRACH configurations

Define the start time of the specific NPRACH configuration (`nprach-StartTime`).

See Figure 6-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:STTM on page 1040

Number of Repetitions ← NB-IoT NPRACH configurations
Indicates the number of NPRACH repetitions per preamble attempt N_{rep}^{NPRACH} (maxNumPreambleAttemptCE-r13).

See Figure 6-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:REP on page 1040

Number of Subcarriers ← NB-IoT NPRACH configurations
Sets the number of NPRACH subcarriers N_{sc}^{NPRACH} (nprach-NumSubcarrierres).

See Figure 6-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SUBC on page 1040

Subcarrier Offset ← NB-IoT NPRACH configurations
Sets the parameter $N_{scoffset}^{NPRACH}$ (nprach-SubcarrierrOffset) and defines the frequency location of the first NPRACH subcarrier.

See Figure 6-20.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SCOF on page 1040

NB-IoT NPRACH allocation per UE
Use this setting to can change the NPRACH allocation per UE, for example:
- The number of preamble attempts
- To select one of the three NPRACH configurations
- To set the parameter n_{int} to define the start of the first symbol group.

See also:
- "NPRACH configuration" on page 398
- Example"NPRACH configuration" on page 399

Mode ← NB-IoT NPRACH allocation per UE
Selects the operating mode, see Figure 6-10.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:MOD on page 1056

Resource Block Index ← NB-IoT NPRACH allocation per UE
Defines the resource block in that the NPRACH is allocated.

The number of resource blocks depends on the selected "Channel Bandwidth" and is indicated with the parameter "UL General Settings > Physical > Number of Resource Blocks per Slot".

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:RBID on page 1056

Delta Frequency to DC, MHz ← NB-IoT NPRACH allocation per UE
In "Mode > In-band/Guardband", indicates the delta frequency with that the NB-IoT carrier is offset form the LTE center frequency.

The value depends on "Resource Block Index" and in in-band mode and per default in the guardband mode it is calculated as follows:

"Delta Frequency" = $\Delta f_{NB\text{-}IoT}$*("RB Index"*N_{SC}^{RB} - floor(N_{RB}^{UL}*N_{SC}^{RB}/2) + N_{SC}^{RB}/2)

Where:
- $\Delta f_{NB\text{-}IoT}$ = "Subcarrier Spacing" = 15 kHz or 3.75 kHz is the NB-IoT subcarrier spacing
- N_{RB}^{UL} is the "Number of Resource Blocks per Slot"
- N_{SC}^{RB} = 12 is the number of subcarriers per RB

Thus, the possible values for the center frequencies of the NB-IoT channels are at 180 kHz offset to each other. In guard band mode, the you can change this spacing and set different "Delta Frequency to DC". If the set value does not correspond to a valid RB index, than the "RB Index = User".

According to the specification, the center frequencies of the NB-IoT channels in guard band mode must satisfy the following conditions:
- The first allocated NB-IoT RB must be orthogonal to the LTE RBs, whereas the following NB-IoT can be at 180 kHz or 15 kHz offset.
- The center frequencies of the NB-IoT carriers must satisfy the EARFCN conditions and hence be an integer multiple of 100 kHz; a raster of ±2.5 kHz and ±7.5 kHz is allowed, too.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:DFReq` on page 1057

Number of Preamble Attempts ← NB-IoT NPRACH allocation per UE
Sets the parameter N_{rep}^{NPRACH} (`maxNumPreambleAttemptCE-r13`) to define how many times a preamble is repeated.

Each attempt can use different NPRACH configuration and different NPRACH time and frequency allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:PRATtempts` on page 1056

NPRACH Configuration ← NB-IoT NPRACH allocation per UE
For each preamble attempt, selects one of the NPRACH configurations configured in the NB-IoT NPRACH configurations dialog.

Any subsequent preamble attempt must use an equal or bigger NPRACH configuration number as the previous one.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:CONFig`
on page 1057

Starting Subframe ← NB-IoT NPRACH allocation per UE
For each preamble attempt, select the subframe (SF) number the first NPRACH symbol group appears for the first time.

See Figure 6-20.

The available subframes depend on the selected NPRACH Configuration in the current and the previous preamble attempts.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:SFSTart`
on page 1057

Number of Repetitions ← NB-IoT NPRACH allocation per UE

Indicates the number of NPRACH repetitions per preamble attempt N_{rep}^{NPRACH} (`maxNumPreambleAttemptCE-r13`).

See Figure 6-20.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:REP` on page 1040

n_{int} ← NB-IoT NPRACH allocation per UE

For each preamble attempt, sets the subcarrier index n_{int}, see "NPRACH allocation" on page 398.

The available subcarriers depend on the number of subcarriers in the selected "NPRACH Configuration", see "Number of Subcarriers" on page 460.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:INIT`
on page 1057

n_{start} ← NB-IoT NPRACH allocation per UE

Indicates the value n_{start}, calculated as function of the selected n_{int}.

To observe the influence of this parameter, use the "Time Plan".

See Figure 6-20.

See "NPRACH allocation" on page 398 for details on the calculation and information on all related parameters.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:STRT?`
on page 1058

Power ← NB-IoT NPRACH allocation per UE

Sets the preamble attempt power relative to the UE power.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:POWer`
on page 1058

ARB Sequece Length > Sugested

Indicates the ARB sequence length that is required for the NPRACH configuration.

Use the "Adjust Length" function to apply the suggested value.

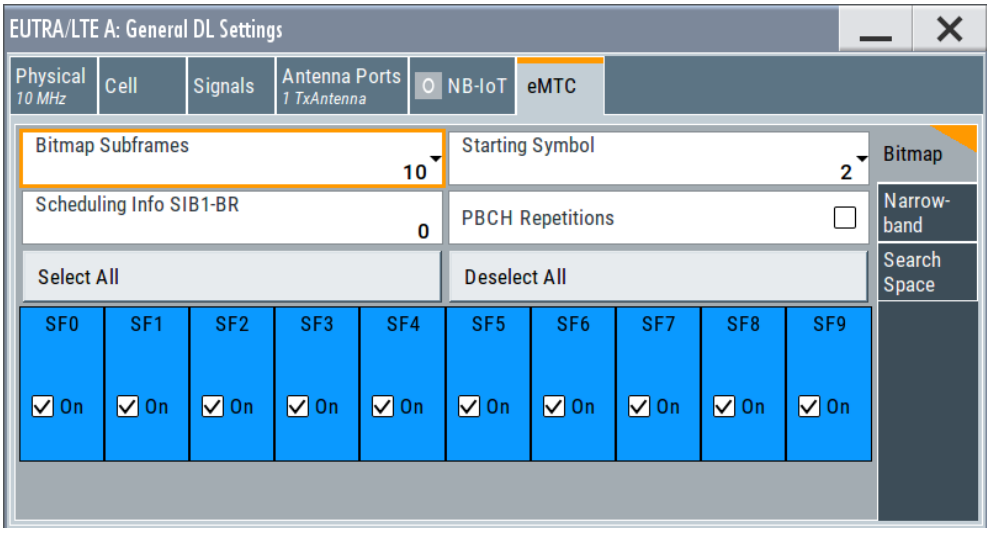
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:ARB:SUGGested?`
on page 1058

6.3.7 eMTC DL allocations settings

6.3.7.1 eMTC DL valid subframes and frequency hopping

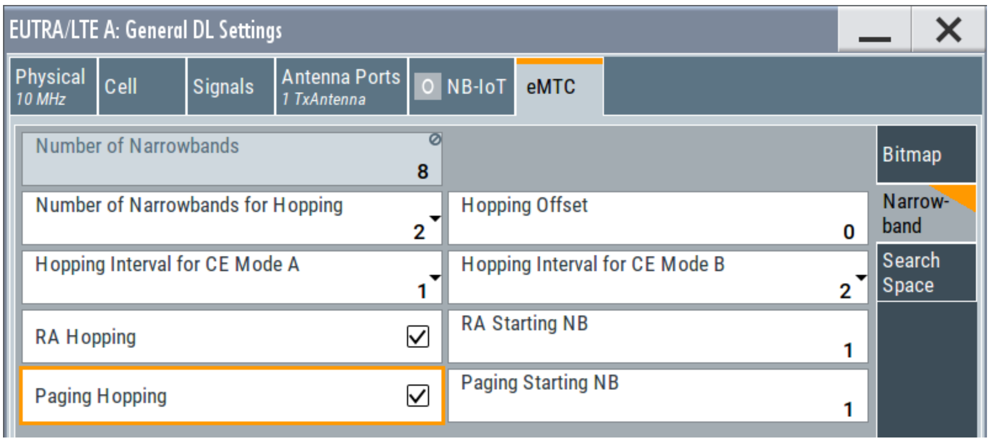
Access:

1. Select "General > Link Direction > Downlink".
2. Select "General > Duplexing > FDD".
3. Select "General DL Settings > eMTC > Bitmap".



4. To configure subframe allocation for eMTC transmission, select:
   a) "Bitmap Subframes = e.g. 10"
   b) A subframe (SF) to enable it for eMTC transmission.

   eMTC transmission is postponed during invalid subframes.
5. To define the cell-specific frequency-hopping patterns of PDSCH and MPDCCH, select "eMTC > Narrowbands".



For description of the common search space settings, see Chapter 6.3.7.2, "Search space settings", on page 466.

Settings:

Bitmap

Comprises general eMTC configuration settings. These settings include defining the valid subframes (SF) that can be used for eMTC transmission, reserving several symbols for the LTE control region, enabling PBCH repetition.

Bitmap Subframes ← Bitmap

Sets the valid subframes configuration over 10ms or 40ms (`subframePattern10-r13, subframePattern40-r13`).

The selected subframes influence the scheduling of the eMTC transmissions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SUBFrames` on page 980

Starting Symbol ← Bitmap

Defines the first symbol within a frame that can be used for eMTC. The parameter is used to protect the LTE control region.

The LTE control region length and thus the eMTC start symbol depends on the channel bandwidth:

- For "Channel Bandwidth ≥ 3MHz": 1, 2 or 3 symbols
- For "Channel Bandwidth = 1.4 MHz": 2, 3 or 4 symbols

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:STARt` on page 980

Scheduling Info SIB1-BR ← Bitmap

Sets the higher-level parameter `schedulingInfoSIB1-BR-r13` and defines the number of times the PDSCH allocation carrying the SIB1-BR is repeated, see Table 6-5.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SIBBr on page 980

PBCH Repetition ← Bitmap
For "Channel Bandwidth ≥ 3MHz", configures the cell for PBCH repetition.

If enabled, the PBCH is repeated as defined in TS 36.211.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:PBCHrep on page 981

Select All/Deselect All ← Bitmap
Sets all SFs as valid or invalid.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SELectlall|DESelectall
on page 981

SF State ← Bitmap
Sets an SF as valid or invalid.

If TDD duplexing is used, the UL subframes cannot be used for eMTC transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:VALSubframes<ch> on page 981

Narrowbands
Comprises settings for frequency-hopping configuration.

Number of eMTC Narrowbands ← Narrowbands
Option: R&S SMW-K115

This parameter is **dedicated to eMTC**.

It indicates the number of eMTC narrowbands N_{RB}^{DL} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 366.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:NNBands? on page 981

Number of Narrowbands for Hopping ← Narrowbands
Set the parameter `mpdcch-pdsch-HoppingNB-r13` ($N_{NB,hop}^{ch,DL}$) and defines the number of narrowbands (2 or 4) over which MPDCCH or PDSCH hops.

See also "PDSCH hopping" on page 368.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOPPing on page 982

Hopping Offset ← Narrowbands
Set the parameter `mpdcch-pdsch-HoppingOffset-r13` ($f_{NB,hop}^{DL}$) and defines the number of narrowbands between two consecutive MPDCCH or PDSCH hops.

See also "PDSCH hopping" on page 368.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOFFset on page 982

Hopping Interval for CE Mode A/B ← Narrowbands
Set the parameter interval-DLHoppingConfigCommon ($N_{NB}^{ch,DL}$) and defines the number of consecutive subframes during which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband.

Table 6-39: Hopping interval $N_{NB}^{ch,DL}$ value range per CE Mode

Duplexing	CE Mode A	CE Mode B
FDD	1, 2, 4, 8	2, 4, 8, 16
TDD	1, 5, 10, 20	5, 10, 20, 40

See also "PDSCH hopping" on page 368.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLA on page 982
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLB on page 982

RA Hopping ← Narrowbands
Enables hopping for the random access.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RHOPpping on page 982

RA Starting NB ← Narrowbands
If "RA Hopping > On", sets the first used narrowband.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RSTNb on page 983

Paging Hopping ← Narrowbands
Enables paging hopping.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PHOPping on page 982

Paging Starting NB ← Narrowbands
If "Paging Hopping > On", sets the first used narrowband.

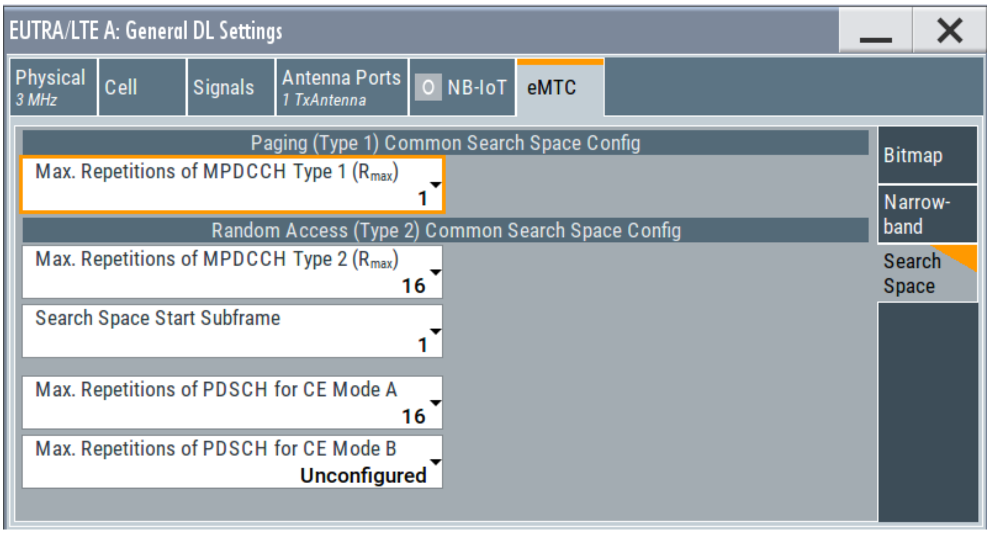
Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PSTNb on page 983

6.3.7.2 Search space settings

Access:

1. Select "General > Link Direction > Downlink".
2. Select "General DL Settings > eMTC > Search Space".

3. Select "Frame Configuration > General > User > UEx > Search Space > Config".



Settings:

Common Search Space

Configures the Type 1 (paging) and Type 2 (random access) common search space.

The common search space defines the MPDCCH candidates that the UE has to monitor.

Max. Repetitions of MPDCCH (Rmax) for Type 1 common search space ← Common Search Space

Sets the maximum number MPDCCH is repeated R_{Max} (`mpdcch-NumRepetitionPaging-r13`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD1` on page 983

Max. Repetitions of MPDCCH (Rmax) for Type 2 common search space ← Common Search Space

Sets the maximum number MPDCCH is repeated R_{Max} (`mpdcch-NumRepetitions-RA`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD2` on page 983

Search Space Start Subframe ← Common Search Space

Sets the start SF for the random access common search space (`mpdcch-StartSF-CSS-RA`).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:STSF` on page 983

Max. Repetitions of PDSCH for CE Mode A/B ← Common Search Space

Sets the cell-specific higher-layer parameter `pdsch-maxNumRepetitionCEmodeA`/ `pdsch-maxNumRepetitionCEmodeB` that defines the PDSCH subframe assignment, if the MPDCCH with DCI format 6-1A/6-1B/6-2 is detected.

- DCI format 6-1A: `pdsch-maxNumRepetitionCEmodeA` = {Unconfigured, 16, 32}
- DCI format 6-1B/6-2: `pdsch-maxNumRepetitionCEmodeB` = {Unconfigured, 192, 256, ..., 2048}

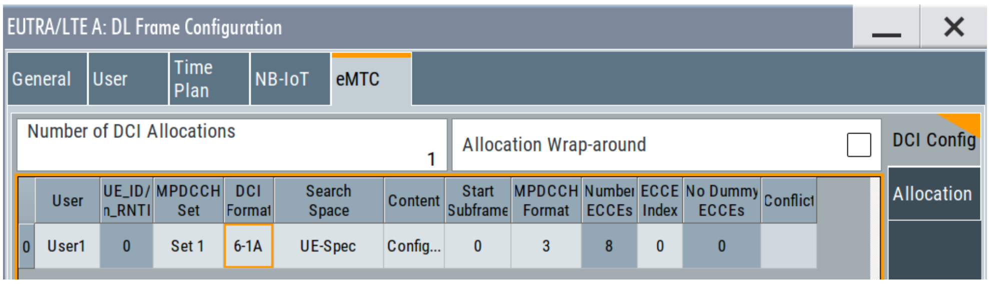
These parameters together with the DCI field PDSCH repetition number define the PDSCH repetitions, see "Repetition of PDSCH not carrying SIB1-BR" on page 368.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSA` on page 983
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSB` on page 984

6.3.7.3 eMTC DCI configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Enable at least one eMTC UE, i.e. select "Frame Configuration > General > User > User 1" > **"3GPP Release = eMTC CE: A/B"**.
3. Select "Frame Configuration > General > eMTC > DCI Configuration".
4. Select "Number of DCI Allocations = 1".
5. Configure the DCI allocations, e.g. select "User > User 1", "DCI Format = 6-1A" and "Start Subframe = 0".



6. For each DCI, select "Content > Config".

Settings:

Number of DCI Allocations

Sets up to 100 configurable DCIs.

There is one table row per DCI in the DCI table.

The default "Number of DCI Allocations" value depends on the availability of eMTC UEs:

- 0: if all "User" are set to NB-IoT.
  Changing the value to "Number of DCI Allocations = 1", enables you to configure P-RNTI or RA-RNTI DCIs.
- 1: if there is at least one "User" with "3GPP Release = eMTC CE: A/B".

Set "Number of DCI Allocations = 0" to disable the DCI-based eMTC configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:NALLoc` on page 1006

Allocation Wrap-around

An MPDCCH can schedule a PDSCH outside of the selected "ARB Sequence Length".

Enable this parameter to ensure a consistent signal, where the PDSCH allocations are relocated at the beginning of the ARB sequence.

`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:AWARound` on page 1007

User

Selects the user the DCI is dedicated to. The available DCI formats depend on the value of this parameter.

"User x" Selects one of the four users with "3GPP Release = eMTC CE: A/B", as configured in the "Frame Configuration > General > User" dialog.

"P-RNTI/RA-RNTI"
A group of users is selected.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:USER on page 1007

UE_ID/n_RNTI

Displays the UE_ID of the "User x" or the n_RNTI for the selected DCI.

The UE_ID is set with the parameter "Frame Configuration > General > User > User x" > UE ID/n_RNTI

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEID? on page 1007

MPDCCH Set

Selects the MPDCCH set by which the DCI is carried.

To enable the second set for "User = User x":

- Select "Frame Configuration > General > User > User x > EPDCCH/MPDCCH > Config"
- Set "Set 2 > State > On".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MPDCchset on page 1008

DCI Format

Sets the DCI format for the selected allocation.

The downlink control information (DCI) is a message used to control the physical layer resource allocation in the UL and DL direction. It carries scheduling information and uplink power control commands.

Depending on the DCI message usage, they are categorized into the following formats: 3/3A, 6-0A/6-0B, 6-1A/6-1B, 6-2.

See Table 6-10.

To configure the parameters per DCI format, select "Content > Config".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:FMT on page 1008

Search Space

Defines the search space for the selected DCI.

The search space defines the MPDCCH candidates that the UE has to monitor. The UE can decode only the control information on an MPDCCH that is transmitted over ECCEs within the search space the UE monitors.

"UE-spec" Non-common DCIs are mapped to the UE-specific search space. Each UE has multiple UE-specific search spaces, determined as a function of its UE ID.

"Type 0 Common/Type 1 Common/Type 2 Common"
The DCI is mapped to the common search space, where:
- Type 1 common search space is used for paging
- Type 2 for random access
- Type 0 common search space is available for "User x > 3GPP Release = eMTC CE-Mode A".

A common search space is used to address all or a group of UEs.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SSP on page 1008

DCI Content Configuration
Configure the parameters per DCI format.

The fields defined in the DCI format are mapped to the information bits according to the 3GPP specification.

The resulting Transport Block Size, Repetitions of MPDCCH, Repetitions of PDSCH, PDSCH Hopping and Starting Redundancy Version values are displayed.

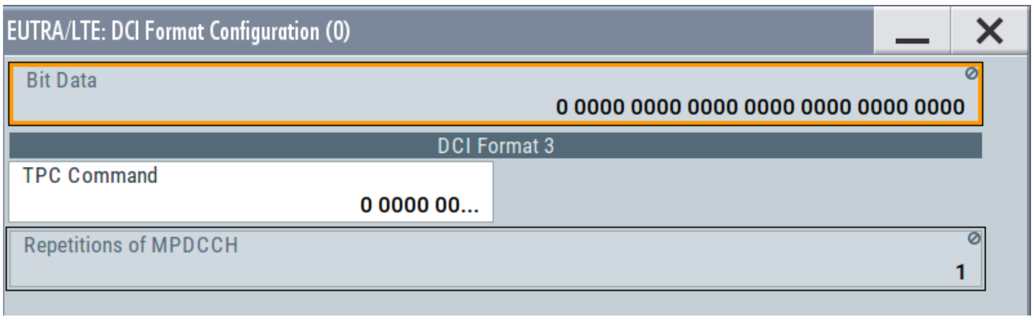
Bit Data ← DCI Content Configuration
Displays the resulting bit data as selected with the DCI format parameters.

The first bit in DCI formats pairs 6-0A and 6-1A, and 6-0B and 6-1B is used as flag to distinguish between the two formats in a pair. It is set as follows:
- DCI format 6-0A/6-0B: First bit = 0
- DCI format 6-1A/6-1B: First bit = 1

Mapping of the information bits is according to TS 36.212.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:BITS? on page 1010

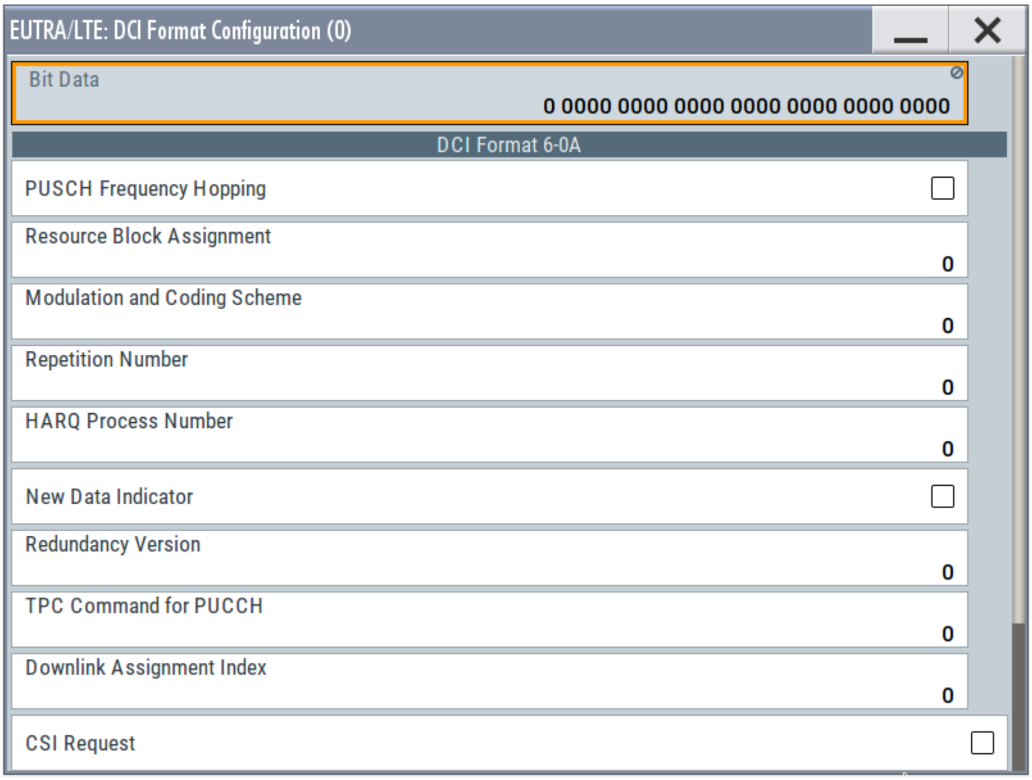
DCI Format 3/3A ← DCI Content Configuration
The DCI Format 3/3A is used for the transmission of TPC Commands for MPUCCH and PUSCH with 2-bit and a single bit power adjustment respectively.



The "TPC Command" is set as a bit pattern.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TCMD on page 1012

DCI Format 6-0A/6-0B ← DCI Content Configuration
The DCI formats 6-0A and 6-0B are used for scheduling of PUSCH in one UL cell, where the formats are used in CE Mode A and CE Mode B respectively.



DCI format 6-0A and 6-0B transmit the information listed in Table 6-40.

Among other, these DCIs carry information on:

- "PUSCH Frequency Hopping": sets the hopping dynamically on a per transmission basis.
  This filed has higher priority as the cell-specific hopping configuration, see Chapter 6.3.8.1, "Cell-specific eMTC PUSCH settings", on page 495.
- "Repetition Number": sets the PUSCH repetition level (n_1 to n_4 or n_8 in DCI formats 6-0A and 6-0B)
- "DCI Subframe Repetition Number": sets the MPDCCH repetition level (r_1 to r_4), see "MPDCCH repetition number" on page 373.

Table 6-40: DCI format 6-0A and 6-0B control information fields

Control Information Field	SCPI command	Dependencies
"PUSCH Frequency Hopping"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PFRHopp` on page 1012	DCI Format 6-0A
"Resource Block Assignment"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA` on page 1013	See Table 6-41.
"Modulation and Coding Scheme"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS` on page 1013	
"Repetition Number"	`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP` on page 1013	"DCI Format 6-0A": 0 to 3 "DCI Format 6-0B": 0 to 7

Control Information Field	SCPI command	Dependencies
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HARQ on page 1013	"DCI Format 6-0A": 0 to 7 "DCI Format 6-0B": 0 to 1
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDINd on page 1014	
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RVER on page 1014	DCI Format 6-0A
"TPC Command for Scheduled PUSCH"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPCPusch on page 1014	DCI Format 6-0A
"UL Index"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:ULINdex on page 1014	DCI Format 6-0A TDD mode and "UL/DL Configuration = 0"
"Downlink Assignment Index (DAI)"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DAINdex on page 1015	DCI Format 6-0A TDD mode and "UL/DL Configuration = 1 to 6"
"CSI Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CSIRequest on page 1015	DCI Format 6-0A
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SRSRequest on page 1015	DCI Format 6-0A
"DCI Subframe Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber on page 1016	For "MPDCCH > Max. Repetitions for MPDCCH Rmax ≥ 2"

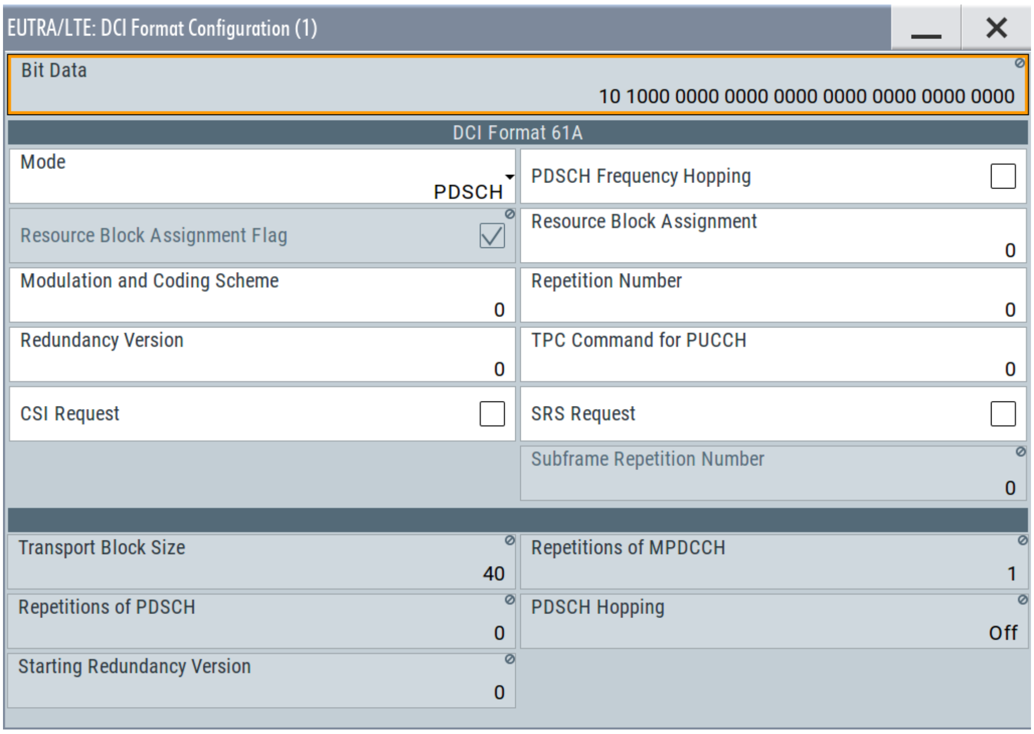
Table 6-41: Control information field Resource Block Assignment value range

Channel Bandwidth	DCI Format 6-0A	DCI Format 6-0B
1.4 MHz	0 to 31	0 to 7
3 MHz	0 to 63	0 to 15
5 MHz	0 to 127	0 to 31
10 MHz	0 to 255	0 to 63
15/20 MHz	0 to 511	0 to 127

In certain cases defined in TS 36.212, zeros are appended to the DCI format 6-0B until its payload size is equal to the size of DCI format 6-0A.

DCI Format 6-1A/6-1B ← DCI Content Configuration

DCI formats 6-1A and 6-1B are used for the compact scheduling of one PDSCH codeword in one cell and random access procedure initiated by a PDCCH order. The two formats are used in CE Mode A and CE Mode B respectively.



DCI format 6-1A and 6-1B transmit the information listed in Table 6-42 and Table 6-43, for PDSCH or PRACH mode respectively.

In certain cases defined in TS 36.212, zeros are appended to:

- DCI format 6-1A until its payload size is equal to the size of DCI format 6-0A
- DCI format 6-1B until its payload size is equal to the size of DCI format 6-0B.

Among other, these DCIs carry information on:

- "PDSCH Frequency Hopping": sets the hopping dynamically on a per transmission basis.
  This filed has higher priority as the cell-specific hopping configuration.
- "Repetition Number": sets the PDSCH repetition level (n_1 to n_4 or n_8 in DCI formats 6-0A and 6-0B), see "Repetition of PDSCH not carrying SIB1-BR" on page 368.
- "DCI Subframe Repetition Number": sets the MPDCCH repetition level (r_1 to r_4), see "MPDCCH repetition number" on page 373.
- "Resource Block Assignment": defines the PDSCH Start NB and No. RB

Table 6-42: Control information fields in Mode = PDSCH

Control Information Field	SCPI command	Dependencies
"Mode"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEMode on page 1016	
"Frequency Hopping"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PFRHopp on page 1012	DCI Format 6-1A

Control Information Field	SCPI command	Dependencies
"Resource Block Assignment Flag"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBAF? on page 1012	Option: R&S SMW-K143 DCI Format 6-1A "Channel Bandwidth = 20 MHz" and "Wideband Config = 20 MHz"
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA on page 1013	See Table 6-44.
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS on page 1013	• DCI Format 6-1A: 0 to 15 • DCI Format 6-1B: 0 to 10
"Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP on page 1013	
"HARQ Process Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HARQ on page 1013	"User x" • FDD: 0 to 7 • TDD: 0 to 15
"New Data Indicator"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDINd on page 1014	"User x"
"Redundancy Version"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RVER on page 1014	DCI Format 6-1A
"TPC Command for PUCCH"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPCPusch on page 1014	DCI Format 6-1A
"Downlink Assignment Index (DAI)"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DAINdex on page 1015	DCI Format 6-1A "User x" TDD mode and "UL/DL Configuration = 1 to 6"
"Antenna Ports and Scrambling Identity"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:APSI on page 1016	DCI Format 6-1A "User x" with "Tx Mode = TM9" and "Search Space = UE-specific"
"CSI Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CSIRequest on page 1015	DCI Format 6-1A
"SRS Request"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SRSRequest on page 1015	DCI Format 6-1A
"TPMI Information for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPMPrec on page 1017	DCI Format 6-1A "User x" with "Tx Mode = TM6" and "Search Space = UE-specific"

Control Information Field	SCPI command	Dependencies
"PMI Confirmation for Precoding"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PMIConfirm on page 1017	DCI Format 6-1A "User x" with "Tx Mode = TM6" and "Search Space = UE-specific"
"HARQ-ACK Ressource Offset"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HRESoffset on page 1016	"User x"
"DCI Subframe Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber on page 1016	For "MPDCCH > Max. Repetitions for MPDCCH Rmax ≥ 2"

Table 6-43: Control information fields in Mode = PRACH

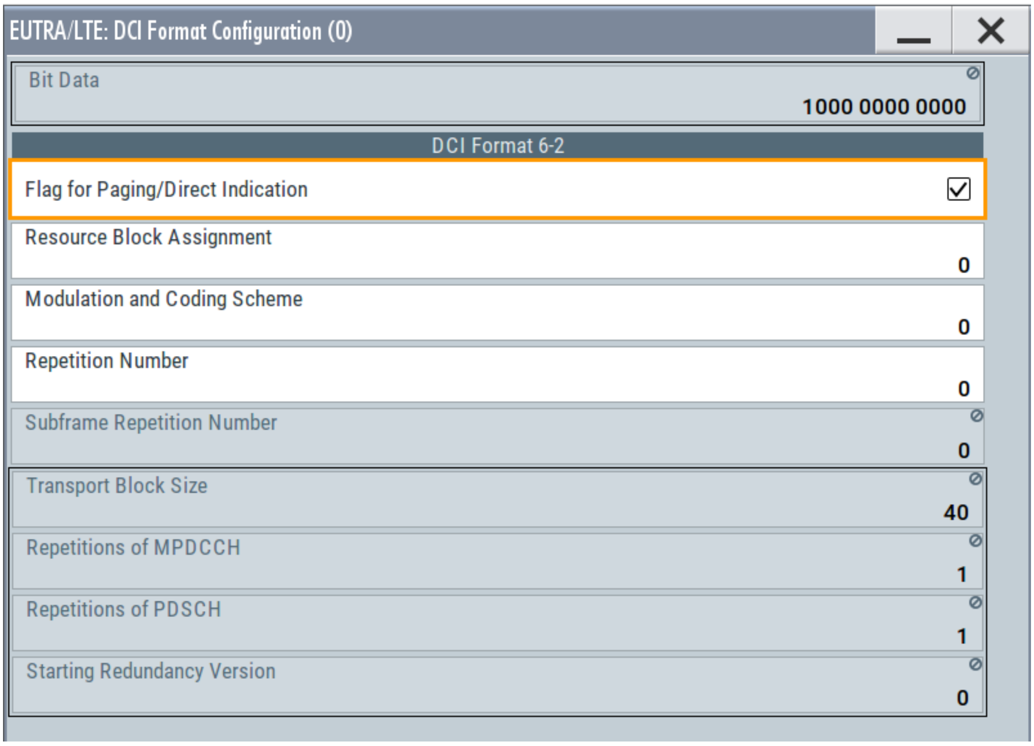
Control Information Field	SCPI command	Dependencies
"Mode"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEMode on page 1016	
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA on page 1013	DCI Format 6-1A See Table 6-44.
"Preamble Index"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble on page 1017	
"PRACH Mask Index"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAMask on page 1017	
"Starting CE Level"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAStart on page 1018	

Table 6-44: Control information field Resource Block Assignment value range

Channel Bandwidth	DCI Format 6-1A PDSCH and PRACH modes	DCI Format 6-1B
1.4 MHz	0 to 31	0 to 1
3 MHz	0 to 63	0 to 3
5 MHz	0 to 127	0 to 7
10 MHz	0 to 255	0 to 15
15/20 MHz	0 to 511	0 to 31

DCI Format 6-2 ← DCI Content Configuration

The DCI format 6-2 is used for paging and direct indication. It is available for "User = P-RNTI".



DCI format 6-2 transmits the following information.

Control Information Field	SCPI command	Dependencies
"Flag for Paging/ Direct Indication"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PAGNg on page 1018	
"Direct Indication Information"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DIINfo on page 1018	
"Modulation and Coding Scheme"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS on page 1013	
"Resource Block Assignment"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA on page 1013	Value range depends on the "Channel Bandwidth": • 1.4 MHz: 0 • 3 MHz: 0 to 1 • 5 MHz: 0 to 3 • 10 MHz: 0 to 7 • 15 MHz: 0 to 12 • 20 MHz: 0 to 15

Control Information Field	SCPI command	Dependencies
"Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP on page 1013	See "Repetition of PDSCH not carrying SIB1-BR" on page 368.
"DCI Subframe Repetition Number"	[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber on page 1016	For "MPDCCH > Max. Repetitions for MPDCCH Rmax ≥ 2"

Transport Block Size ← DCI Content Configuration
Indicates the TBS, calculated for the selected "Modulation and Coding Scheme" and "Resource Assignment Field".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TBS? on page 1010

Repetitions of MPDCCH ← DCI Content Configuration
Displays the resulting number of MPDCCH repetitions, calculated for the selected "DCI Subframe Repetition Number".

See "MPDCCH repetition number" on page 373.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPMpdcch? on page 1011

Repetitions of PDSCH ← DCI Content Configuration
Displays the resulting number of PDSCH repetitions, calculated from the selected "Repetition Number".

See "Repetition of PDSCH not carrying SIB1-BR" on page 368.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPPdsch? on page 1011

PDSCH Hopping ← DCI Content Configuration
Indicates if PDSCH hopping is enabled or not, as set with the DCI form 6-1A/B field "PDSCH Frequency Hopping".

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDSHopping? on page 1011

Starting Redundancy Version ← DCI Content Configuration
Indicates the starting RV, calculated from the value of the "Redundancy Version" field.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STRV? on page 1012

Start Sufbrame
Sets the next valid starting subframe for the particular MPDCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STSFrame on page 1008

MPDCCH Format
Selects one of the five MPDCCH formats, where the available values depend on the "Search Space":
- "Search Space = UE-spec": MPDCCH formats 0 to 5
- "Search Space = Type 0 common": MPDCCH formats 2, 3 and 5
- "Search Space = Type 1 common": MPDCCH format 5
- "Search Space = Type 2 common": MPDCCH formats 2, 3 and 5

MPDCCH format defines the "Number ECCEs", see Table 6-6.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDCCh on page 1009

Number ECCEs
MPDCCH is transmitted on an aggregation of one or two consecutive control channel elements (ECCE).

The value is selected automatically, depending on the selected MPDCCH format, see Table 6-6.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CCES? on page 1009

ECCE Index
For UE-specific search space, sets the ECCE start index.

The available ECCEs depend on the selected MPDCCH Format.

ECCE index	Occupied subcarriers per subframe
0	0 to 5
1	6 to 11

See also Figure 6-14.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:IDCCe on page 1009

No. Dummy ECCEs
Indicates the number of dummy ECCEs that are appended to the corresponding MPDCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDCCes? on page 1010

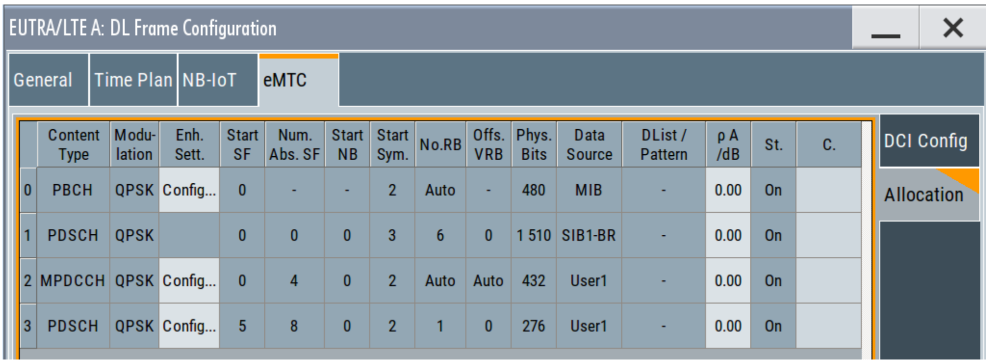
Conflict
Indicates a conflict between two DCI formats, for example if they have the same ECCE index and start subframe.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CONFlict?
on page 1010

6.3.7.4 eMTC allocations (PBCH, MPDCCH, PDSCH)

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > eMTC > Allocation".
3. Select "ρ A" to boost the power of a particular allocation.



The PBCH allocation and the SIB1-BR transmissions are configured automatically, but the PBCH allocation can be changed.
The PDSCH and MPDCCH allocations are configured according to the current DCI configuration, see Chapter 6.3.7.3, "eMTC DCI configuration", on page 468. Merely some of the PDSCH precoding settings can be adjusted and scrambling and channel coding disabled.

Settings:

Allocation number
Consecutive number of the allocation.

Content Type
Indicates the channel type.

Allocation number	Channel	Description
0	PBCH	Broadcast channel
1	• PDSCH SIB1-BR • MPDCCH	• If PBCH is scheduled and Scheduling Info SIB1-RB ≥ 1, one PDSCH that carries the SIB1-BR message is automatically configured Otherwise, MPDCCH is configured
> 1	• MPDCCH • MPDCCH and PDSCH	Allocated automatically, depending on the current DCI configuration, Chapter 6.3.7.3, "eMTC DCI configuration", on page 468: • One MPDCCH per P-RNTI, RA-RNTI and DCI of an active eMTC user, see "Configure User" > 3GPP Release • One pair per: – DCI format 6-1A/B used for PDSCH scheduling of an active eMTC user or RA-RNTI – DCI format 6-2 with "Flag for Paging/Direct Indication = On".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONType?` on page 1019

Modulation
Indicates the modulation per channel.

eMTC allocations are QPSK modulated, but the PDSCH allocations not carrying SIB1-BR can also use 16QAM. The modulation scheme in the latter case is defined by the DCI filed "Modulation and Coding Scheme".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:MODulation?` on page 1019

Enhanced Settings > Config
Accesses the precoding, scrambling and channel coding settings of the selected channel, see Chapter 6.3.7.6, "PDSCH channel coding and scrambling", on page 487.

To configure the MPDCCH settings, select "Frame Configuration > General > User > User x > 3GPP Release = CE Mode A/B > EPDCCH/MPDCCH > Config".

Start SF
Indicates the first subframe where the channel can be allocated.

PBCH and PDSCH carrying SIB1-BR always start in the first subframe.

The start subframe of a PDSCH allocation associated with an MPDCCH transmission is calculated as follows:

$\text{Start SF}_{PDSCH} = \text{Start SF}_{MPDCCH} + N_{abs}^{MPDCCH} + 2$

Where N_{abs}^{MPDCCH} depends on the N_{rep}^{MPDCCH} and the valid eMTC DL subframes, see:
- "Repetitions of MPDCCH" on page 478
- "SF State" on page 465

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSFrame?` on page 1020

Num. Abs. SF
Indicates the number of absolute subframes, i.e. number of subframes the allocation spans.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:ABSFrames?` on page 1020

Start NB
Indicates the first narrowband where the channel can be allocated.

- For MPDCCH, the value resembles the one set with the parameter "User > MPDCCH Config" > Starting NB
- For PDSCH not carrying SIB1-BR, the value is determined by the DCI field "3GPP Release = CE Mode A".
- The scheduling and hopping pattern of the PDSCH carrying SIB1-BR incl. all related parameter is performed automatically, as defined in TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STNB?` on page 1020

Start Symbol
Indicates the first symbol where the channel can be allocated.

The PDSCH carrying SIB1-BR starts always at symbol#3. The start symbol for all other allocations resembles the value set with "General Settings > eMTC > Bitmap" > Starting Symbol.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSYmbol?` on page 1020

No. RB
Indicates used number of resource blocks and thus the allocation's bandwidth.

For PDSCH not carrying SIB1-BR, the value is determined by the DCI field "3GPP Release = CE Mode A".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:NORB?` on page 1021

Offset VRB
Values different than 0 indicate resource block shift within the narrowbands.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:OVRB?` on page 1021

Phys. Bits
Displays the allocation size in bits. The value is calculated similar to the physical bits value in NB-IoT, see "Phys. Bits" on page 431.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits?` on page 1021

Data Source
Indicates the data source depending on the "Content Type".

The data source is configurable for:
- PBCH with "PBCH > Config > Channel Coding > MIB (including SFN) = Off"
- PDSCH SIB1-BR allocation
- PDSCH allocations that are configured for "eMTC > DCI Config > User = P-RNTI or RA-RNTI"

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DATA on page 1022
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DSELect on page 1022
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PATTern on page 1022

ρ A
Sets the power P_{MPDCCH} or P_{PDSCH} (ρ A) of the selected allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:POWer on page 1023

State
Indicates that the allocation is active.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STATe? on page 1023

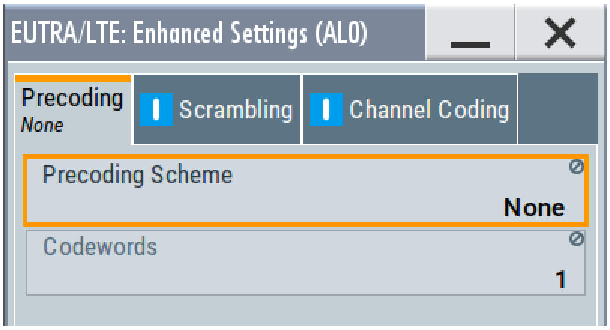
Conflict
Indicates a conflict between allocations.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONFlict? on page 1023

6.3.7.5 PBCH channel coding and SIB-BR configuration

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > eMTC > Allocation".
3. Select "PBCH > Enchanced Settings > Config".



PBCH can be generated in one of the following modes:

- Without channel coding, if "Channel Coding > State > Off"
  Dummy data or user-defined data lists are used.
- Channel coding with arbitrary transport block content
  If channel coding is activated ("Channel Coding > State > On") and parameter "MIB (including SFN) > Off"
- Channel coding with real data (MIB) including SFN
  If channel coding and "MIB (including SFN)" are activated
  This mode is required for the generation of SIB1-BR message.

Settings:

Precoding
Comprises the precoding settings.

Most of the parameters are set automatically, depending on the selected:
- [Tx Mode] of the corresponding UE ("Frame Configuration > UEx > Tx Mode")
- Number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration"

See also Table 6-11.

Precoding Scheme ← Precoding
Selects the precoding scheme.

"None" Disables precoding.

"Tx Diversity"
If "Global MIMO Configuration ≥ 2 Tx Antennas", select precoding for transmit diversity.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCHeme`
on page 1024

Number of Layers ← Precoding
Displays the number of layers for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:NOLayers?`
on page 1025

Scrambling
Comprises the scrambling settings.

Scrambling State ← Scrambling
Enables scrambling.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe`
on page 1029

UE ID/n_RNTI ← Scrambling
Indicates the user equipment identifier (n_RNTI) or UE ID of the user to which the PDSCH transmission is intended. The displayed "UE ID/n_RNTI" value is used to calculate the scrambling sequence.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:UEID?`
on page 1029

Channel Coding
Comprises the channel coding settings. Channel coding state is configurable. All other settings are configured automatically.

Channel Coding State ← Channel Coding
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:STATe
on page 1029

Type Channel Coding ← Channel Coding
Displays the used channel coding scheme and channel coding rate.

PBCH uses always tail biting convolution coding with code rate 1/3; PDSCH uses always turbo code with code rate 1/3.

Remote command:
n.a.

Number of Physical Bits ← Channel Coding
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits? on page 1021

MIB (including SFN) ← Channel Coding
Enables transmission of real MIB (master information block) data. The SFN (system frame number) is included as well.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MIB on page 1030

SFN Offset ← Channel Coding
By default, the counting of the SFN (system frame number) starts with 0. This parameter sets a different start SFN value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SOFFset
on page 1031

SFN Restart Period ← Channel Coding
Determines the time span after which the SFN (system frame number) restarts.

"Sequence Length"
The SFN restart period is equal to the ARB sequence length.

"3GPP (1024 Frames)"
The PBCH including SFN is calculated independently from the other channels. The SFN restarts after 1024 frames and the generation process is fully 3GPP compliant, but the calculation can take long time.
Tip: Use the "3GPP (1024 Frames)" mode only if 3GPP compliant SFN period is required.
This mode is disabled if a baseband generates more than one carrier.
Depending on the configured "System Configuration > Mode > Advanced", this parameter is not available in all baseband blocks.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SRPeriod
on page 1032

Scheduling Info SIB1-RB ← Channel Coding
Sets the parameter `schedulingInfoSIB1-RB` that defines the PDSCH number of repetitions N_{Rep}^{PDSCH}. the resulting value is indicated with PDSCH Repetitions SIB1-RB.

The parameter works like the setting "General DL > eMTC > Bitmap" > Scheduling Info SIB1-BR.

For "Scheduling Info SIB1-RB = 0" there is no PDSCH carrying SIB1-BR scheduled and hence no such allocation in the eMTC allocation table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SIB` on page 1031

PDSCH Repetitions SIB1-RB ← Channel Coding
Indicates the number of PDSCH repetitions N_{Rep}^{PDSCH}, as defined with the parameter Scheduling Info SIB1-RB.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:RSIB?`
on page 1031

MIB Spare Bits ← Channel Coding
Sets the 5 spare bits in the PBCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MSPare`
on page 1031

Transport Block Size/Payload (DL) ← Channel Coding
Displays the size of the transport block/payload in bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSize?`
on page 1030

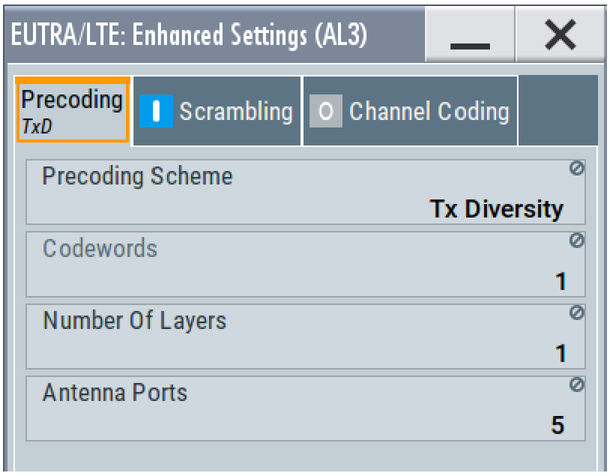
6.3.7.6 PDSCH channel coding and scrambling

Access:

1. Select "General > Link Direction > Downlink".
2. Select "Frame Configuration > General > eMTC > Allocation".
3. Select "PDSCH > Enchanced Settings > Config".

   The displayed settings depends on the:
   - Number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration")
   - "Tx Mode" of the corresponding UE.

   See also Table 6-11.



Settings:

Precoding
Comprises the precoding settings.

Most of the parameters are set automatically, depending on the selected:
- "Tx Mode" of the corresponding UE ("Frame Configuration > UEx > Tx Mode")
- Number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration"

See also Table 6-11.

Precoding Scheme ← Precoding
Indicates the precoding scheme.

"None" Precoding is disabled.

"Spatial Multiplexing/Tx Diversity/Beamforming (UE-spec.RS)"
For "General DL Settings > Antenna Ports > Global MIMO Configuration ≥ 2 Tx Antennas", indicates that precoding for spatial multiplexing, beamforming or transmit diversity is performed according to TS 36.211.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCHeme` on page 1024

Transmission Scheme ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the used transmission scheme.

See Table 6-11.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme?` on page 1026

Number of Layers ← Precoding
Displays the number of layers for the selected allocation.

See also Table 6-11.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:NOLayers?` on page 1025

Codeword ← Precoding
Displays the number of the codeword and the total number of codewords used for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CODWords?` on page 1024

Cyclic Delay Diversity ← Precoding
If "Precoding Scheme = Spatial Multiplexing", sets the CDD for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CCD` on page 1025

Codebook Index ← Precoding
If "Precoding Scheme = Spatial Multiplexing/Beamforming (UE-spec.RS)", sets the codebook index for the selected allocation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CBINdex` on page 1025

Antenna Ports ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the antenna ports for the current "Transmission Scheme".

The value is selected from the Tx Mode of the corresponding UE and the number of Tx antennas ("General DL Settings > Antenna Ports > Global MIMO Configuration").

See Table 6-11.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP?` on page 1026

Scrambling Identity n_SCID ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the scrambling identity (as of TS 36.211).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCID?` on page 1027

Antenna Port Mapping ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", indicates the way that the logical antenna ports are mapped to the physical TX antennas.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:APM?` on page 1027

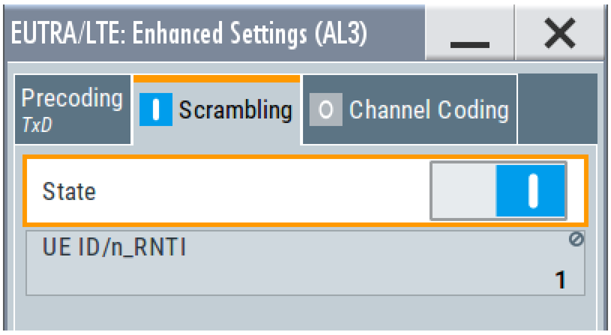
Mapping Coordinates ← Precoding
For "Precoding Scheme = Beamforming (UE-spec.RS)", switches between the "Cartesian" and "Cylindrical" coordinates representation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:DAFormat` on page 1027

Mapping Table ← Precoding
Defines the mapping of the antenna ports (AP) to the physical antennas

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:REAL?` on page 1028
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:IMAGinary?` on page 1028

Scrambling
Comprises the scrambling settings.



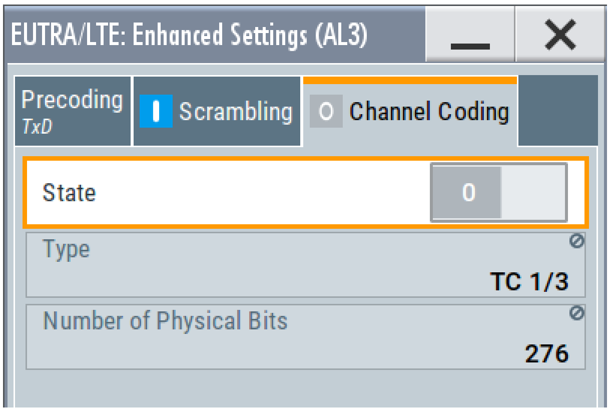
Scrambling State ← Scrambling
Enables scrambling.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe
on page 1029

UE ID/n_RNTI ← Scrambling
Indicates the user equipment identifier (n_RNTI) or UE ID of the user to which the PDSCH transmission is intended. The displayed "UE ID/n_RNTI" value is used to calculate the scrambling sequence.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:UEID?
on page 1029

Channel Coding
Comprises the channel coding settings. Channel coding state is configurable. All other settings are configured automatically.



Channel Coding State ← Channel Coding
Enables channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:STATe
on page 1029

Type Channel Coding ← Channel Coding
Displays the used channel coding scheme and channel coding rate.

PBCH uses always tail biting convolution coding with code rate 1/3; PDSCH uses always turbo code with code rate 1/3.

Remote command:
n.a.

Number of Physical Bits ← Channel Coding
Indicates the calculated number of physical bits; resembles the information displayed with parameter Phys. Bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits?` on page 1021

Transport Block Size I_{TBS} ← Channel Coding
Displays the resulting transport block size index.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSI` on page 1030

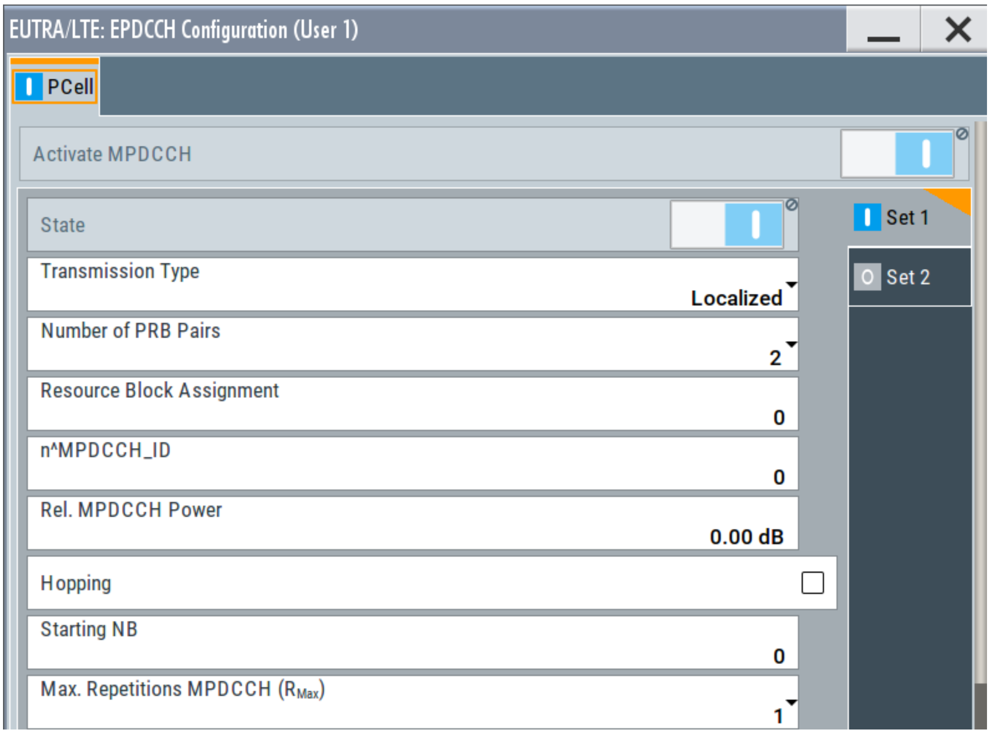
Transport Block Size/Payload (DL) ← Channel Coding
Displays the size of the transport block/payload in bits, calculated from the selected "Resource Assignment Field" and "Modulation and Coding Scheme".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSize?`
on page 1030

6.3.7.7 MPDCCH configuration

Access:

1. Select "Frame Configuration > General > User Configuration".
2. Select "User > 3GPP Release = CE Mode A/B > EPDCCH/MPDCCH > Config".



3. To activate the secon state, select "Set 2 > State > On".
4. Select "Frame Configuration > eMTC > Allocation" to observe the MPDCCH allocation.

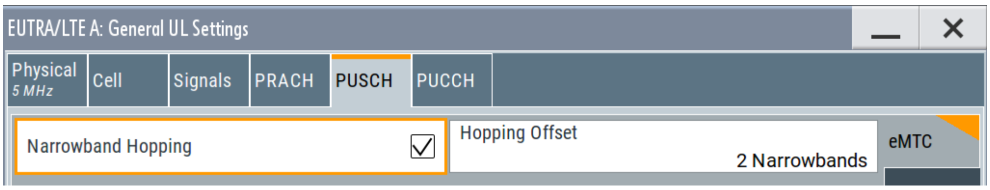
Settings:

See Chapter 4.3.5, "EPDCCH configuration settings", on page 156.

6.3.8 eMTC PUSCH settings

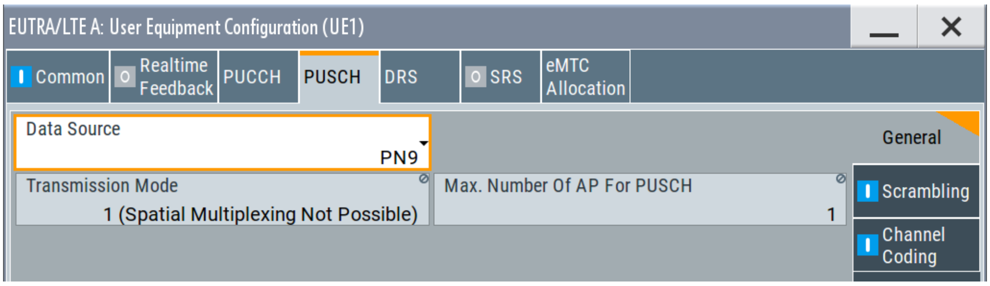
Access:

1. Select "General > General UL Settings > PUSCH > eMTC Parameters".



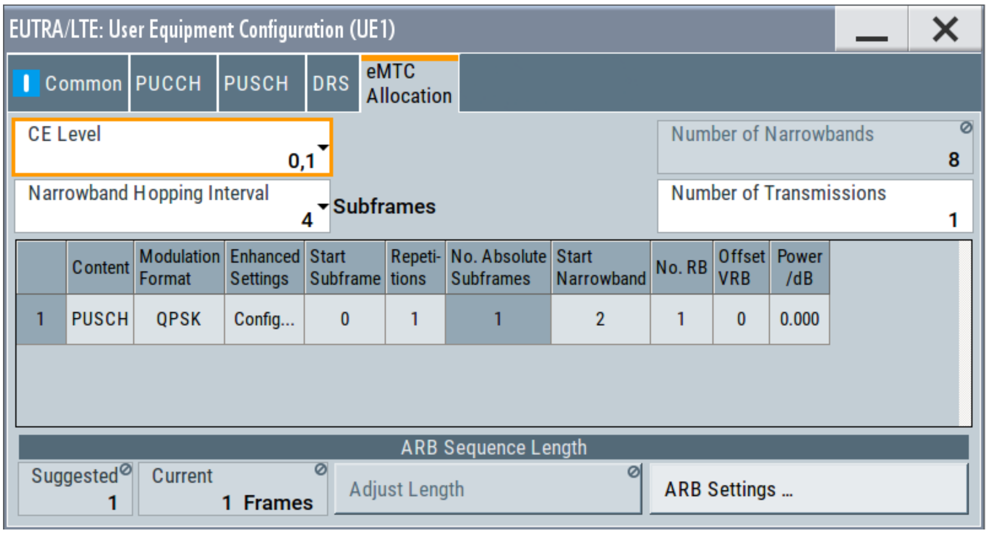
The dialog displays general PUSCH configuration parameters.
To access the UE-specific PUSCH settings, follow the following instructions.
2. Select "Frame Configuration > UE x > 3GPP Release" = **"eMTC"**.
3. To access the settings of the individual UE, click the "UE x" block.

4. Select "UE x > PUSCH".



You can enable PUSCH scrambling and channel coding and multiplexing.
The provided settings are the same as for LTE, expect that eMTC UEs do not support MIMO and the rank indication (RI) concept.
The "Transmission Mode = TM 1" and "Max. Number of AP for PUSCH = 1" are fixed.

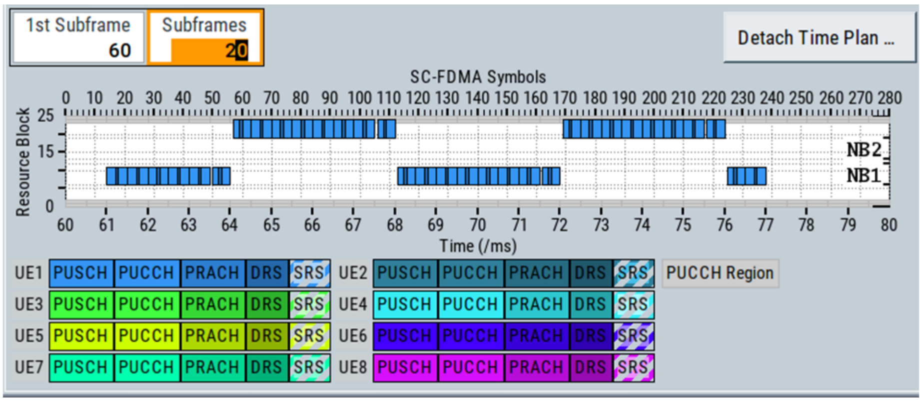
5. To configure the **PUSCH transmission per UE**, select "Frame Configuration > UE x > eMTC Allocation".



The eMTC allocation is individual per UE, in terms of used CE level, frequency hopping and number of transmissions.
There can be up to 20 PUSCH or PUCCH transmissions per UE, each of them using different format and occupying different resources in the time and in the frequency domain.

6. In the "eMTC Allocation" table, select "Transmission # > Content = PUSCH > Enhanced Settings > Config" to configure the channel coding and multiplexing of an eMTC allocation.
See Chapter 6.3.8.3, "eMTC PUSCH channel coding and multiplexing settings", on page 501.

7. To observe the PUSCH allocations, select "EUTRA/LTE > Frame Configuration > Time Plan".



6.3.8.1 Cell-specific eMTC PUSCH settings

Access: see Chapter 6.3.8, "eMTC PUSCH settings", on page 493.

Narrowband Hopping

Enables narrowband hopping so that PUSCH allocations can change the used narrowband.

PUSCH hopping pattern is individual per UE. The number of subframes the PUSCH allocation remains in the same NB is defined with the UE-specific parameter Narrowband Hopping Interval.

If hopping is disabled, the PUSCH repetitions are located in the same resource block at the same narrowband.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOPping` on page 1037

Hopping Offset

If "Narrowband Hopping > On", sets the value of the cell-specific higher-level parameter f_{hop}^{NB} required to calculate the PUSCH frequency hopping pattern. The hopping offset is difference in narrowbands between the narrowband number of the current and the subsequent narrowband.

The max possible hopping offset depends on the number of available narrowbands (see Number of eMTC Narrowbands).

Use the "Time Plan" to visualize the PUSCH allocation.

For example, see Example"PUSCH hopping" on page 377.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOFfset` on page 1037

6.3.8.2 UE-specific eMTC PUSCH transmissions settings

Access: see Chapter 6.3.8, "eMTC PUSCH settings", on page 493.

The eMTC allocation configuration is individual per UE and is defined **per coverage extension level CE**. eMTC allocation is composed of up to 20 PUCCH or PUSCH transmissions, each one described in a row in the eMTC allocation table.

Settings:

CE Level

Sets the coverage extension level (CE).

3GPP defines two CE modes for eMTC, CEModeA and CEModeB:

- "CE Level = 0, 1" corresponds to CEModeA
  This mode uses small number of PUSCH or PUCCH repetitions.
- "CE Level = 2, 3" corresponds to CEModeB
  This mode enables large number of PUSCH or PUCCH repetitions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:CELevel` on page 1061

Number of eMTC Narrowbands

Option: R&S SMW-K115

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" is selected.

It indicates the number of eMTC narrowbands N_{NB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Narrowbands" = "Number of Resource Blocks" / 6

For more information, see "Narrowbands" on page 366.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NNBands? on page 1035

Number of eMTC Widebands
Option: R&S SMW-K143

This parameter is **dedicated to eMTC** and available if "Mode > eMTC/NB-IoT or LTE/eMTC/NB-IoT" and Wideband Config > "On" is selected.

It indicates the number of eMTC widebands N_{WB} available within the selected channel bandwidth.

The value is calculated as follows:

"Number of Widebands" = Number of eMTC Narrowbands / 4

For more information, see "Widebands" on page 367.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NWBands? on page 1035

Narrowband Hopping Interval
Sets the higher-level parameter N_{ch}^{NB}.

It defines the number of consecutive subframes the hopping pattern remains in the same narrowband.

Table 6-45: Hopping intervals N_{ch}^{NB} per CE level and duplexing mode

"CE Level"	"Duplexing > FDD"	"Duplexing > TDD"
0, 1	1, 2, 4, 8	1, 5, 10, 20
2, 3	2, 4, 8, 16	5, 10, 20, 40

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:HOPP on page 1062

Number of Transmissions
Enables up to 20 individual PUSCH and PUCCH transmissions, where each transmission is configured in a separate row in the eMTC allocation table.

Use the "Time Plan" to visualize the eMTC allocation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:NTRansmiss on page 1062

Content
Selects the channel type and defines whether PUSCH or PUCCH is transmitted.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CONTent
on page 1062

Modulation/Format
For PUSCH transmission, this parameter sets the used modulation scheme (QPSK, 16QAM or 64QAM).

For PUCCH transmission, this parameter sets the PUCCH format.

Table 6-46: PUCCH formats depending on the CE mode and duplexing mode

"CE Level"	"Duplexing > FDD"	"Duplexing > TDD"
0, 1	1, 1a, 2, 2a, 2b	1, 1a, 1b, 2, 2a, 2b
2, 3	1, 1a	1, 1a

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:MODulation
on page 1062
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:FORMat on page 1063

Enhanced Setting > Config
Access dialogs with further channel coding and multiplexing settings.

The displayed settings depend on the transmission content, see:
- Chapter 6.3.8.3, "eMTC PUSCH channel coding and multiplexing settings", on page 501
- Chapter 6.3.9.3, "eMTC PUCCH channel coding and multiplexing settings", on page 509

Start Subframe
Sets the subframe number in that the PUSCH/PUCCH allocation is scheduled for the first time.

The following applies for each subsequent allocation:

$Start\_SF_{PUSCH,i+1} = Start\_SF_{PUSCH,i} + n_{Rep}^{PUSCH} + n_{invalid\_SF} + 1$

Where:
- $n_{invalidSF}$ is the number of SF that is set as not valid for eMTC in the "General UL Settings" dialog (see "Valid Subframes" on page 244).
- n_{Rep}^{PUSCH} is set with the parameter Repetitions.

Example:
- Allocation#1
  PSUCH with Start_SF = 0, n_{Rep}^{PUSCH} = 8 and $n_{invalid\_SF}$ = 2
- The first possible "Start Subframe" for allocation#2
  Start_SF = 0 + 8 + 2 + 1 = 11

Note: If more than one UE are configured, the UEs have to use different "Start Subframe".
Otherwise, a conflict is indicated in the "UL Frame Configuration > Subframe > Allocation Table" dialog.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STSFrame
on page 1063

Repetitions
Sets how many times a transmission is repeated.

Table 6-47: Possible number of repetitions (n_{Rep}^{PUSCH} and n_{Rep}^{PUCCH}) depending on the CE mode and the channel type

"CE Level"	PUSCH	PUCCH
0, 1	1, 2, 4, 8, 16, 32 Option: R&S SMW-K143 12, 24	1, 2, 4, 8
2, 3	1, 4, 8, 16, 32, 64, 128, 192, 256, 384, 512, 768, 1024, 1536, 2048	4, 8, 16, 32 Option: R&S SMW-K143 64, 128

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:REPetitions`
on page 1063

No. Absolute Subframes
Number of absolute subframes (n_{abs_SF}) is calculated as follows:

$n_{abs\_SF} = n_{Rep}^{PUSCH} + n_{invalid\_SF}$

Where:
- $n_{invalidSF}$ is the number of SF that is set as not valid for eMTC in the "General UL Settings" dialog (see "Valid Subframes" on page 244).
- n_{Rep}^{PUSCH} is set with the parameter Repetitions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ASFRrame?`
on page 1063

Start Narrowband
Sets the first NB used for the PSUCH/PUCCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STNBand`
on page 1064

No. RB
Sets the number of used resource blocks (RB) within one narrowband.

According to TS 36.211, a UE can allocate between one RB and the whole narrowband, where:
- For CEModeA UE, the used number of RBs is configurable value between 1 and 6 RBs
- For CEModeB UE, the allocations are predefined, see Table 6-48.

Table 6-48: Resource blocks allocation for UE configured in CEModeB [TS 36.213]

Value of resource allocation field	Allocated resource blocks
000	0
001	1
010	2
110	3

Value of resource allocation field	Allocated resource blocks
100	4
101	5
110	0 and 1
111	2 and 3

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NRBLocks
on page 1064

Offset VRB
For allocations that span less than 6 RB, this parameter shifts the selected No. RB within the NB.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:RBOFfset
on page 1064

Start Wideband
Option: R&S SMW-K143

Sets the first wideband used for the PSUCH/PUCCH transmission.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STWBand
on page 1064

No. RB
Option: R&S SMW-K143

Sets the number of used resource blocks (RB) within one wideband.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WRBLocks
on page 1065

Offset VRB
Option: R&S SMW-K143

Shifts the selected No. RB within the wideband.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WBRBoffset
on page 1065

Power, dB
Sets the power of the eMTC PUSCH and PUCCH transmission (P_{PUSCH} or P_{PUCCH}).

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:POWer on page 1065

ARB Sequence Length
Comprises setting for automatic adjustment of the ARB sequence length.

Suggested ← ARB Sequence Length

- NB-IoT allocations:
  Indicates the ARB sequence length that is required for the selected NPUSCH transmissions.
- eMTC allocations:
  Number of frames required for the one complete transmission.
  The value is calculated as the sum of the Start_SF and n_{abs_SF}.

Use the "Adjust Length" function to apply the suggested value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:ARB:SUGGested? on page 1049
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:ARB:SUGGested? on page 1066

Current ← ARB Sequence Length
Indicates the current ARB sequence length.

Adjust Length ← ARB Sequence Length
Sets the ARB sequence length to the suggested value.

ARB Settings ← ARB Sequence Length
Opens the ARB dialog.

6.3.8.3 eMTC PUSCH channel coding and multiplexing settings

Access: see Chapter 6.3.8, "eMTC PUSCH settings", on page 493.

In this dialog you can:

- Set the cyclic shift used by the demodulation reference signal (DMRS)
- Adjust the parameters for channel coding of the control information (HARQ and CQI)
- Configure the multiplexing of the control information with the data transmission over the uplink shared channel (UL-SCH)

The eMTC PUSCH configuration reuses the LTE concept, expect:

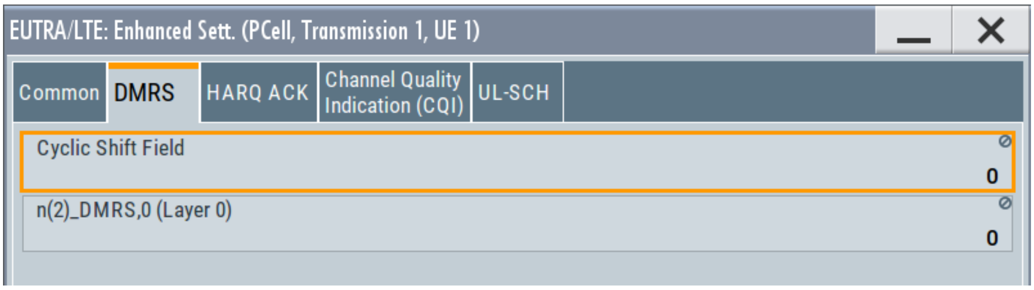
- In eMTC, PUSCH frequency hopping is configured in a different way.
- eMTC does not support rank indication (RI)
- eMTC uses different parameter "Starting Redundancy Version Index (rv_idx)".

Settings:

Common

The "Common" dialog indicates the type of the selected channel.

DMRS



The provided settings are identical to the LTE demodulation reference signal (DMRS) settings.

Cyclic Shift Filed ← DMRS

Sets the cyclic shift field in the uplink-related DCI formats.

Cyclic shifts are used to separate the DMRS signals of different users in the time domain.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:DRS:CYCShift?`
on page 1066

n(2)_DMRS,0 (Layer 0) ← DMRS

Displays the part of the demodulation reference signal (DMRS) index $n^{(2)}_{DMRS,\,0}$ for layer 0.

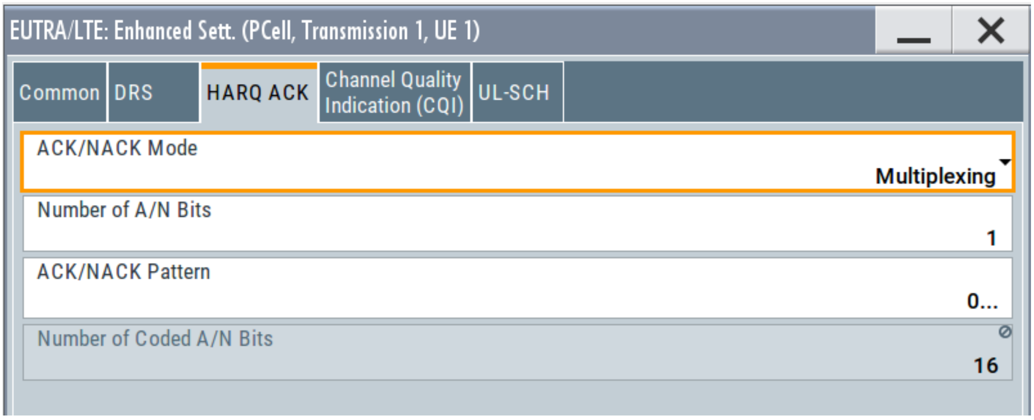
"Cyclic Shift Field"	n(2)_DMRS, 0
000	0
001	6
010	3
011	4
100	2
101	8

"Cyclic Shift Field"	n(2)_DMRS, 0
110	10
111	9

The DMRS index is part of the uplink scheduling assignment and valid for one UE in the subframe. This index applies when multiple shifts within a cell are used and is used by the calculation of the DMRS sequence.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NDMRs?
on page 1066

HARQ ACK
Access: "UEx > PUSCH > Channel Coding and Multiplexing > State > On" and "Mode = UCI only/UCI + UL-SCH".



The provided settings are identical to the LTE HARQ ACK settings.

ACK/NACK Mode ← HARQ ACK
Sets the ACK/NACK mode.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:MODE
on page 1067

Number of A/N Bits ← HARQ ACK
Sets the number of ACK/NACK bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:BITS
on page 1069

ACK/NACK Pattern ← HARQ ACK
Sets the ACK/NACK bit pattern.

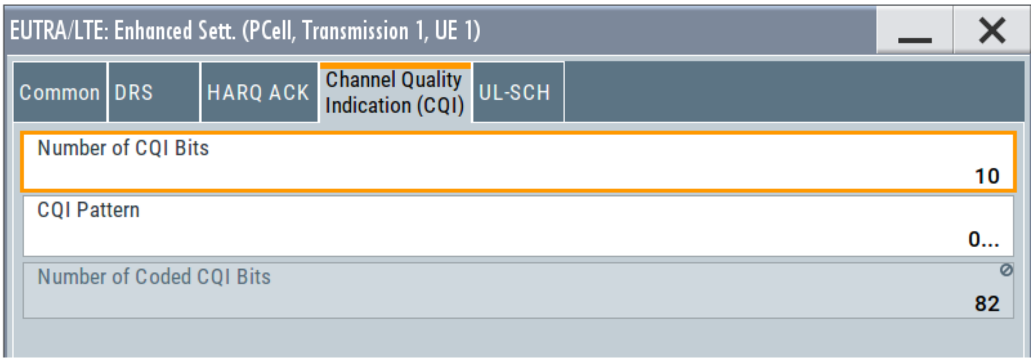
A "1" indicates an ACK, a "0" - a NACK.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:PATTern
on page 1069

Number of Coded A/N Bits ← HARQ ACK
Displays the number of coded ACK/NACK bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:CBITs?
on page 1069

Channel Quality Indication CQI
Access:
- "UEx > PUSCH > Channel Coding and Multiplexing > State > On"
- "Mode = UCI only/UCI + UL-SCH".



The provided settings are identical to the LTE CQI settings.

Number of CQI Bits ← Channel Quality Indication CQI
Sets the number of CQI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:BITS
on page 1066

CQI Pattern ← Channel Quality Indication CQI
Sets the CQI pattern for the PUSCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:PATTern on page 1067

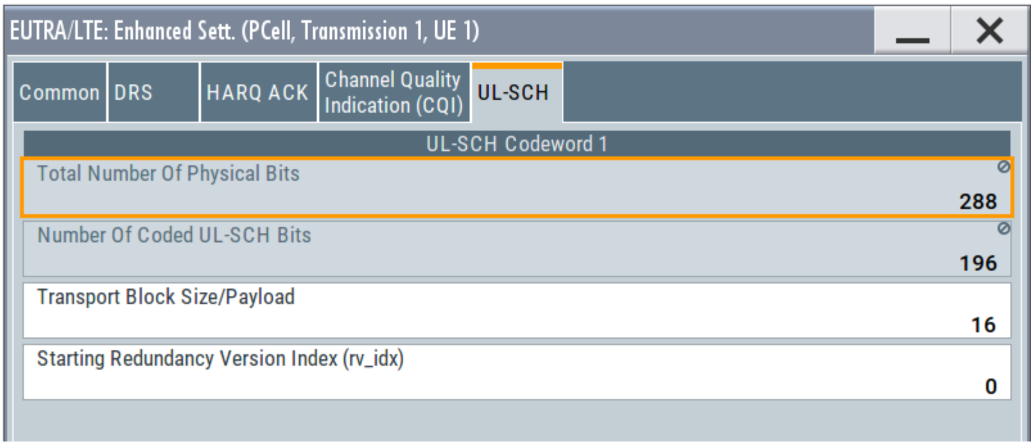
Number of Coded CQI Bits ← Channel Quality Indication CQI
Displays the number of coded CQI bits.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:CBITs?
on page 1067

Enhanced Setting > UL-SCH
Access:
- "UEx > PUSCH > Channel Coding and Multiplexing > State > On"

- "Mode = UL-SCH only/UCI + UL-SCH".

The eMTC PUSCH configuration reuses the LTE concept.



The same settings and interdependency apply expect the used "Starting Redundancy Version Index (rv_idx)".

Total Number of Physical Bits ← Enhanced Setting > UL-SCH
Displays the size of the eMTC allocation in bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PHYSbits?`
on page 1070

Number of Coded UL-SCH Bits ← Enhanced Setting > UL-SCH
Displays the number of physical bits used for UL-SCH transmission.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ULSCh:BITS?`
on page 1068

Transport Block Size/Payload ← Enhanced Setting > UL-SCH
Sets the size of the transport block.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:TBSize`
on page 1068

Starting Redundancy Version Index (rv_idx) ← Enhanced Setting > UL-SCH
Sets the redundancy version index.

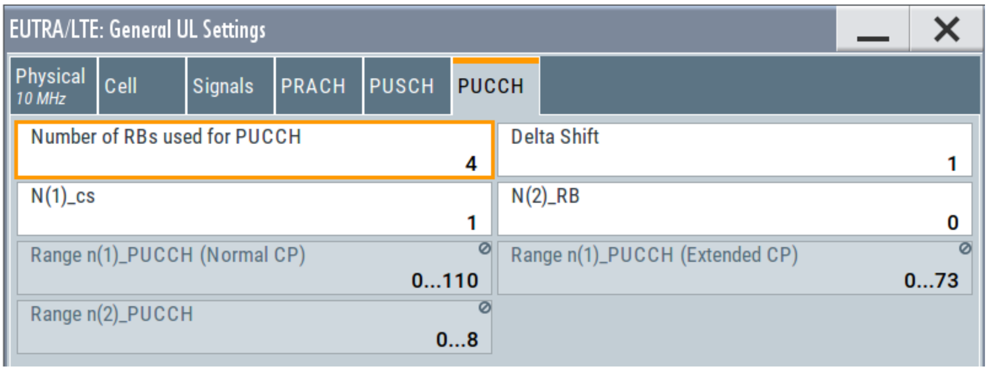
Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:RVINdex`
on page 1070

6.3.9 eMTC PUCCH settings

Access:

1. Select "General > General UL Settings > PUCCH" to access the **cell-specific PUCCH** settings.

   eMTC reuses the LTE PUCCH configuration.

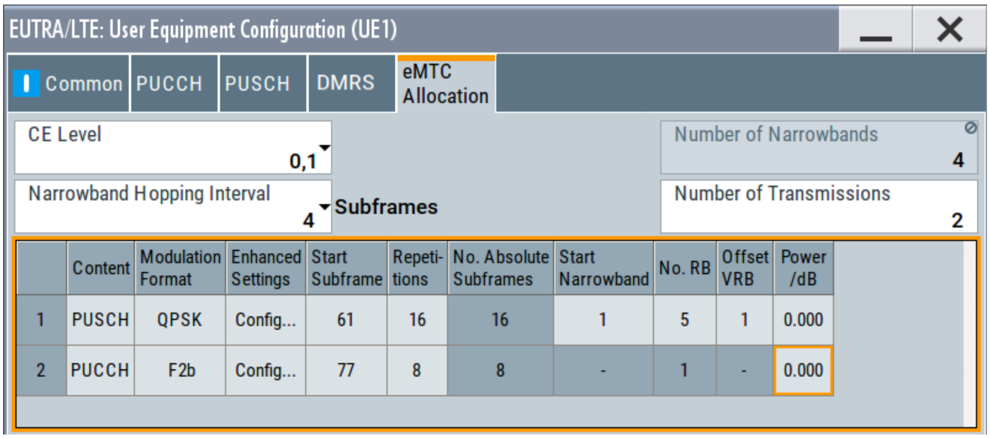
   

   To access the **UE-specific PUCCH settings**, follow the following instructions.

2. Select "Frame Configuration > UE" > **"3GPP Release = eMTC"**.
3. Select "UE x > PUCCH".

   eMTC reuses the UE-specific PUCCH configuration, except that eMTC UEs do not support MIMO and PUCCH format 3.
   Hence "Number of AP for PUCCH Formats = 1".

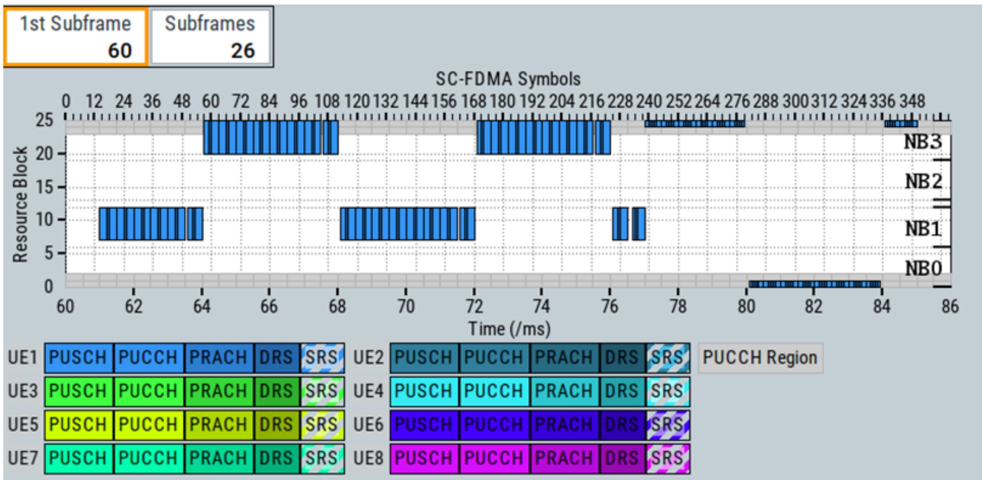
4. To configure the **PUCCH transmission per UE**, select "Frame Configuration > UE x" > **"eMTC Allocation"**.

   The eMTC allocation is individual per UE, in terms of used CE level, frequency hopping and number of transmissions. There can be up to 10 PUSCH or PUCCH transmissions per UE, each of them using different format and occupying different resources in the time and in the frequency domain.

For settings description, see Chapter 6.3.8.2, "UE-specific eMTC PUSCH transmissions settings", on page 495.

5. In the "eMTC Allocation" table, select "Transmission # > Content = PUCCH > Enhanced Settings > Config" to configure the **channel coding and multiplexing of an eMTC allocation**.
   See Chapter 6.3.9.3, "eMTC PUCCH channel coding and multiplexing settings", on page 509.
6. To observe the PUCCH allocations, select "EUTRA/LTE > Frame Configuration > Time Plan".



6.3.9.1 Cell-specific eMTC PUCCH settings

Access: see Chapter 6.3.9, "eMTC PUCCH settings", on page 506.

Settings:

Number of RBs used for PUCCH

Sets the PUCCH region in terms of reserved resource blocks, at the edges of the channel bandwidth (see Figure 2-18).

The PUCCH region is displayed on the time plan.

Example:

- "Physical > Channel Bandwidth = 3 MHz"
- "General UL Settings > PUCCH > Number of RBs used for PUCCH = 3"
- "UL Frame Configuration > PUCCH > Format = 2a" and "PUCCH State > On"

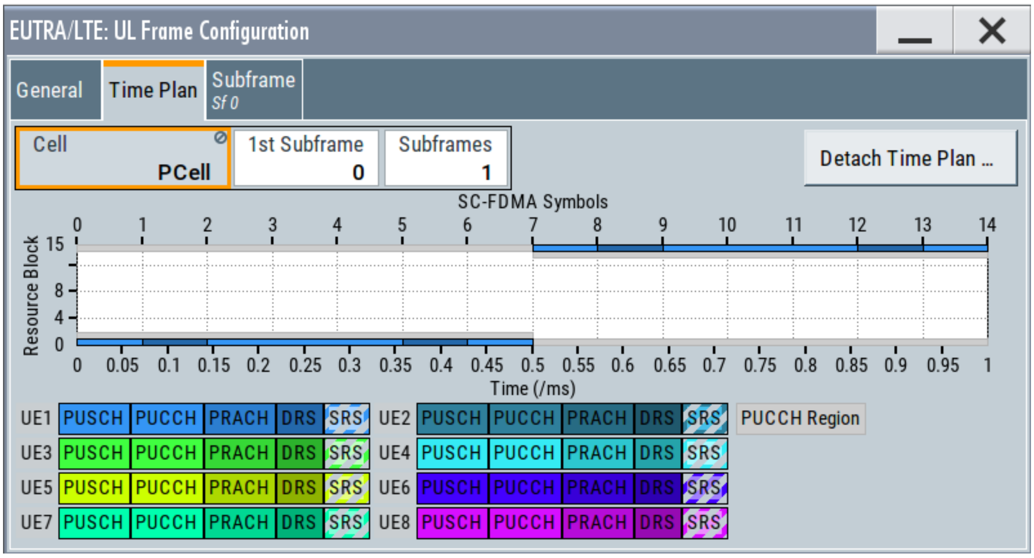


Figure 6-21: Example: Representation of subframe with PUCCH region with three reserved resource blocks on the time plan

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB` on page 733

Delta Shift

Sets the delta shift parameter, i.e. the cyclic shift difference between two adjacent PUCCH resource indices with the same orthogonal cover sequence (OC).

The delta shift determinates the number of available sequences in a resource block that can be used for PUCCH formats 1/1a/1b (see also Table 2-5).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:DESHift` on page 734

N(1)_cs

Sets the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Only one resource block per slot can support a combination of the PUCCH formats 1/1a/1b and 2/2a/2b.

The number of cyclic shifts available for PUCCH format 2/2a/2b N(2)_cs in a block with combination of PUCCH formats is calculated as follows:

N(2)_cs = 12 - N(1)_cs -2

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1CS` on page 734

N(2)_RB
Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

There can be only one resource block per slot that supports a combination of the PUCCH formats 1/1a/1b and 2/2a/2b. Hence, the number of RBs per slot available for PUCCH format 1/1a/1b is determinate by "N(2)_RB".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2RB` on page 734

Range n(1)_PUCCH (Normal/Extended CP)
Displays the range of the possible PUCCH format 1/1a/1b transmissions from different UEs in one subframe and per cyclic prefix.

Insufficient ranges are displayed as '-'.

The parameter "Range n(1)_PUCCH (Normal CP)" determines the value range of the index "n_PUCCH" for PUCCH format 1/1a/1b.

See n_PUCCH

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1NMax?` on page 735
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax?` on page 735

Range n(2)_PUCCH
Displays the range of possible number of PUCCH format 2/2a/2b transmissions from different UEs in one subframe.

Insufficient ranges are displayed as '-'.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2Max?` on page 735

6.3.9.2 UE-specific eMTC PUCCH settings

Access: see Chapter 6.3.9, "eMTC PUCCH settings", on page 506.

Number of Antenna Ports for PUCCH per PUCCH Format
For 3GPP Release = "LTE-Advanced" UEs, sets the number of antenna ports used for every PUCCH format transmission.

eMTC UEs ("3GPP Release = eMTC") support transmission with one antenna port.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport` on page 896
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport` on page 896
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F3Naport` on page 896
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F4Naport?` on page 895
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F5Naport?` on page 895

6.3.9.3 eMTC PUCCH channel coding and multiplexing settings

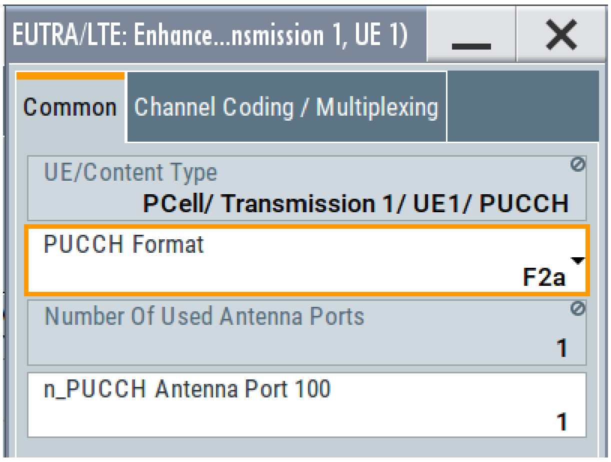
Access: see Chapter 6.3.9, "eMTC PUCCH settings", on page 506.

The eMTC PUCCH configuration reuses the LTE concept.

Settings:

Common

The "Common" settings dialog indicates the type and format of the selected channel.



The "UE/Content" indication resembles related information from the "eMTC Allocation" table.

Format ← Common

For PUCCH transmission, this parameter sets the PUCCH format.

Table 6-49: PUCCH formats depending on the CE mode and duplexing mode

"CE Level"	"Duplexing > FDD"	"Duplexing > TDD"
0, 1	1, 1a, 2, 2a, 2b	1, 1a, 1b, 2, 2a, 2b
2, 3	1, 1a	1, 1a

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:FORMat`
on page 1063

Number of Used Antenna Port ← Common

Indicates that one antenna port is used.

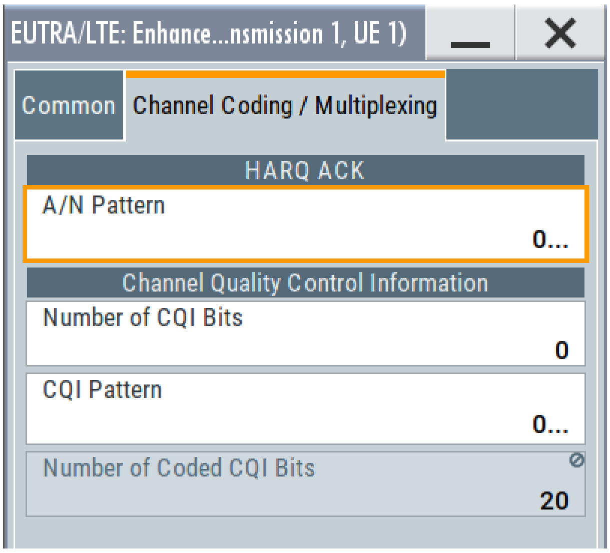
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NAPused?
on page 1068

n_PUCCH Antenna Port 100 ← Common
Sets the PUCCH resource index.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NPUCch
on page 1068

Channel Coding and Multiplexing
Access: "UEx > eMTC Allocation > PUCCH > Format = F2b".

The provided settings are identical to the LTE settings.



A/N Pattern ← Channel Coding and Multiplexing
Sets the PUCCH ACK/NACK pattern.

A "1" indicates an ACK, a "0" - a NACK.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:HARQ:PATTern on page 1070

Number of CQI Bits ← Channel Coding and Multiplexing
Sets the number of CQI bits before channel coding.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:BITS
on page 1070

CQI Pattern ← Channel Coding and Multiplexing
Sets the CQI pattern for the PUCCH.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:PATTern on page 1071

Number of Coded CQI Bits ← Channel Coding and Multiplexing

Displays the number of coded CQI bits.

The number of coded CQI bits for PUCCH is always 20.

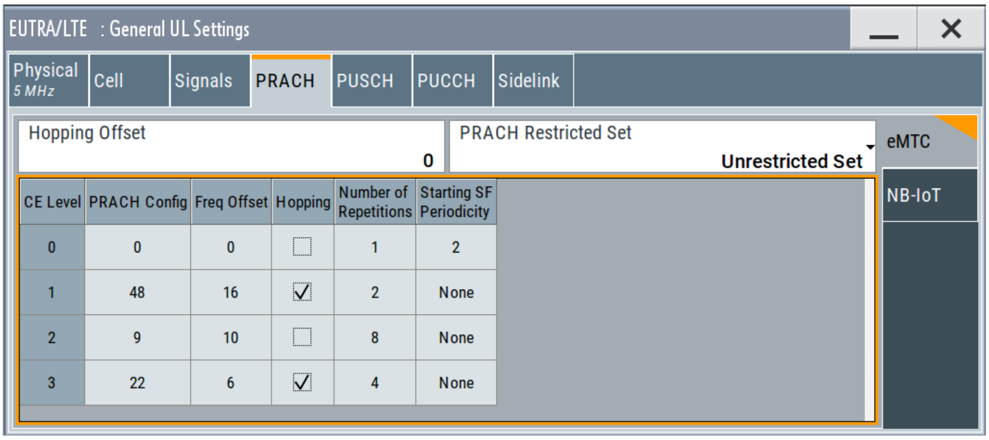
Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:CBITs? on page 1071

6.3.10 eMTC PRACH settings

Access:

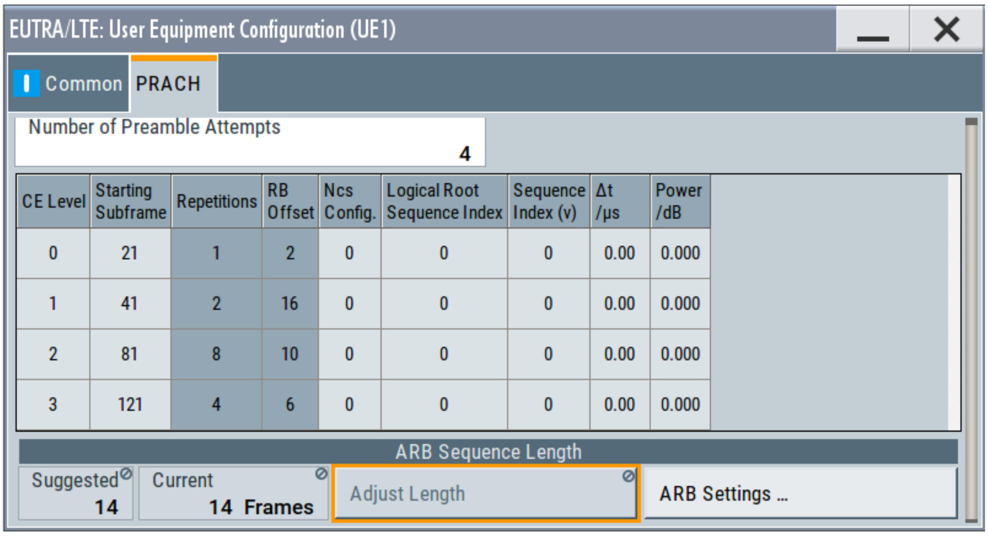
1. Select "General > General UL Settings > PRACH".
2. Select the "eMTC" side tab.

   The dialog comprises the parameters to define the PRACH per coverage extension level (CE level).



   The group of LTE parameters has no effect on the eMTC PRACH configuration.

3. To allocate the NPRACH for a specific UE, use the following parameters:
   a) Select "UL Frame Configuration > UE1 > 3GPP Release = eMTC".
   b) Select "UE1 > Settings > Common > Mode = PRACH".
   c) Select "PRACH".



You can change the number of preamble attempts, select one of the PRACH configurations per attempt and PRACH allocation.

For description of the related settings, see "eMTC PRACH allocation per UE" on page 515.

4. If necessary, use the "Adjust Length" function to enable larger number of frames automatically so that the PRACH frequency hopping pattern is completed.

5. Open the "Time Plan" to visualize the PRACH allocation:
   a) Select "UL Frame Configuration > Time Plan".
   b) Configure the subframes to be displayed.
      For example "1st Subframe = 80" and "Subframes = 30".

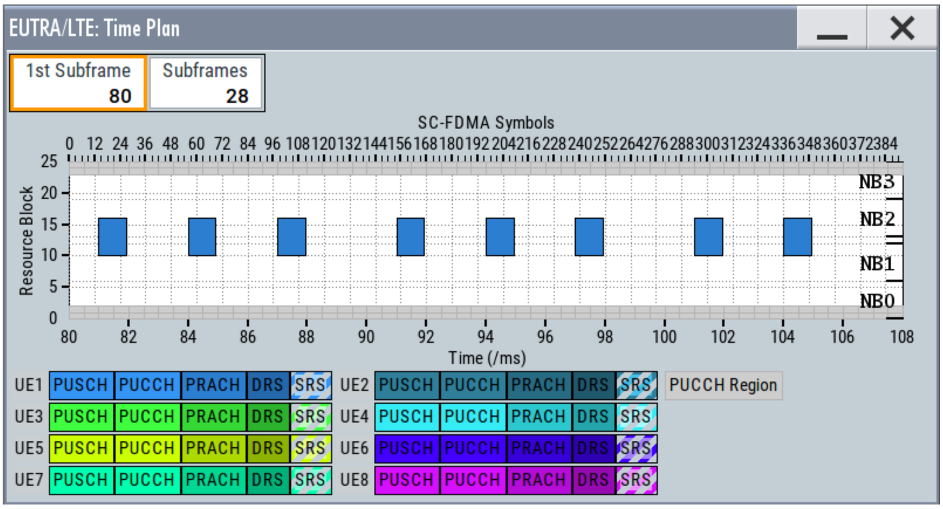


Figure 6-22: PRACH configuration visualization in the "Time Plan" ("PRACH Configuration = 9", "Repetitions = 8"; PRACH bandwidth = 6 RB)

PRACH settings:

eMTC PRACH configurations

Use the provided settings to configure three PRACH configurations for the different coverage levels (CE).

Hopping Offset ← eMTC PRACH configurations

Sets a PRACH hopping offset as number of resource blocks (RB).

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:HOFF` on page 1041

Restricted Set ← eMTC PRACH configurations

Set the higher-layer parameter `High-speed-flag` and defines whether unrestricted set or one of the restricted sets ("Type A" or "Type B") is used.

The value influences the PRACH generation out of the Zadoff-Chu sequence.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:RSET` on page 1041

CE Level ← eMTC PRACH configurations

Indicates the CE level.

PRACH Configuration ← eMTC PRACH configurations

Selects one of the predefined 64 PRACH configurations.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:CONFig` on page 1041

Freq. Offsets ← eMTC PRACH configurations
Shifts the PRACH allocation in the frequency domain in terms of resource blocks (RB).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:FOFFset`
on page 1042

Hopping ← eMTC PRACH configurations
Enables frequency hopping per CE level and PRACH configuration.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:HOPPing`
on page 1041

Number of Repetitions ← eMTC PRACH configurations
Defines how many times a PRACH is repeated.

According to TS 36.211, PRACH can be repeated N_{rep}^{PRACH} = 1, 2, 4, 8, 16, 32, 64 or 128 times.

If "Hopping > On", the repetitions use different frequency allocations.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:REPetit`
on page 1042

Starting SF Periodicity ← eMTC PRACH configurations
Sets the higher-layer parameter N_{start}^{PRACH}:

"2, 4, 8, 16, 32, 64, 128 or 256"
Indicates the periodicity of the starting subframes in terms of subframes that are allowed for PRACH transmission.
The following applies:
"Starting SF Periodicity" ≥ Number of Repetitions.

"None"
The periodicity of the allowed starting subframes is N_{rep}^{PRACH}, as set with the parameter Number of Repetitions.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:SSFPeriod`
on page 1042

eMTC PRACH allocation per UE
Comprises the UE-specific PRACH configuration.

Use this setting to can change the PRACH allocation per UE, for example:
- The number of preamble attempts
- To select starting subframe and configure PRACH allocations.

Number of Preamble Attempts ← eMTC PRACH allocation per UE
Each preamble attempt is defined in a row in the PRACH table.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:PRATtempts`
on page 1071

CE Level ← eMTC PRACH allocation per UE
Selects the CE level. Several PRACH settings are set as configured in the common PRACH setting for the particular CE level, see "eMTC PRACH configurations" on page 514.

Each subsequent preamble attempt (i.e. subsequent row in the PRACH table) has to use a higher CE level.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:CELV`
on page 1072

Starting Subframe ← eMTC PRACH allocation per UE
The value is calculated automatically, based on the CE level and the CE level and the CE level used by the previous preamble attempt.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SFSTart`
on page 1072

Repetitions ← eMTC PRACH allocation per UE
Displays the values set in the general PRACH settings dialog for the selected CE level, see Number of Repetitions.

Frequency Resource Index ← eMTC PRACH allocation per UE
For "Duplexing > TDD", sets the frequency resource index f_{RA} for the selected subframe.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:FRINdex`
on page 1072

RB Offset ← eMTC PRACH allocation per UE
Indicates the starting RB. The value is calculated form the parameter Freq. Offsets.

Ncs Configuration ← eMTC PRACH allocation per UE
Sets the Ncs configuration and determines the Ncs value for the preamble attempt according to TS 36.211.

Table 6-50: Value range Ncs configuration

Parameter	Ncs configuration
"PRACH > Restricted Set = Off"	0 to 15
"PRACH > Restricted Set = Type A"	0 to 14
"PRACH > Restricted Set = Type B"	0 to 12
"Duplexing > TDD" and "PRACH Configuration" > 47	0 to 6

Remote command:
`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:NCSConf`
on page 1072

Logical Root Sequence Index ← eMTC PRACH allocation per UE
Sets the logical root sequence index.

Parameter	Root sequence (u)
"Duplexing > TDD" and "PRACH OCnfiguration" > 47	0 to 137
Otherwise	0 to 838

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:RSEQuence
on page 1073

Sequence Index (v) ← eMTC PRACH allocation per UE
Sets the sequence index **v**.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SINDex
on page 1073

Delta t /us ← eMTC PRACH allocation per UE
Sets the parameter Delta_t in us.

Any Δt value different than 0 shifts the preamble in the time domain.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:DT
on page 1073

Power, dB ← eMTC PRACH allocation per UE
Sets the preamble attempt power relative to the UE power.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:POWer
on page 1073

ARB Sequece Length > Sugested
Indicates the ARB sequence length that is required for the current PRACH configuration.

Use the "Adjust Length" function to apply the suggested value.

Remote command:
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:ARB:SUGGested?
on page 1074

7 Observing current allocations on the time plan

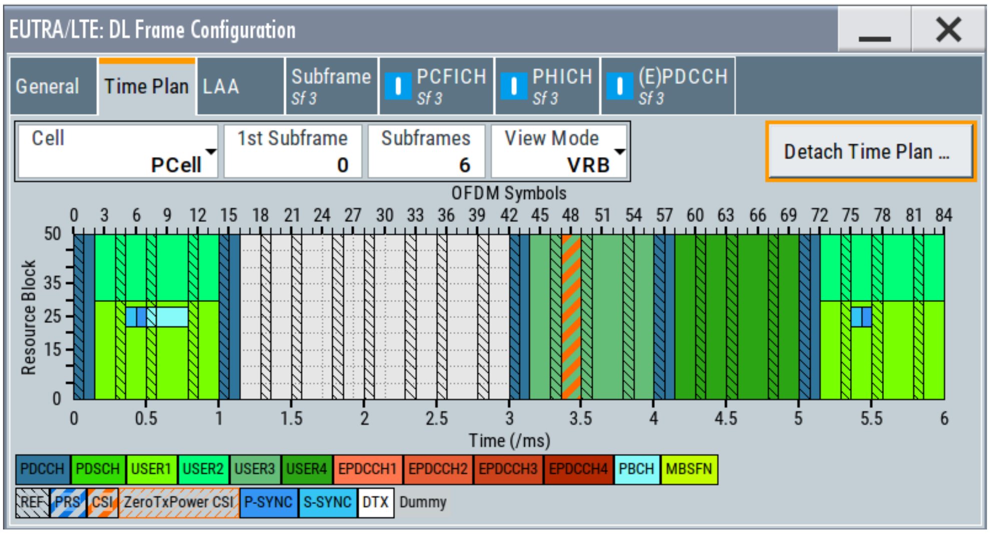
You can observe the current allocations on the time plan. There are dedicated uplink and downlink time plans and, if TDD duplexing mode is used, the time plan also visualizes the special subframes.

The time plan shows active channels and signals, the allocations of the active UEs and indicates the cell it applies for if a carrier aggregation is used. Per default, the time plan shows the allocation per used channel bandwidth and one subframe but you can extend the displayed time region to up to 40 subframes. You can also scroll over all available subframes and open the time plan in a separate window.

7.1 OFDMA time plan

Access:

1. Select "General > Link Direction > Downlink (OFDMA)".
2. Select "Frame Configuration > Time Plan".



The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain. One allocation to a UE can span 1 to up to "No. of Resource Blocks" in the frequency domain.

P-SYNC/S-SYNC is automatically calculated according to the settings in General DL Settings dialog.

Cell
With enabled "General DL Settings > CA > Activate Carrier Aggregation > On" state, indicates to which cell (i.e. component carrier) the settings apply.

Remote command:
n.a

First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
Determines how the allocations are displayed.

If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"PRB/VRB" The "Time Plan" displays the entire channel bandwidth. It shows the allocated virtual resource blocks (VRBs) or the physical resource blocks (PRBs).
In this granularity, an in-band or guard band NB-IoT allocation is indicated as one resource block; NRS are not visible. This mode is not available in standalone NB-IoT operation.

"Single RB" The "Time Plan" displays the allocation of the anchor carrier (one single RB) as selected in the RB index field.
The NRS, NPSS/NSSS and the downlink channels are shown in greater detail.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

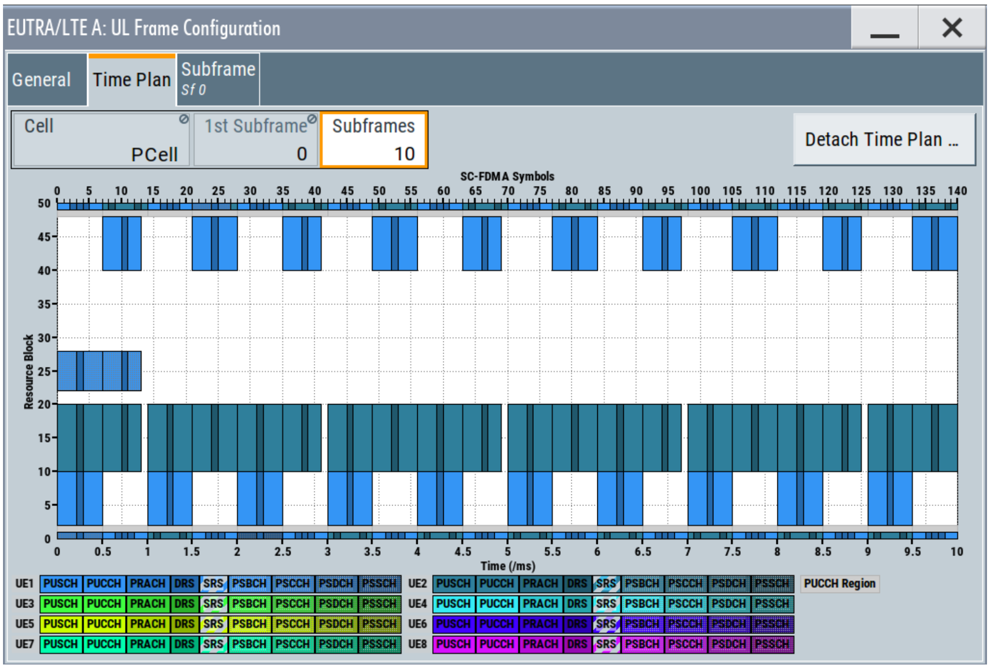
Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

7.2 SC-FDMA time plan

Access:

1. Select "General > Link Direction > Uplink (SC-FDMA)".
2. Select "Frame Configuration > Time Plan".



This dialog shows the uplink time plan.

The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain. One allocation of a UE can span 1 to up to "No. of Resource Blocks" in the frequency domain.

Sounding Reference Signals (SRS) are automatically calculated according to the settings for signal structure in "User Equipment" dialog.

An enabled SFN offset is also displayed, see "SFN Offset" on page 243.

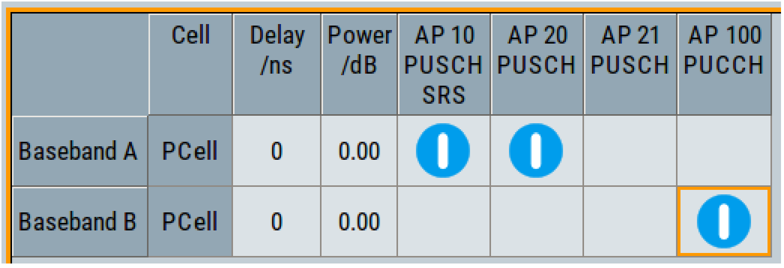
Cell
In enabled "General UL Settings > CA > Activate Carrier Aggregation > On" state, determines the settings of which cell (Primary Cell or SCell) are displayed.

Baseband
In advanced system configuration with coupled BB sources, determines the time plan of which baseband is displayed.

Alternatively, the aggregated time plan of all basebands can be displayed.

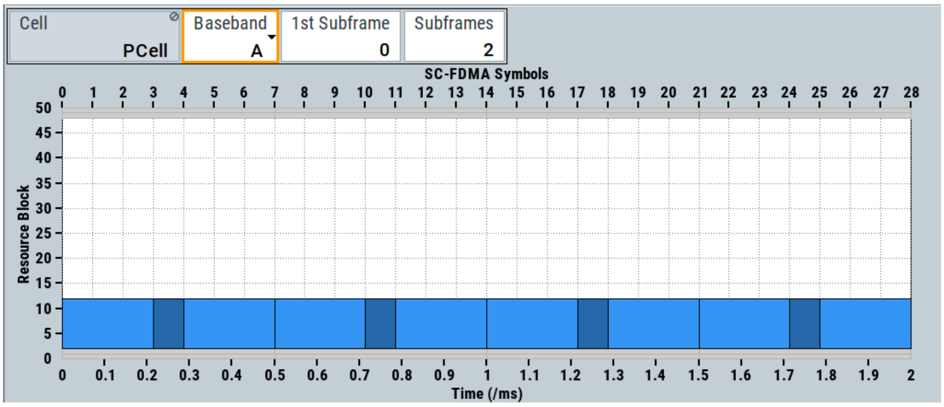
Example:

- "System Configuration = 1x2x2"
- "BB Source Config > Coupled Sources"
- "Baseband > EUTRA/LTE > Link Direction > Uplink"
- "Frame Configuration > Subframe#0 > PUCCH > State > On"
- Configure the "Frame Configuration > General > UE1 > Antenna Port Mapping" so that Baseband A transmits only PUSCH and Baseband B, PUCCH only.

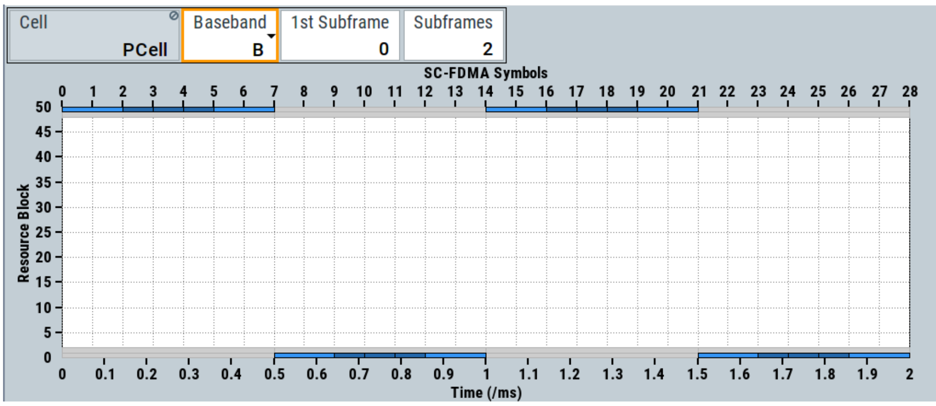


	Cell	Delay /ns	Power /dB	AP 10 PUSCH SRS	AP 20 PUSCH	AP 21 PUSCH	AP 100 PUCCH
Baseband A	PCell	0	0.00				
Baseband B	PCell	0	0.00				

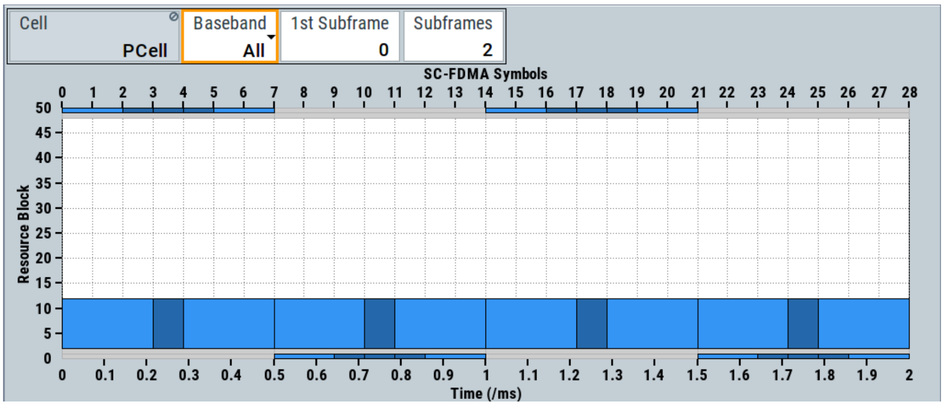
- Open the Time plan and observe the display for the three cases: "Baseband = A", "Baseband = B" and "Baseband = All"
  – Baseband A



  – Baseband B



  – All Basebands



First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

7.3 TDD time plan

1. To access this dialog, select "General > Duplexing > TDD".

2. Select "Frame Configuration > Time Plan"

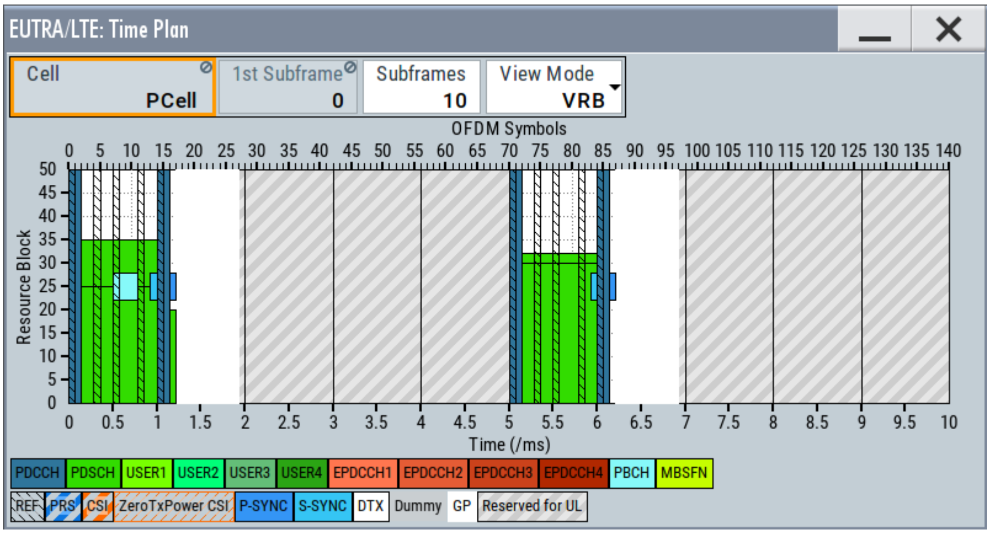


Figure 7-1: TDD time plan (DL)

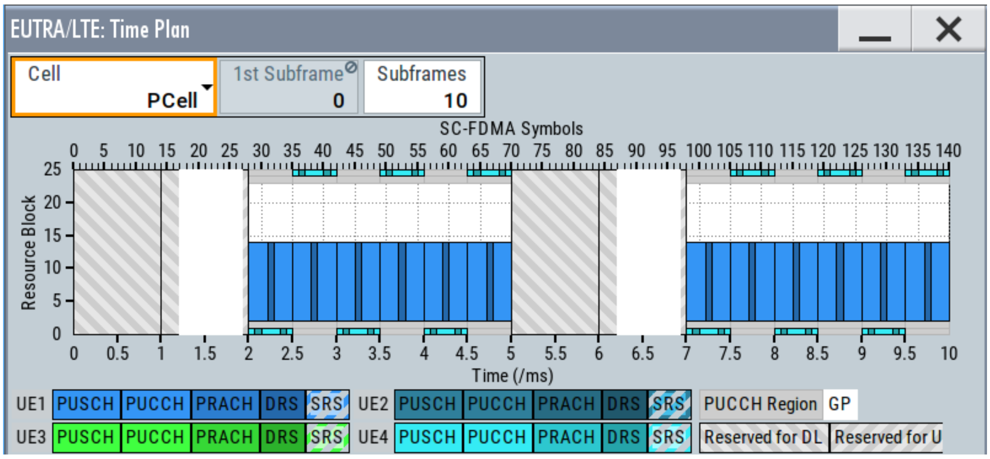


Figure 7-2: TDD time plan (UL)

This dialog shows the time plan for "Duplexing Mode > TDD".

The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain.

The frame structure depends on the selected "DL/UL Configuration" and the "Configuration of Special Subframe".

First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
Determines how the allocations are displayed.

If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"PRB/VRB" The "Time Plan" displays the entire channel bandwidth. It shows the allocated virtual resource blocks (VRBs) or the physical resource blocks (PRBs).
In this granularity, an in-band or guard band NB-IoT allocation is indicated as one resource block; NRS are not visible. This mode is not available in standalone NB-IoT operation.

"Single RB" The "Time Plan" displays the allocation of the anchor carrier (one single RB) as selected in the RB index field.
The NRS, NPSS/NSSS and the downlink channels are shown in greater detail.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

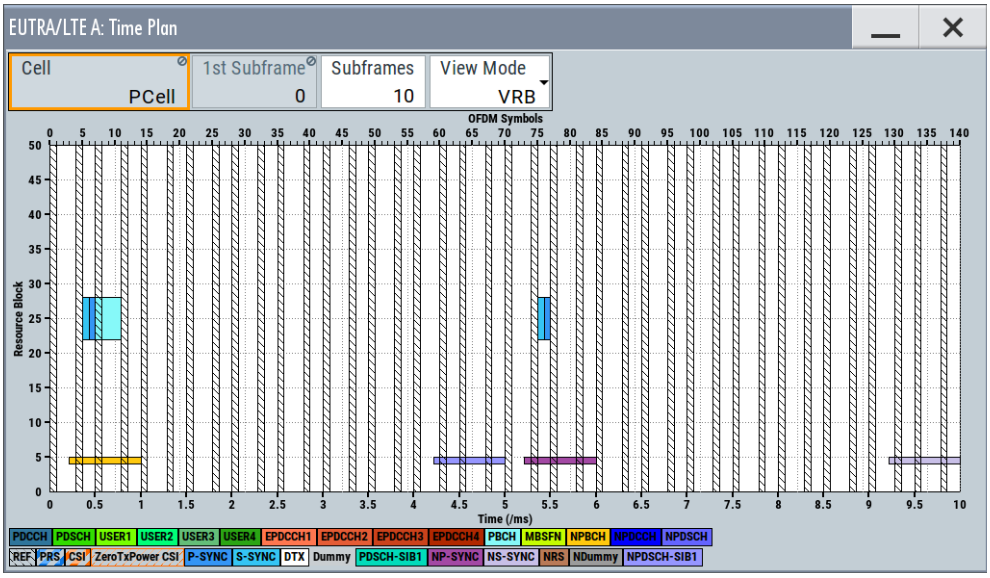
Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

7.4 eMTC/NB-IoT indication in the DL time plan

Access:

1. In the "General" dialog, select "Mode > LTE/eMTC/NB-IoT".
2. Select **"Link Direction > Downlink"**.
3. In the "General DL Settings > NB-IoT Carriers" dialog, for the anchor carrier set "Mode = In-Band"
4. Select "Frame Configuration > Time Plan".



5. To display the NB-IoT allocations in greater detail:
   a) Select "View Mode > Single RB".
   b) Select the RB number in that the anchor carrier is allocated, for example "RB = 2".

   This dialog shows the downlink time plan.

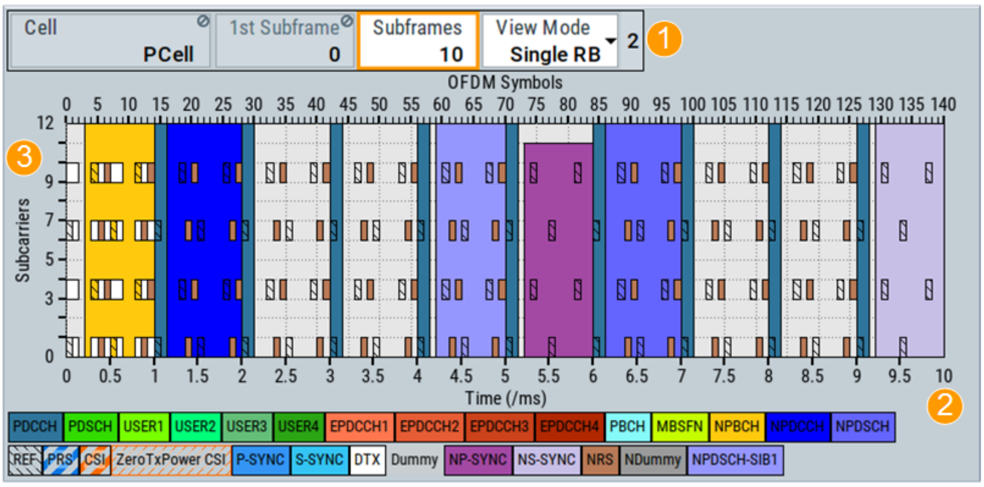


Figure 7-3: Time Plan: understanding the displayed information

1 = "View Mode > Single RB"
2 (x-axis) = Shows the allocations in the time domain
3 (y-axis) = Shows the allocations in the frequency domain, expressed in the smallest allocation granularity

Note that the y-axis indicates the frequency allocation in terms of **number of subcarriers**.

Allocations are calculated as configured in the "DL Frame Configuration > NB-IoT Allocations" dialog.

With the default settings as in this example, displayed are only the NPBCH and the NPSS/NSSS; other downlink channels are not configured.

Settings:

First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
Determines how the allocations are displayed.

If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"PRB/VRB" The "Time Plan" displays the entire channel bandwidth. It shows the allocated virtual resource blocks (VRBs) or the physical resource blocks (PRBs).
In this granularity, an in-band or guard band NB-IoT allocation is indicated as one resource block; NRS are not visible. This mode is not available in standalone NB-IoT operation.

"Single RB" The "Time Plan" displays the allocation of the anchor carrier (one single RB) as selected in the RB index field.
The NRS, NPSS/NSSS and the downlink channels are shown in greater detail.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

7.5 eMTC/NB-IoT indication in the UL time plan

Access:

1. In the "General" dialog, select "Mode > LTE/eMTC/NB-IoT".
2. Select **"Link Direction > Uplink (SC-FDMA)"**.
3. Select "Frame Configuration > Time Plan".
4. Select "View Mode > Channel BW".

   This dialog shows the uplink time plan.

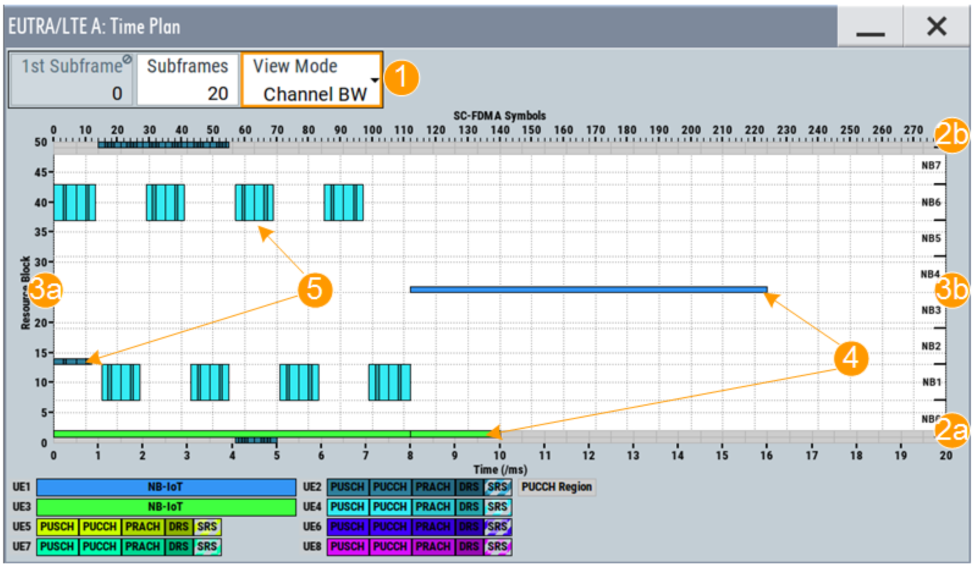


Figure 7-4: Time Plan: understanding the displayed information

1 = "View Mode > Channel BW"
x-axis = Shows the allocations in the time domain
2a, 2b = Time, expressed in the time units and as number of SC-FDMA symbols
y-axis = Shows the allocations in the frequency domain, expressed in the smallest allocation granularity
3a, 3b = Frequency, expressed as number of resource blocks (RB) for the LTE and eMTC UEs and narrowband (NB) for the NB-IoT UEs
4 = NB-IoT allocations of UE1 and UE3
5 = eMTC allocations of UE2

Allocations are calculated as configured in the "User Equipment" dialog.

5. To display the NB-IoT allocations in greater detail:
   a) Select "View Mode > Single RB".
   b) Select the number of RB, for example "RB = 1" or "RB = 24".

   See for example the time plan on Figure 6-20.
   Note that the y-axis indicates the frequency allocation in terms of number of subcarriers. The left and the right y-axis shows the subcarrier numbering depending on the subcarrier spacing ("@15kHz" and "@3.75kHz").

Settings:

First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"Channel BW" The "Time Plan" displays the entire channel bandwidth.
In this granularity, an NB-IoT allocation is indicated as one resource block. NPUSCH or NPRACH hops are not visible.

"Single RB" The "Time Plan" displays one single RB as selected in the RB index field.
The NPRACH and NPUSCH incl. the NDRS signals are shown in greater detail. Frequency hops are visible.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

The left and the right y-axis shows the subcarrier numbering depending on the subcarrier spacing:
- "@15kHz", one RB consists of 12 subcarrieres.
- "@3.75kHz", there are 48 subcarriers.

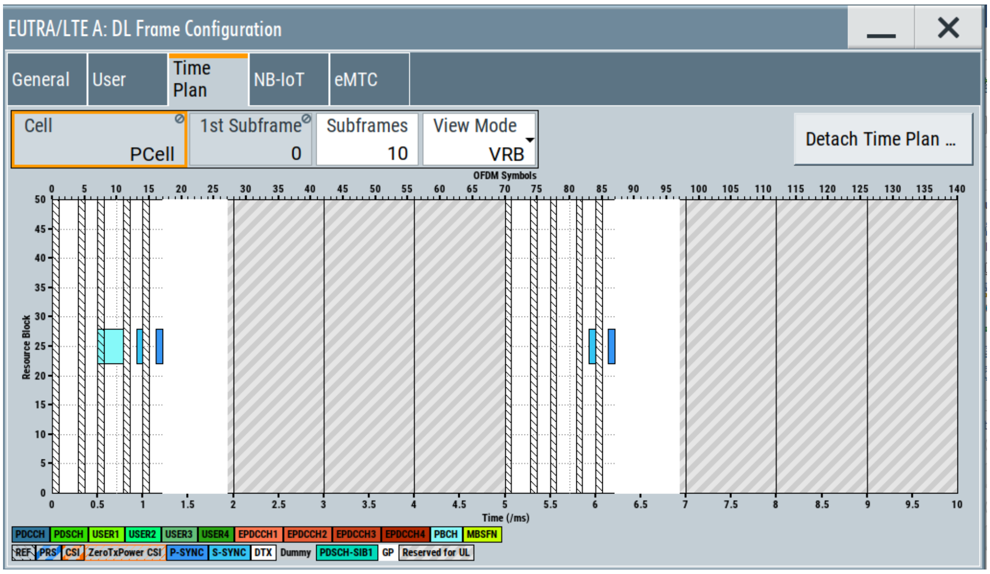
Detach Time Plan
Enlarges the time plan display.

7.6 TDD time plan

Access:

1. Select "General > Duplexing > TDD".

2. Select "Frame Configuration > Time Plan"



The x-axis shows allocation in the time domain. The y-axis shows the resource blocks as smallest allocation granularity in the frequency domain.
The frame structure depends on the selected "DL/UL Configuration" and the "Configuration of Special Subframe".

First Subframe
Selects the first subframe to be displayed.

Remote command:
n.a.

Subframes
Selects the number of subframes to be displayed.

Remote command:
n.a.

View Mode
Determines how the allocations are displayed.

If at least one NB-IoT UE is enabled, you use this parameter to zoom in and out in the frequency domain.

"PRB/VRB" The "Time Plan" displays the entire channel bandwidth. It shows the allocated virtual resource blocks (VRBs) or the physical resource blocks (PRBs).
In this granularity, an in-band or guard band NB-IoT allocation is indicated as one resource block; NRS are not visible. This mode is not available in standalone NB-IoT operation.

"Single RB" The "Time Plan" displays the allocation of the anchor carrier (one single RB) as selected in the RB index field.
The NRS, NPSS/NSSS and the downlink channels are shown in greater detail.
Note that the y-axis indicates the frequency allocation in terms of number of subcarriers.

Remote command:
n.a.

Detach Time Plan
Enlarges the time plan display.

8 Performing BS tests according to TS 36.141

The "Test Case Wizard" supports tests on base stations in conformance with the 3GPP specification for Base Station conformance testing. It offers a selection of predefined settings according to Test Cases in TS 36.141. For an overview of the test cases covered by the test case wizard, refer to Chapter 8.3, "Supported test cases", on page 534.

With the "Test Case Wizard", it is possible to create highly complex test scenarios with just a few keystrokes.

The "Test Case Wizard" has effect on frequency and level settings, link direction, filter, trigger, baseband clock source, marker settings and base station or user equipment configuration.

The "Test Case Wizard" also effects:

- AWGN
- Co-located modulation signals
- Fading profiles
- CW interferers.

The "Test Case Wizard" presets the instrument for tests according to the test specification. If it is required, you can change the predefined settings by varying the corresponding parameter in the EUTRA dialogs.

The test setups and the hardcopies in this description assume a fully equipped R&S SMW.

8.1 Introduction to conformance testing

The main purpose of the conformance testing is to ensure that the base station (BS) and the user equipment (UE) are fulfilling a defined level of minimum performance.

The 3GPP organization defines three groups of conformance testing for the UE: Radio Frequency (RF), Radio Resource Management (RRM) and Signaling. There is only one group conformance testing for the BS, the RF conformance tests.

This chapter is intended to give an overview of the 3GPP test specifications dealing with the conformance tests. Only a brief description is provided.

8.1.1 UE conformance testing

The UE conformance tests are not in the scope of this description.

UE RF FDD/TDD Conformance Test Specifications

The UE RF conformance tests are based on the core specification TS 36.101 and are defined in the TS 36.521. The following list gives an overview of the related specifications:

- TS 36.124 "ElectroMagnetic Compatibility (EMC) requirements for mobile terminals and ancillary equipment"
- TS 36.521-1 "User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing"

  Overview of the test cases:
  - Subclause 6: UE RF transmitter test cases
    Transmit power, Output power dynamics, Transmit signal quality, Output RF spectrum emissions and Transmit intermodulation
  - Subclause 7: UE RF receiver test cases
    Diversity characteristics, Reference sensitivity power level, Maximum input level, Adjacent Channel Selectivity (ACS), In-band blocking, Out-of-band blocking, Narrow band blocking, Spurious response, Intermodulation characteristics, Spurious emissions
  - Subclause 8: UE RF FDD/TDD performance test cases
    Demodulation of PDSCH (Cell-Specific Reference Symbols), Demodulation of PDSCH (User-Specific Reference Symbols), Demodulation of PDCCH/PCFICH, Demodulation of PHICH, Demodulation of PBCH
- TS 36.521-2 "User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Implementation Conformance Statement (ICS)"
- TS 36.521-3 "User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing"

UE RRM Conformance Test Specifications

The following specifications deal with UE RRM conformance testing:

- TS 36.133 "Requirements for support of radio resource management"
- TS 36.521-3 "User Equipment (UE) conformance specification; Part 3: Test suites"

UE Signaling Conformance Test Specifications

The UE signaling conformance tests are defined in the TS 36.523.

- TS 36.523-1 "User Equipment (UE) conformance specification; Part 1: Protocol conformance specification"
- TS 36.523-2 "User Equipment (UE) conformance specification; Part 2: Implementation Conformance Statement (ICS) pro-forma specification"
- TS 36.523-3 "User Equipment (UE) conformance specification; Part 3: Test suites"

8.1.2 BS conformance testing

BS RF FDD/TDD Conformance Test Specifications

The BS RF conformance tests are based on the core specification TS 36.101 and are defined in the TS 36.141

- TS 36.113 "Base Station (BS) and repeater ElectroMagnetic Compatibility (EMC)"
- TS 36.141 "Base Station (BS) conformance testing"
  The BS RF Conformance Tests are described in Chapter 8.3, "Supported test cases", on page 534.

8.1.3 Repeater conformance testing

The repeater conformance tests are based on the core specification TS 36.106 and defined in the TS 36.143 "FDD repeater conformance testing".

8.2 Required options

The basic equipment layout for preforming test with the aid of "Test Case Wizard" is the same as for the EUTRA/LTE signal generation. It includes the options:

- Standard or wideband Baseband Generator (R&S SMW-B10/-B9)
- Baseband Main Module (R&S SMW-B13) or Wideband baseband main module (R&S SMW-B13XT)
- Digital Standard EUTRA/LTE (R&S SMW-K55)
- Frequency option (e.g. R&S SMW-B1003)

Some of the tests require further options. You find a list of the required option at the beginning of each section that describes a group of test cases.

The following equipment and options are required to support **all test cases**:

- 2x option Baseband Generator (R&S SMW-B10)
- 1x option Baseband Main Module (R&S SMW-B13T)
- 1x option Frequency (e.g. R&S SMW-B1003)
- 1x option Frequency (e.g. R&S SMW-B2003)
- 4x option Fading Simulator (R&S SMW-B14/B15)
- 1x option Fading Simulator Extension (R&S SMW-K71)
- 1x option MIMO Fading and Routing (R&S SMW-K74)
- 2 option Additive White Gaussian Noise AWGN (R&S SMW-K62)
- 2x option Digital Standard EUTRA/LTE (R&S SMW-K55)
- 2x option Digital Standard EUTRA/LTE Release 10, LTE-Advanced (R&S SMW-K85)
- 1x option LTE closed loop BS Test (R&S SMW-K69)

Test cases where the signal generator hardware and/or software equipment is not sufficient are shown in grey color but are not selectable.

RF power and frequency limitations of the hardware equipment restrict the setting ranges.

8.3 Supported test cases

The BS RF conformance tests defined in the TS 36.141 are divided into three main parts, the RF transmitter characteristics, the RF receiver characteristics and the RF performance requirements.

The "Test Case Wizard" supports the test cases listed in the tables below.

Only the test cases that require a signal generator are implemented in the "Test Case Wizard".

Table 8-1: Transmitter Tests

Chapter in TS 36.141	Test Case	Section in this document with further information
	Output power dynamics	these test cases do not require a signal generator
6.3.1	RE Power control dynamic range	
6.3.2	Total power dynamic range	
6.4	Transmit ON/OFF power	
	Transmitted signal quality	
6.5.1	Frequency error	
6.5.2	Error Vector Magnitude	
6.5.3	Time alignment between transmitter branches	
6.5.4	DL RS power	
	Unwanted emissions	
6.6.1	Occupied bandwidth	
6.6.2	Adjacent Channel Leakage power Ratio (ACLR)	
6.6.3	Operating band unwanted emissions	
6.6.4	Transmitter spurious emissions	
6.7	Transmitter intermodulation	chap. 8.7.6, on page 559

Table 8-2: Receiver Characteristics

Chapter in TS 36.141	Test Case	Section in this document with further information
7.2	Reference sensitivity level	chap. 8.8.5, on page 568
7.3	Dynamic range	chap. 8.8.6, on page 570
7.4	In-channel selectivity	chap. 8.8.7, on page 572
7.5A	Adjacent Channel Selectivity (ACS)	chap. 8.8.8, on page 574
7.5B	Narrow-band blocking	chap. 8.8.9, on page 577
7.6	Blocking	chap. 8.8.10, on page 579
7.7	Receiver spurious emissions	this test case does not require a signal generator
7.8	Receiver intermodulation	chap. 8.8.11, on page 582

Table 8-3: Performance Requirement

Chapter in TS 36.141	Test Case	Section in this document with further information
	Performance requirements for PUSCH	
8.2.1	Performance requirements of PUSCH in multipath fading propagation conditions	chap. 8.9.4, on page 593
8.2.2	Performance requirements for UL timing adjustment	chap. 8.9.5, on page 595
8.2.3	Performance requirements for HARQ-ACK multiplexed on PUSCH	chap. 8.9.6, on page 600
8.2.4	Performance requirements for High-Speed Train conditions	chap. 8.9.7, on page 602
8.2.6	Enhanced performance requirements type A of PUSCH in multipath fading propagation conditions with synchronous interference	chap. 8.9.8, on page 606
8.2.6A	Enhanced performance requirements type A of PUSCH in multipath fading propagation conditions with asynchronous interference	chap. 8.9.9, on page 608
8.2.7	Performance requirements of PUSCH in multipath fading propagation conditions transmission on single antenna port for coverage enhancement	chap. 8.9.10, on page 610
8.2.9	Enhanced performance requirements type B of PUSCH in multipath fading propagation conditions	chap. 8.9.11, on page 612
	Performance requirements for PUCCH	
8.3.1	ACK missed detection for single user PUCCH format 1a	chap. 8.9.12, on page 615
8.3.2	CQI performance requirements for PUCCH format 2	chap. 8.9.13, on page 617
8.3.3	ACK missed detection for multi user PUCCH format 1a	chap. 8.9.14, on page 619

Chapter in TS 36.141	Test Case	Section in this document with further information
8.3.4	ACK missed detection for PUCCH format 1b, channel selection	chap. 8.9.15, on page 623
8.3.5	ACK missed detection for PUCCH format 3	chap. 8.9.16, on page 625
8.3.6	NACK to ACK detection for PUCCH format 3	chap. 8.9.17, on page 628
8.3.7	ACK missed detection for PUCCH format 1a transmission on two antenna ports	chap. 8.9.18, on page 630
8.3.8	CQI performance requirements for PUCCH format 2 transmission on two antenna ports	chap. 8.9.19, on page 632
8.3.9	CQI Performance for PUCCH format 2 with DTX detection	chap. 8.9.20, on page 633
8.3.10	ACK missed detection for PUCCH format 1a transmission on single antenna port for coverage enhancement	chap. 8.9.21, on page 635
8.3.11	CQI performance requirements for PUCCH format 2 transmission on single antenna port for coverage enhancement	chap. 8.9.22, on page 637
8.3.12	ACK missed detection for PUCCH format 4	chap. 8.9.23, on page 639
8.3.13	ACK missed detection for PUCCH format 5	chap. 8.9.24, on page 640
	Performance requirements for PRACH	
8.4.1	PRACH false alarm probability and missed detection	chap. 8.9.25, on page 642
8.5.1	Performance requirements for NPUSCH format 1	chap. 8.9.26, on page 646
8.5.2	ACK missed detection for NPUSCH format 2	chap. 8.9.27, on page 648
8.5.3	Performance requirements for NPRACH	chap. 8.9.28, on page 650

8.3.1 Generic structure of the description of the implemented test cases

The description of the test cases in this document follows a common structure.

- Test Case Number and Test Case Name
- Short Description and Test Purpose
  Some of the definitions are directly taken from the 3GPP test specification.
- Prerequisites, required hardware and software options
- Test setup
- Description of test case-specific parameters

8.4 Standard test setups

The tests can be performed using the standard test setup according to TS 36.141. Test setups beside the three standard test setups described below are specified at the individual description of the corresponding test case.

8.4.1 Standard test setup - one path

In case of two-path instruments signal routing to path A is assumed for the graph below. RF port A outputs the wanted signal (with or without fading and/or interference) and is connected to the Rx port of the base station. The signal generator will start signal generation at the first received eNB frame trigger.

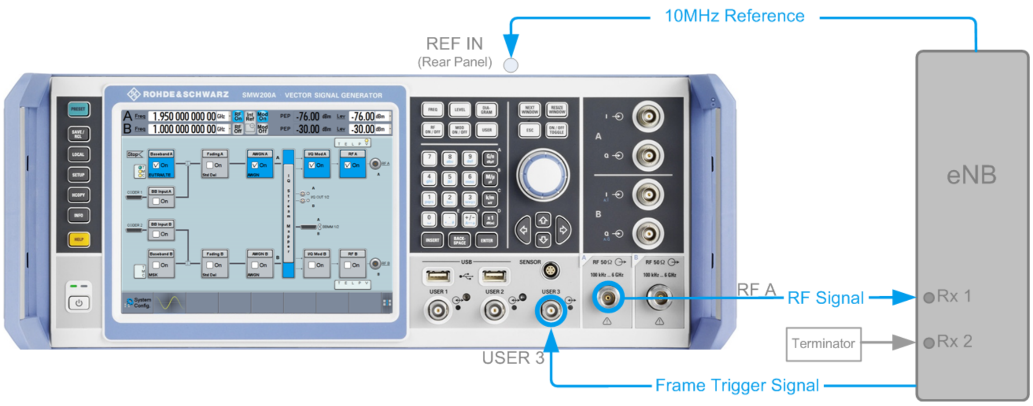


Figure 8-1: One Path Standard Test Setup (Example of R&S SMW simulating the test case 7.3 "Dynamic Range")

For two-path instruments it is also possible to route baseband signal A to RF output B and connect RF output B to the Rx port of the base station.

8.4.2 Standard test setup - two paths

For two-paths measurements, the test cases always require option Second RF path (R&S SMW-B20x), an option Baseband Main Module (R&S SMW-B13T) and at least one option to generate the interfering signal in addition to the basic configuration. The signal routing is fixed.

The signal generator outputs the reference measurement channel signal, i.e. the wanted signal at output RF A and the interfering signal(s) at output RF B. After combining the two (three) signals the sum signal is fed into the base station Rx port. The signal generator will start signal generation at the first received eNB frame trigger.

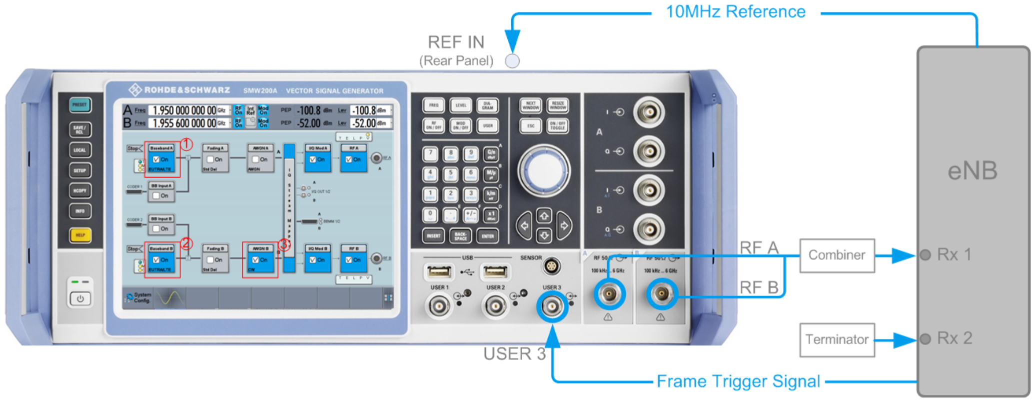


Figure 8-2: Two Paths Standard Test Setup (Example of R&S SMW simulating test case 7.8 "Receiver Intermodulation")

1 = Baseband A generates the wanted signal
2 = Baseband B generates the EUTRA/LTE interfering signal
3 = AWGN B generates the CW interfering signal

8.4.3 Test setup - diversity measurements

For diversity measurements, the test cases always require at least option Second RF path (R&S SMW-B20x) and an option Baseband Main Module (R&S SMW-B13T) in addition to the basic configuration. The signal routing is fixed.

RF output A and RF output B transmit the corrupted reference measurement channel signal (wanted signal) and are connected to the Rx ports of the base station for diversity reception. The signal generator will start signal generation at the first received eNB frame trigger.

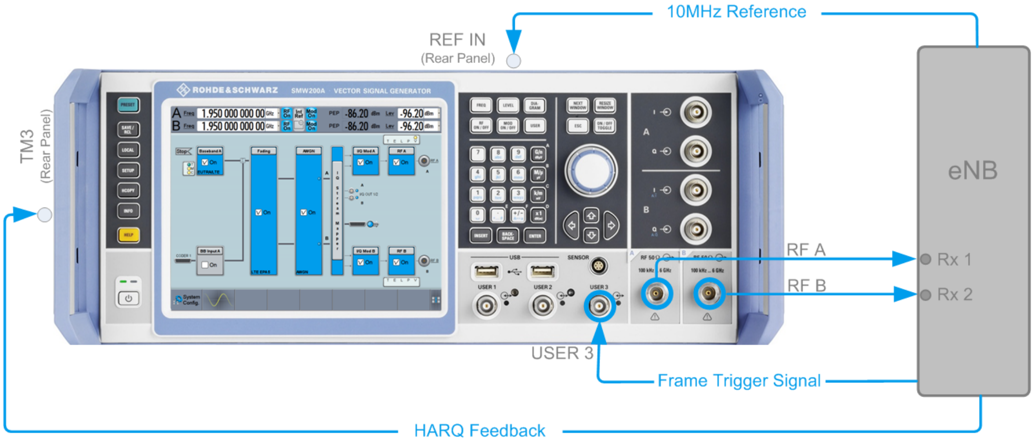


Figure 8-3: Test Setup for Diversity Measurements (Example of R&S SMW simulating test case 8.2.1 "PUSCH in Multipath Fading Propagation Conditions" with two Rx antennas)

As signal routing takes place at the output of the baseband block, the interference settings of the two paths are identical for diversity measurements.

8.4.4 Test setup - four RX antennas

Test setup with four RX antennas require additional instrument(s) that act as external RF outputs for the R&S SMW, for example:

- two R&S SGS100A connected to the analog [I/Q OUT 1/2] connectors of the instrument
- two R&S SMBV100A connected to the digital I/Q interfaces [BBMM 1/2 OUT] of the instrument
- one two-path signal generator, e.g. a R&S SMU200A or a second R&S SMW

The external instruments have to be equipped with the suitable frequency options. The signal routing is fixed.

RF output A and RF output B transmit the corrupted reference measurement channel signal (wanted signal) and are connected to the Rx ports of the base station for diversity reception. The signal generator will start signal generation at the first received eNB frame trigger.

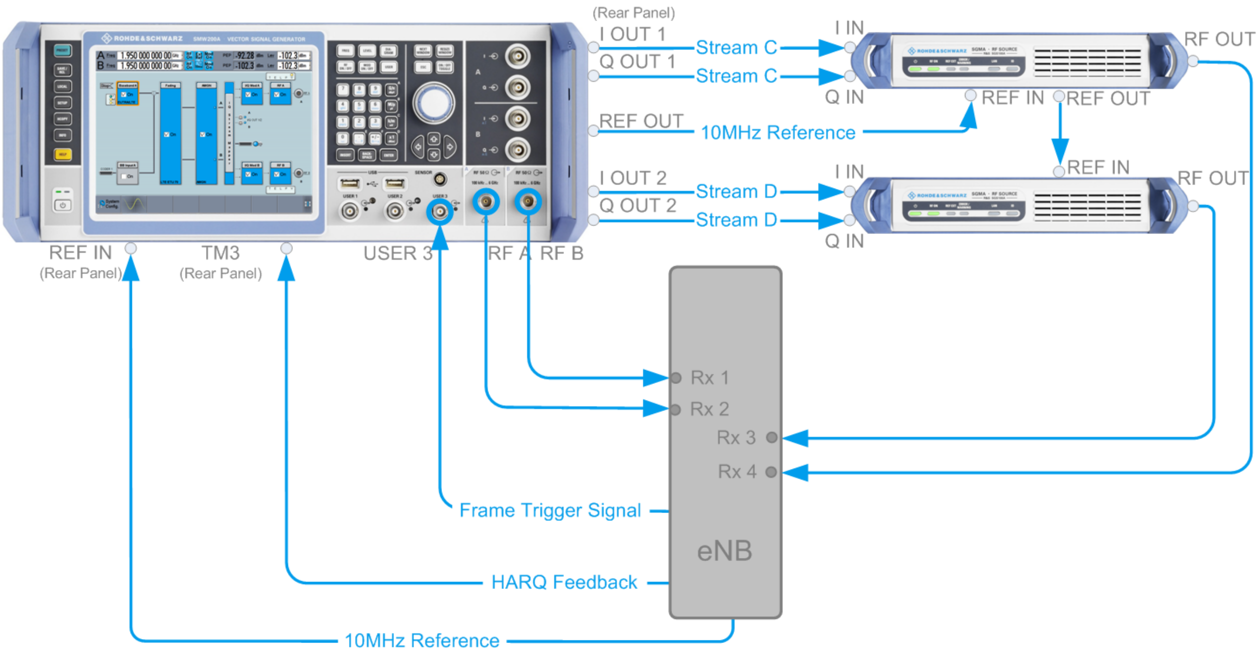


Figure 8-4: Test Setup for tests with four Rx antennas (Example of R&S SMW and 2xR&S SGS simulating test case 8.2.1 "PUSCH in Multipath Fading Propagation Conditions")

grey connectors = rear panel connectors
blue connectors = front panel connectors

As signal routing takes place at the output of the baseband block, the interference settings of the two paths are identical for diversity measurements.

8.5 General considerations

This section lists some common topics for all BS RF conformance tests. Considerations specific to one conformance test part, are described at the corresponding section.

Test Frequencies

EUTRA/LTE is designed to operate in the operating bands defined in Table 8-4. The table shows the start and the stop frequencies of both uplink and downlink frequency bands according to TS 36.141.

Table 8-4: EUTRA/LTE operating bands

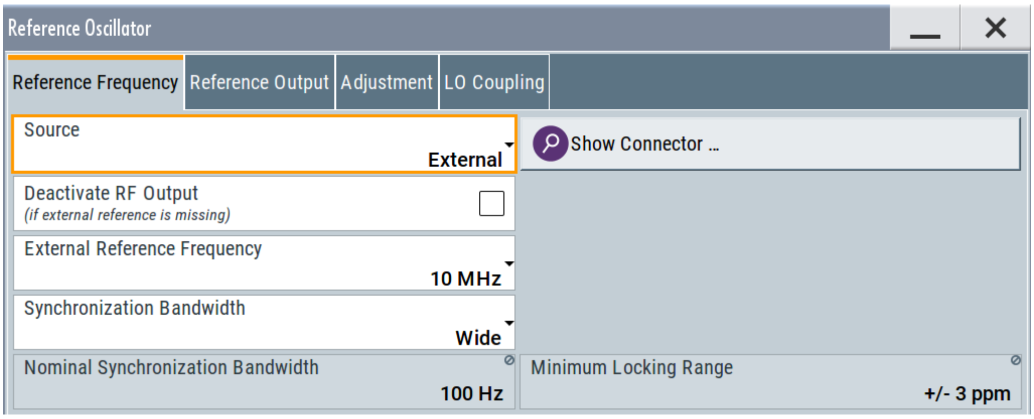
EUTRA Operating Band	Uplink (UL) band BS receive UE transmit F_{UL_low} to F_{UL_high}	Downlink (DL) operating band BS transmit UE receive F_{DL_low} to F_{DL_high}	Duplex Mode
1	1920 MHz to 1980 MHz	2110 MHz to 2170 MHz	FDD
2	1850 MHz to 1910 MHz	1930 MHz to 1990 MHz	FDD
3	1710 MHz to 1785 MHz	1805 MHz to 1880 MHz	FDD
4	1710 MHz to 1755 MHz	2110 MHz to 2155 MHz	FDD
5	824 MHz to 849 MHz	869 MHz to 894MHz	FDD
6	830 MHz to 840 MHz	875 MHz to 885 MHz	FDD
7	2500 MHz to 2570 MHz	2620 MHz to 2690 MHz	FDD
8	880 MHz to 915 MHz	925 MHz to 960 MHz	FDD
9	1749.9 MHz to 1784.9 MHz	1844.9 MHz to 1879.9 MHz	FDD
10	1710 MHz to 1770 MHz	2110 MHz to 2170 MHz	FDD
11	1427.9 MHz to 1447.9 MHz	1475.9 MHz to 1495.9 MHz	FDD
12	699 MHz to 716 MHz	729 MHz to 746 MHz	FDD
13	777 MHz to 787 MHz	746 MHz to 756 MHz	FDD
14	788 MHz to 798 MHz	758 MHz to 768 MHz	FDD
...			
17	704 MHz to 716 MHz	734 MHz to 746 MHz	FDD
...			
33	1900 MHz to 1920 MHz	1900 MHz to 1920 MHz	TDD
34	2010 MHz to 2025 MHz	2010 MHz to 2025 MHz	TDD
35	1850 MHz to 1910 MHz	1850 MHz to 1910 MHz	TDD

EUTRA Operating Band	Uplink (UL) band BS receive UE transmit F_{UL_low} to F_{UL_high}	Downlink (DL) operating band BS transmit UE receive F_{DL_low} to F_{DL_high}	Duplex Mode
36	1930 MHz to 1990 MHz	1930 MHz to 1990 MHz	TDD
37	1910 MHz to 1930 MHz	1910 MHz to 1930 MHz	TDD
38	2570 MHz to 2620 MHz	2570 MHz to 2620 MHz	TDD
39	1880 MHz to 1920 MHz	1880 MHz to 1920 MHz	TDD
40	2300 MHz to 2400 MHz	2300 MHz to 2400 MHz	TDD

The measurements that have to be performed according to TS 36.141 for verifying a proper operation of systems apply to appropriate frequencies in the bottom, middle and top of the operating frequency band of the base station (BS). These frequencies are denoted as RF channels B (bottom), M (middle) and T (top).

Reference Frequency

When building up the measurement setups according to TS 36.141 it might be useful that all the instruments share a common reference clock. When you feed an external clock, the RF module configuration should be switched to external reference frequency.



In the external reference mode an external signal with selectable frequency and defined level must be input at the REF IN connector. This signal is output at the REF OUT connector. The reference frequency setting is effective for both paths. For achieving very good reference sources of high spectral purity a wideband setting is provided.

Baseband Clock

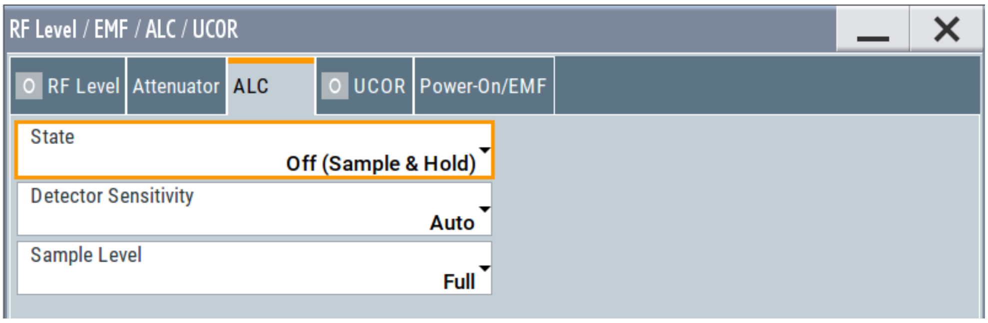
The clock source is automatically switched to internal when the test case settings are activated.

Improvement of signal quality

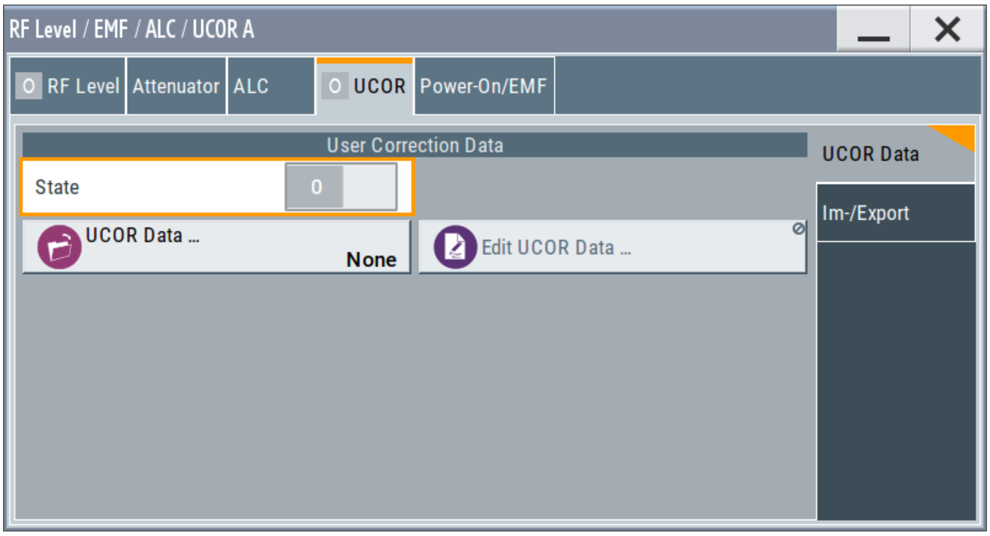
Improvement of signal quality is possible via several settings:

- In the "I/Q Mod > I/Q Settings > General" dialog, select a "Baseband Gain = 2 dB" to improve the ACLR performance

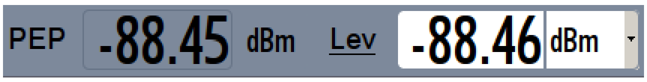
- In the "RF > RF Level > Automatic Level Control Settings" dialog, select "State > Off (Sample&Hold)".
  This is recommended for multi-transmitter measurements if in CW mode the signal/intermodulation ratio is to be improved.
  With setting "Auto", the level control is automatically adapted to the operating conditions, it may cause increased intermodulation, however.



- To consider the frequency response of the test setup, select "RF > User Correction" and crate a list of correction values.



- To compensate cable loss and additionally inserted attenuator, adjust the RF level ("Status Bar > Level").



Virtual Resource Block (VRB) Offset

In this implementation, the RBs are allocated by default at the left edge of the spectrum. However, some test cases do not require allocation of the entire bandwidth or RB allocation at a specific part of the bandwidth. Adjust the additional parameter "Offset VRB" to define the position of the RBs.

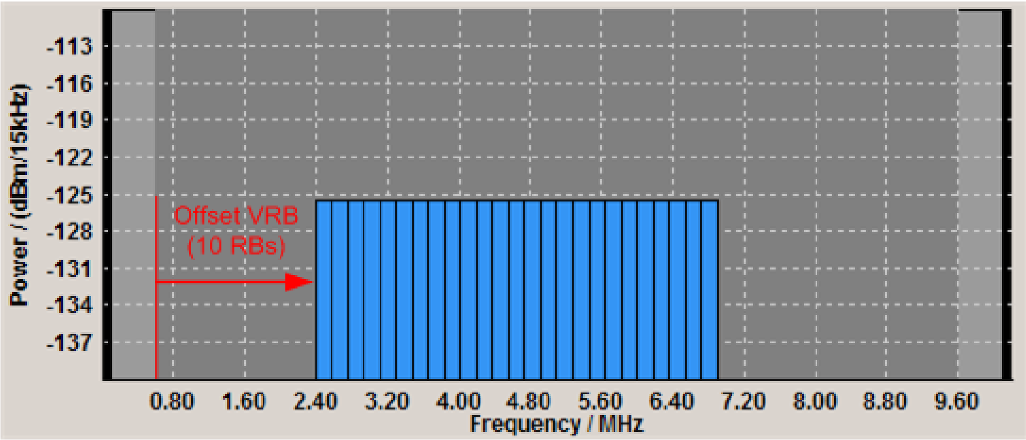
Example: Offset VRB

"Channel Bandwidth" = 10 MHz, i.e. 50 RBs

"Allocated Resource Blocks" = 25

"Offset VRB" = 10

The RBs are offset by 10 RBs and allocated RBs start at position 11.



Use also the SC-FDMA time plan to visualize the RB allocation for the wanted signal (path A) and the interfering signal (path B).

8.6 User interface

Access:

► Select "Baseband Block > EUTRA/LTE > Test Case Wizard".

There is only one "Test Case Wizard" in the instrument, i.e. the same dialog can be accessed via each of the baseband blocks.

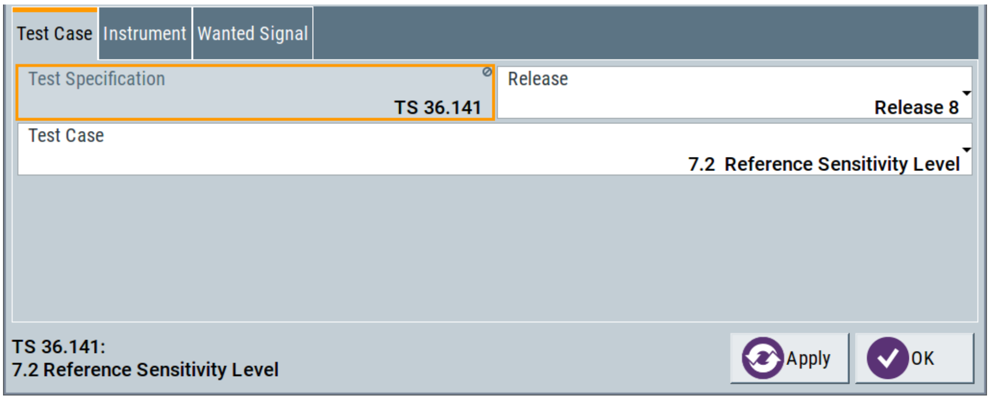
The "Test Case Wizard" dialog is divided into several tabs: the "Test Case" tab for selecting the test case, the "TMR" tab for settings regarding routing, trigger and marker configuration, one or more tabs with corresponding names comprising the additional parameters like the configuration of the wanted and interfering signals, AWGN and fading settings and the "Apply" button.

The graph indicates the interference scenario defined by power level and frequency offset. A permanent display shows a graph of the currently selected test case.

8.6.1 Test case settings

Access:

1. Select "Baseband Block > EUTRA/LTE > Test Case Wizard".
2. Select "Test Case".



This dialog comprises the settings for selecting the test case, the 3GPP test specification and release as well as other general settings.

Test Specification

Selects the 3GPP test specification used as a guide line for the test cases.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SPEC on page 1078

Release

Displays the 3GPP test specification release version used as a guide line for the test cases.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:GS:RELease on page 1078

Base Station Class

Determines whether the test is to be performed for a local area, home area, medium range or a wide area base station. The different base station classes are specified for different output power ("Power Level" on page 550).

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:GS:BSCLass on page 1080

Test Case

Selects the test case.

Note: Not all test case are available for all instruments. The enabled test cases depend on the instrument's hardware (e.g. instrument equipped with one or two paths, etc) and/or the installed SW options (e.g. Fading Simulator, etc.).

See Chapter 8.3, "Supported test cases", on page 534 for an overview of the available test cases.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:TC` on page 1088

Number of Rx Antennas

For performance requirement tests, determines the number of the Rx antennas.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:GS:RXANtennas` on page 1080

Number of Tx Antennas

For performance requirement tests, determines the number of the Tx antennas.

Remote command:

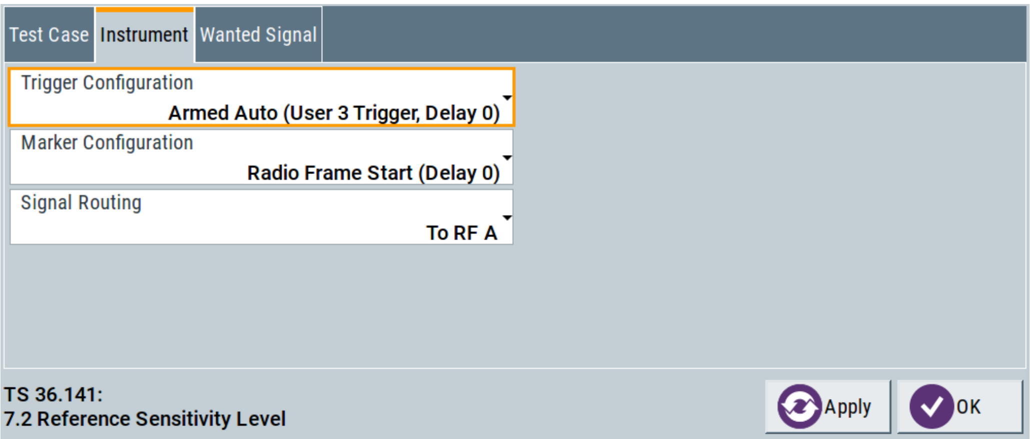
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:TXANtennas` on page 1080

8.6.2 Instrument settings

Access:

1. Select "Baseband Block > EUTRA/LTE > Test Case Wizard".
2. Select "Instrument".

   The "Instrument" dialog comprises instrument-related settings, like trigger and marker settings or routing related settings.



Trigger Configuration

Selects the trigger configuration. The trigger is used to synchronize the signal generator to the other equipment.

"Armed Auto (User 3 Trigger, Delay 0)"
The trigger settings are customized for the selected test case. The following settings apply:

- "Trigger Mode > Armed Auto"
- "Trigger Source > External Global Trigger 1"
- "Global Connector Settings > User 3 > Direction > Input" and "User 3 > Signal > Global Trigger 1"
- "Trigger Delay = 0"
  Thus, the base station frame timing is able to synchronize the signal generator by a periodic trigger.

"Unchanged" The current trigger settings of the signal generator are retained unchanged.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:TRIGgerconfig` on page 1081

Marker Configuration

Selects the marker configuration. The marker can be used to synchronize the measuring equipment to the signal generator.

"Radio Frame Start (Delay 0)"
The marker settings are customized for the selected test case. The following settings apply:

- "Marker Mode 1/2/3 > Radio Frame Start"
- "Global Connector Settings > User 1/2 > Direction > Output" and "User 1/2 > Signal > Baseband A Marker 1/2"
  "Local Connector Settings > T/M 2/3 > Direction > Output" and "T/M 2/3 > Signal > Marker A 1/2"
  Marker signals Marker 1 and Marker 2 are output at the local T/M 2/3 and global USER1/2 connectors
- "Marker Delay = 0"

"Unchanged" The current marker settings of the signal generator are retained unchanged.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:MARKerconfig` on page 1079

Instrument Setup

(two-path instruments only)

Determines whether only one or both paths are used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:INSTsetup on page 1079

Signal Routing
Selects the signal routing for baseband A signal which in most test cases represents the wanted signal.

"To RF A"
The baseband signal is routed to RF output A.

"To RF B"
The baseband signal is routed to RF output B.
Tip: Some transmitter tests like test case 7.2 require separate measurements on both Rx port. Use this feature to route the same baseband signal to the second RF output and perform the measurements.

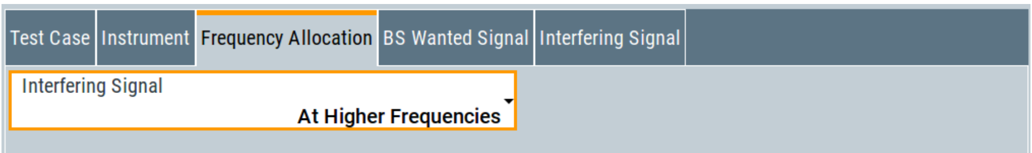
Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:SIGRout on page 1080

Antenna Subset
In test setups with more than two Rx antennas, determines the signal of which antenna couple ("Antenna 1 and 2" or "Antenna 3 and 4") or of all antennas is generated by the instrument.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:ANTSubset on page 1078

8.6.3 Frequency allocation settings

Determines the frequency position of the wanted and the interfering signal.



Frequency Allocation of the Interfering signal
Determines the frequency position of the wanted and the interfering signal.

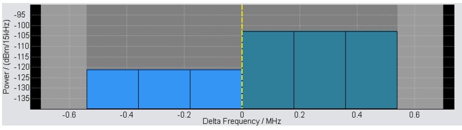
Example: Wanted and interfering signal within the same channel

"Test Case" = 7.4 "In Channel Selectivity"

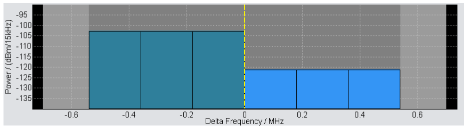
"Channel Bandwidth" = 1.4 MHz

The parameter "Frequency Allocation" determines the position of the allocated RBs within the channel. Allocation in the lower or higher frequencies is possible.

"Frequency Allocation of the Interfering signal" = At Higher Resource Blocks



"Frequency Allocation of the Interfering signal" = At Lower Resource Blocks



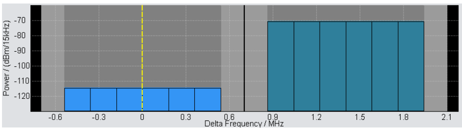
Example: Interfering signal in the adjacent channel

"Test Case" = 7.5A "Adjacent Channel Selectivity"

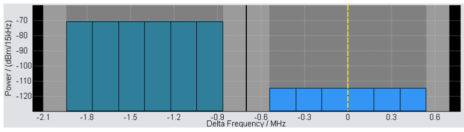
"Channel Bandwidth" = 1.4 MHz

The parameter "Frequency Allocation" determines the position of the wanted signal compared to the interfering signal. Allocation in the lower or higher frequencies is possible, i.e. the position of the allocated bandwidth of the wanted and the interfering signal can be mirrored.

"Frequency Allocation of the Interfering signal" = At Higher Resource Blocks



"Frequency Allocation of the Interfering signal" = At Lower Resource Blocks



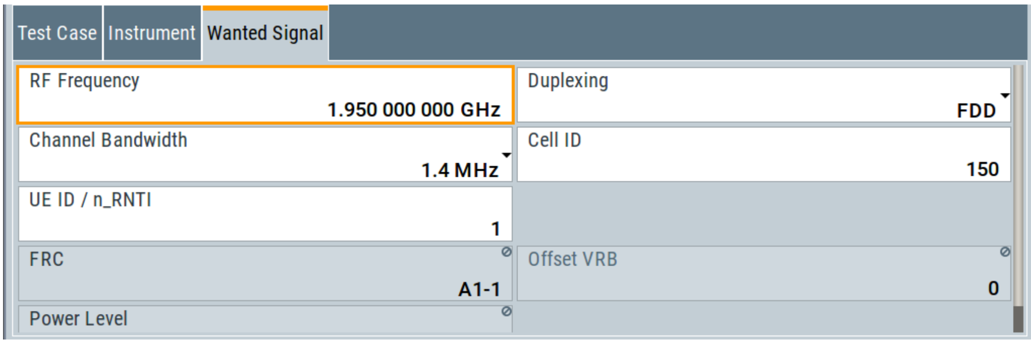
Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:FA:FRALlocation on page 1077
[:SOURce<hw>]:BB:EUTRa:TCW:FA:RBALlocation on page 1077

8.6.4 Wanted signal and cell-specific settings

The following settings are available for almost all transmitter and receiver characteristics and performance requirements tests. Specific parameters are listed together with the description of the corresponding test case.

For the in-channel test cases 7.4, 8.2.2 and 8.3.3, the cell-specific settings apply also for the interfering signal, respectively for the signal of the stationary UE.



RF Frequency

Sets the RF frequency of the wanted signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:RFFRequency on page 1095

Duplexing

Selects whether TDD or FDD duplexing mode is used.

See also "Duplexing" on page 66.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:DUPLex on page 1092

TDD UL/DL Configuration

For TDD mode, selects the UL/DL Configuration number (see also "TDD UL/DL Configuration" on page 108).

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:TDDConfig on page 1095

Signal Advance N_TA_offset

Sets the parameter $N_{TAoffset}$.

See also "Signal Advance N_TA_offset" on page 675.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:NTAOffset on page 1093

Channel Bandwidth
Selects the channel bandwidth.

See also Chapter 4.6.2, "Physical settings", on page 237.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CHBW on page 1091

Cell ID
Sets the Cell ID.

See also Chapter 4.6.3, "Cell-specific settings", on page 241 .

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CLID on page 1091

Cyclic Prefix
Selects normal or extended cyclic prefix.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CYCPrefix on page 1091

UE ID/n_RNTI
Sets the UE ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:UEID on page 1096

FRC
Displays the fixed reference channel used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:FRC on page 1092

Offset VRB
Sets the number of RB the allocated RB(s) are shifted with (see also Example"Offset VRB" on page 543).

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:OVRB on page 1094

Power Level
Displays the power level, depending on the selected test case.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLEVel? on page 1094

CE Mode
Selects the CEMode according to table 8.2.7.4.2-2: Test parameters for testing PUSCH of TS 36.141.

The parameter is relevant test cases 8.2.7, 8.3.10.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:CEMode on page 1096

Repetitions
Sets the Tx repetitions of wanted signal (e.g. PUCCH Tx repetitions for test cases 8.3.10 and 8.3.11).

The parameter is relevant for several Rel. 15 test cases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:REPetitions on page 1097

DIP
Selects the dominant interferer proportion (DIP) set within the cell-specific settings.

The parameter is relevant for Rel. 15 test cases 8.2.6, 8.2.6A, and 8.2.9.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:CS:DIP on page 1077

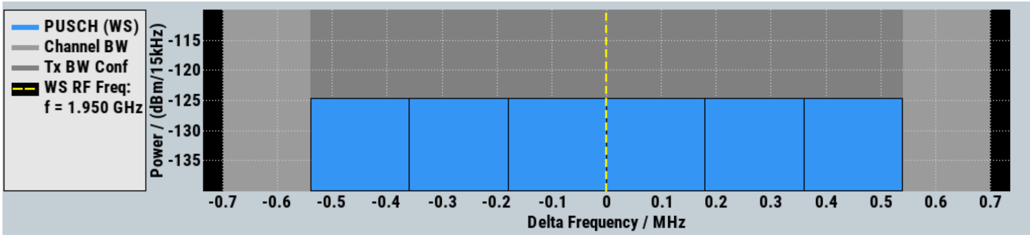
Relative Power
Selects the power configuration according to dominant interferer proportion (DIP) set within the cell-specific settings.

The parameter is relevant for Rel. 15 test case 8.2.9.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:CS:RPOW? on page 1077

8.6.5 Diagram

The graph displays the interference scenario defined by power level and frequency offset of the currently selected test case.



8.6.6 Apply settings

The "Apply" trigger a selective preset of the signal generator prior to presetting the setting according to the selected test case. Further modification of the generator settings is still possible. Signal generation starts with the first trigger event.

Use "Ok" to apply the settings and close the dialog.

Apply Settings
Activates the current settings of the test case wizard.

Note: The settings of the selected test case becomes active only after selecting "Apply Settings".

Initialization of the signal generator with the test case settings is performed by a partial selective reset that includes only the baseband, fading and AWGN module and the RF frequency and RF level settings. Other settings of the signal generator are not altered.

Before triggering the signal generator the user still can change these other settings. This is particularly useful when compensating for cable loss and additionally inserted attenuators by adjusting the RF power level offset is required.

Signal generation is started at the first trigger received by the generator. The RF output is not activated /deactivated by the test case wizard. Activate the "RF > State > On" at the beginning of the measurement.

Note: For safety reasons the RF is not active unless the button "RF ON" has been selected.

Note: The settings in the dialogs "EUTRA/LTE > Trigger/Marker/Clock" and in the "Global/Local Connector Settings" are not affected by the selective preset, if the parameter "Trigger/Marker Configuration" is set to "Unchanged".

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:APPLysettings` on page 1076

8.7 Transmitter characteristics (TS 36.141, chapter 6)

The transmitter characteristics comprise the maximum output power, output power dynamics, transmitted signal quality, unwanted emissions and transmitter intermodulations. The "Test Case Wizard" supports the generation of signals in accordance with the transmitter intermodulations test case. A brief description about the unwanted emission tests is also provided (see Chapter 8.7.3, "Introduction to the unwanted emissions tests", on page 553).

8.7.1 Required options

Table 8-5 lists the required options for performing the test cases according to TS 36.141, Chapter 6.

Table 8-5: Required options

Chapter in TS 36.141-1	**Hardware options**					**Software options**	
	RF path		**Baseband**		**BB generator**	**AWGN**	**LTE**
	A	**B**	**1 path**	**2 paths**			
	e.g. B1003	**e.g. B2003**	**B13** **B13XT**	**B13T** **B13XT**	**B10** **B9**	**K62**	**K55**
6.7 Transmitter intermodulation	1	-	1	-	1	-	1

8.7.2 Prior considerations

Test Models

3GPP specifies EUTRA test models (E-TM) for testing the transmitter characteristic. For an overview, see "Test Models" on page 67.

Channels

According to the TS 36.141, the channels to test are located in the bottom (B), middle (M) and the top (T) of the supported frequency range of the base station. See Table 8-4 for an overview of the supported frequency operating bands.

Filter Settings

The 3GPP EUTRA/LTE specifications do not define a standardized transmit filter neither for the UE nor for the base station. Therefore, when a test case is activated, a filter type EUTRA/LTE with "Best ACP Optimization" is automatically selected.

Test Setup

Transmitter tests require a separate measuring equipment, e.g. the Vector Signal Analyzer R&S FSV.

8.7.3 Introduction to the unwanted emissions tests

The unwanted emissions from the transmitter are divided into two main groups, the out-of-band (OOB) emissions and the spurious emissions. The out-of-band emissions are emissions on frequencies close to the frequency of the wanted signal. Spurious emissions are emissions caused by unwanted transmitter effects, like harmonics, parasitic emissions, intermodulation products and frequency conversion products.

- ACLR
  The Adjacent Channel Leakage power Ratio (ACLR) is defined as the ratio between the power transmitted in the channel bandwidth of the wanted signal to the power of the unwanted emissions transmitted on the adjacent channel.
  The corresponding receiver requirement is the Adjacent Channel Selectivity (ACS), described in Chapter 8.8.8, "Test case 7.5A: adjacent channel selectivity (ACS)", on page 574.
  The test specification defines ACLR requirements for LTE and UTRA receivers. Different setting applies for paired and unpaired spectrum (see Table 8-6 and Table 8-7).

Table 8-6: Base Station ACLR in paired spectrum

EUTRA transmitted signal channel bandwidth $BW_{Channel}$, MHz	BS adjacent channel center frequency offset below the first or above the last carrier center frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
1.4 / 3 / 5 / 10 / 15 / 20	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	44.2 dB
	$2xBW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$BW_{Channel}/2$+ 2.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	
	$BW_{Channel}/2$+ 7.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	

Table 8-7: Base Station ACLR in unpaired spectrum with synchronized operation

EUTRA transmitted signal channel bandwidth $BW_{Channel}$, MHz	BS adjacent channel center frequency offset below the first or above the last carrier center frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
1.4 / 3	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	44.2 dB
	$2xBW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$BW_{Channel}/2$+ 0.8 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
	$BW_{Channel}/2$+ 2.4 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
5 / 10 / 15 / 20	$BW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$2xBW_{Channel}$	EUTRA of same BW	Square (BW_{Config})	
	$BW_{Channel}/2$+ 0.8 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
	$BW_{Channel}/2$+ 2.4 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	
	$BW_{Channel}/2$+ 2.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	
	$BW_{Channel}/2$+ 7.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	
	$BW_{Channel}/2$+ 5 MHz	7.68 Mcps UTRA	RRC (7.68 Mcps)	
	$BW_{Channel}/2$+ 15 MHz	7.68 Mcps UTRA	RRC (7.68 Mcps)	

- Operating Band Unwanted Emissions
  The 3GPP specification introduces the term operating band unwanted emissions instead of the spectrum mask. The operating band unwanted emissions requirements are defined from 10 MHz below the lowest frequency of the downlink operating band up to 10 MHz above the highest frequency of the operating band.

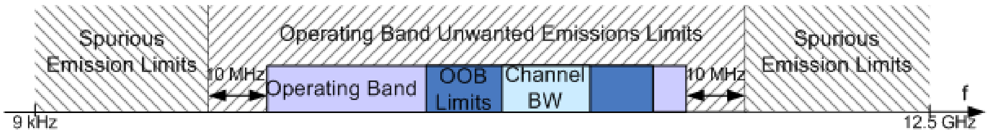


Figure 8-5: Transmitter tests frequency limits

The operating band unwanted emissions require a 100 kHz measurement bandwidth.

- Spurious Emissions
  The transmitter spurious emissions limits apply from 9 kHz to 12.5 GHz, excluding the frequency range defined for the operating band unwanted emissions (see Figure 8-5).
  Refer to Table 8-8 for an overview of the general settings for the measurements.
  Additional requirements may apply for co-existence with other systems and/or co-location with other base stations. For detailed requirements, refer to the TS 36.141.

Table 8-8: Spurious emissions

Frequency range	Maximum level Category A	Maximum level Category B	Measurement Bandwidth
9kHz - 150kHz	-13 dBm	-36 dBm	1 kHz
150kHz - 30MHz			10 kHz
30MHz - 1GHz			100 kHz
1GHz - 12.75 GHz		-30 dBm	1 MHz

8.7.4 General workflow for carrying out a transmitter test

The following describes the general workflow, only the basic steps are listed.

For detailed description about working with the analyzer and the base station, refer to the corresponding description.

The basic test setup is illustrated on Figure 8-6.

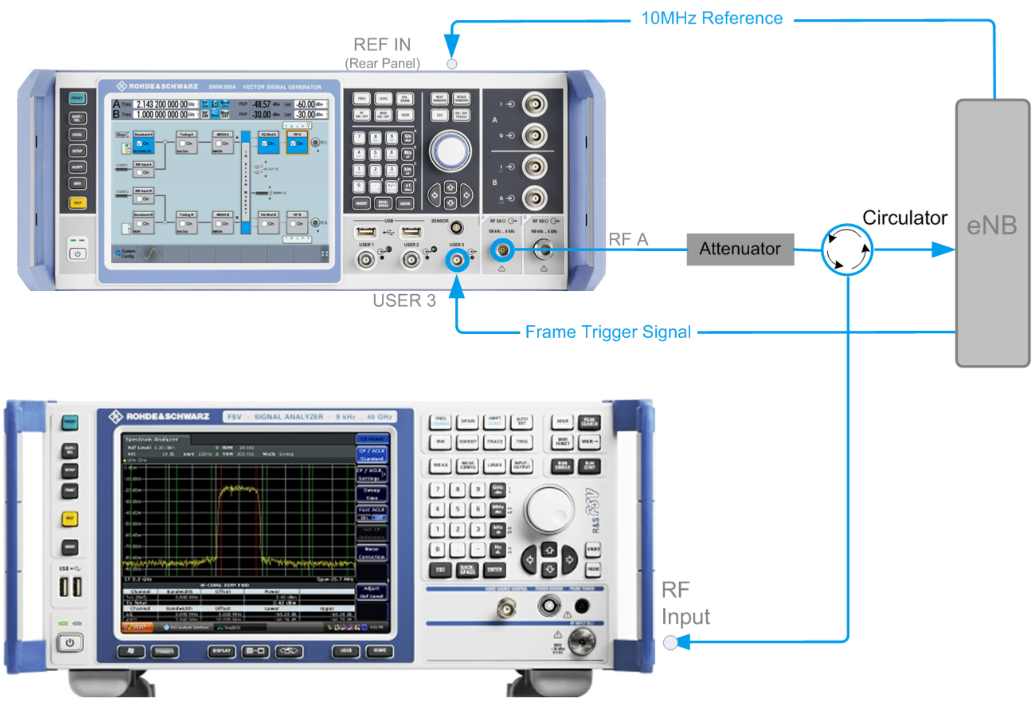


Figure 8-6: Test setup for Test case 6.7: Transmitter Intermodulation

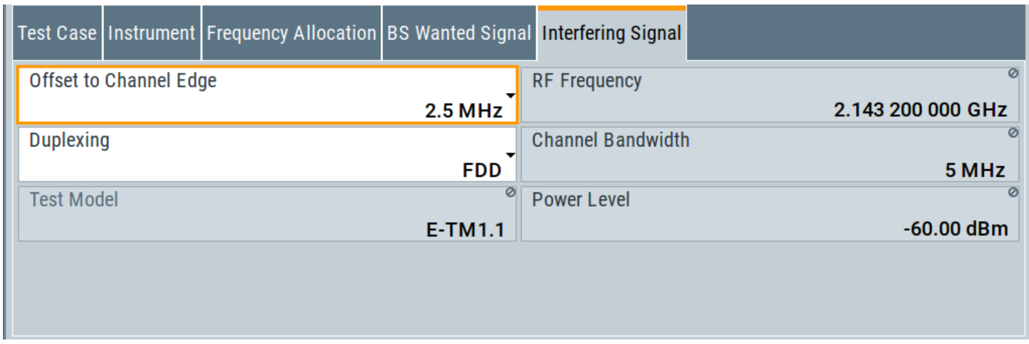
1. Set the base station to the basic state and configure it for the selected test case.
   a) Initialize the base station,
   b) Set the base station to test model E-TM1.1,
   c) Set maximum transmit power,
   d) Set the frequency.
2. Set the signal generator to the basic state
   a) Preset the signal generator unless some settings (e.g. in terms of I/Q and RF blocks) have to be kept.
3. Set the analyzer to the basic state
4. Set the test case wizard
   a) Select "Baseband Block > EUTRA/LTE > Test Case Wizard"
   b) Select "Test Case 6.7: Transmitter Intermodulation".
   The parameters are preset according to TS 36.141
   c) Adjust the settings of the wanted signal (RF level and Channel Bandwidth).
   d) Enter the test frequency (e.g. M). It must be the same as the base station has been set to.
   e) Enter the Interfering Signal parameters.
   f) Activate the settings with the "Apply Settings" button.
   The signal generator is now ready to start signal generation
5. Set the analyzer to the measurement frequency and perform further necessary settings.
   Refer to the description of the analyzer for further information.

6. In the signal generator, switch on the RF output.
7. Start the measurement
   a) Send a start trigger impulse from the base station to the signal generator and to the analyzer.

   The signal generator outputs the test model interfering signal; Measurement procedures are started.
8. Calculate the result
   The analyzer calculates the out-of-band emission and the spurious emission.

8.7.5 Interfering signal settings

The following settings are common for the transmitter tests that require interfering signal (IS). Specific parameters are listed together with the description of the corresponding test case.



The interfering signal is an E-TM1.1 signal with 5 MHz channel bandwidth and center frequency relative to the carrier frequency of the wanted signal.

Offset to Channel Edge
Defines the offset of the interfering signal center frequency relative to edge of the wanted channel bandwidth. This parameter determines the carrier frequency of the interfering signal (see RF Frequency).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:OCEDge` on page 1083

RF Frequency
Displays the RF Frequency of the interfering signal, determined by the RF Frequency of the wanted signal and the selected Offset to Channel Edge.

The RF $\text{Frequency}_{\text{interfering signal}}$ is calculated as follows:
- For "Frequency Allocation > Interfering Signal > At Higher Frequencies"
  "RF $\text{Frequency}_{\text{interfering signal}}$" = "RF $\text{Frequency}_{\text{wanted signal}}$" + Delta
- For "Frequency Allocation > Interfering Signal > At Lower Frequencies"
  "RF $\text{Frequency}_{\text{interfering signal}}$" = "RF $\text{Frequency}_{\text{wanted signal}}$" - Delta

Where for both cases **Delta** is calculated as follows:

Delta = "$\text{BW}_{\text{wanted signal}}$"/2 + $\text{Offset}_{\text{interfering signal}}$

Example: Calculation of RF Frequency in Test Case 6.7

"$BW_{wanted\ signal}$" = 1.4 MHz

"RF $Frequency_{wanted\ signal}$" = 1 950 MHz

$Offset_{interfering\ signal}$ = 7.5 MHz

Delta = 1.4/2 + 7.5 = 8.2 MHz

For "Frequency Allocation > Interfering Signal > At Higher Frequencies": "RF Fre-$quency_{interfering\ signal}$" = 1 950 + 8.2 = 1 958.2 GHz

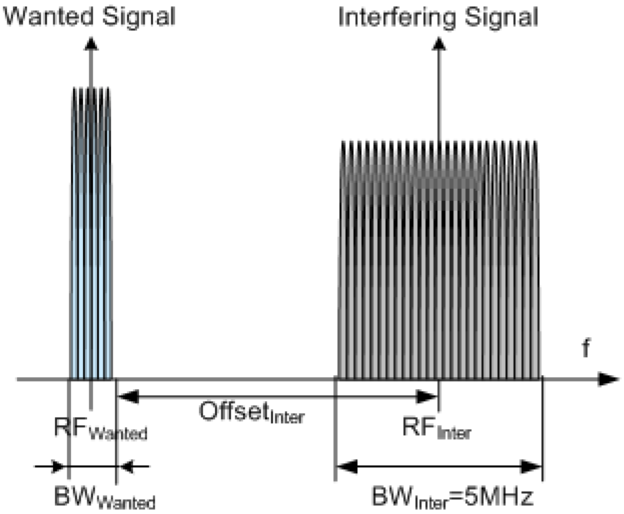


Figure 8-7: Example: Offset to Channel Edge (Channel Bandwidth = 1.4 MHz)

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency on page 1084

Channel Bandwidth
Displays the channel bandwidth of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW? on page 1081
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:CHBW? on page 1081

Duplexing
Selects whether TDD or FDD duplexing mode is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex on page 1082
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:DUPLex on page 1082

Test Model
Displays the test model. The interfering signal is generated according to E-TM1.1 test model.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:TMODel? on page 1085

Power Level/Power Level P-CPICH
Displays the power level of the interfering signal.

Test Case	Power level
6.7	The power level is always 30 dB below the Output Power Level of the wanted signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?` on page 1084

8.7.6 Test case 6.7: transmitter intermodulation

Test Purpose

The test purpose is to verify the ability of the BS transmitter to restrict the generation of intermodulation products in its nonlinear elements caused by presence of the own wanted signal and an interfering signal reaching the transmitter via the antenna (TS 36.141).

Required Options

See Chapter 8.7.1, "Required options", on page 552.

Test Setup

See Figure 8-6.

The [RF] output of the signal generator is connected to the analyzer via a circulator and external attenuator. The Tx signal of the base station is connected to the RF input of the analyzer via a circulator.

Short Description

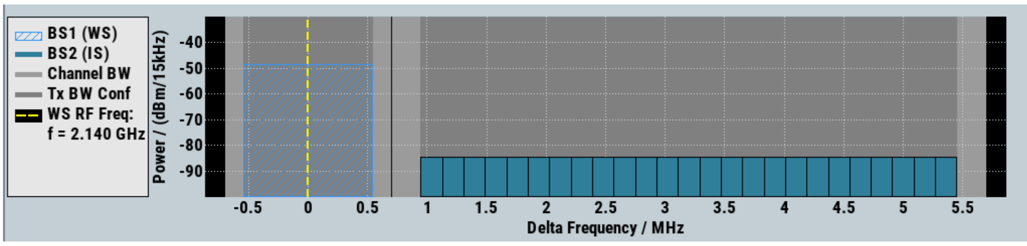
The transmitter intermodulation test is intended to verify the ability of the BS transmitter to restrict the generation of intermodulation products in its nonlinear elements caused by presence of wanted signal and an interfering signal reaching the transmitter via the antenna.

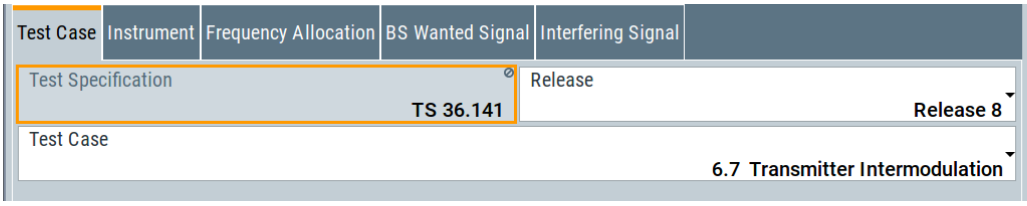
The BS transmits signals in accordance with E-TM1.1 at maximum power and with channel bandwidth $BW_{Channel}$ corresponding to the maximum bandwidth supported by the base station. The interfering signal is an E-TM1.1 signal with 5 MHz channel bandwidth. The interfering signal power shall be 30 dB lower than the power of the wanted signal at the frequency offsets of ±2.5 MHz, ±7.5 MHz and ±12.5 MHz.

The transmit intermodulation level shall not exceed the out-of-band emission requirements and transmitter spurious emissions requirements for all third and fifth order intermodulation products which appear in the frequency ranges defined in Table 8-6, Table 8-7 and Table 8-8. For detailed information about the operating band unwanted emissions, refer to section 6.6.3.5 in TS 36.141.

The test shall be done on three channels (B, M and T).

User Interface

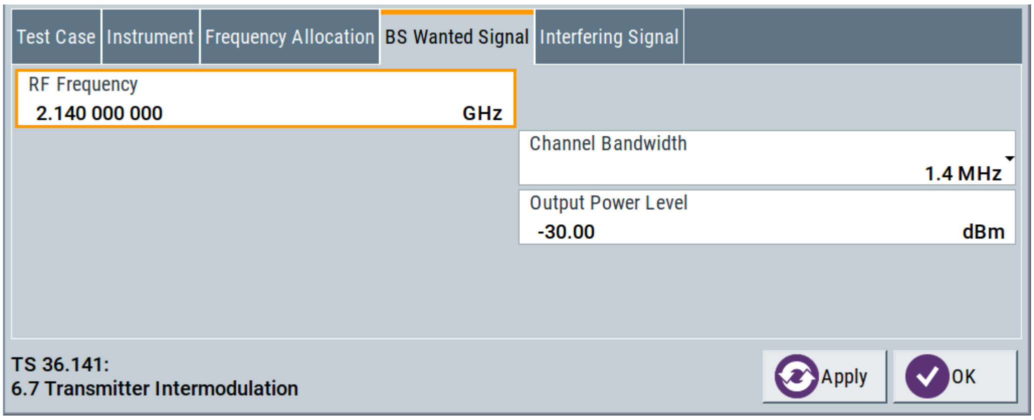




The settings of the interfering signal are described in Chapter 8.7.5, "Interfering signal settings", on page 557.

Base Station Wanted Signal

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.



Output Power Level ← Base Station Wanted Signal

Sets the output power level of the wanted signal. The power level of the interfering signal is always 30 dB lower than this level.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:OUPLevel` on page 1094

8.8 Receiver characteristics (TS 36.141, chapter 7)

Most of the receiver tests can be performed with the signal generator only, i.e. without additional measurement equipment.

The receiver requirements are divided into the following main categories, intended to

- Prove the receiver's ability to receive the wanted signal:
  - Chapter 8.8.5, "Test case 7.2: reference sensitivity level", on page 568
  - Chapter 8.8.6, "Test case 7.3: dynamic range", on page 570
- Prove how susceptible the receiver is to different types of interfering signals:
  - Chapter 8.8.7, "Test case 7.4: in-channel selectivity (ICS)", on page 572
  - Chapter 8.8.8, "Test case 7.5A: adjacent channel selectivity (ACS)", on page 574
  - Chapter 8.8.9, "Test case 7.5B: narrow-band blocking", on page 577
  - Chapter 8.8.10, "Test case 7.6: blocking", on page 579
  - Chapter 8.8.11, "Test case 7.8: receiver intermodulation", on page 582

  The several test cases shell cover a wide range of scenarios with different types of impairments on the wanted signal, that occur depending on the frequency offset between the wanted and the interfering signal.

8.8.1 Required options

Table 8-9 lists the required options for performing the test cases according to TS 36.141, Chapter 7.

Table 8-9: Required options

Chapter in TS 36.141-1	**Hardware options**					**Software options**	
	RF path		**Baseband**		**BB generator**	**AWGN**	**LTE**
	A	**B**	**1 path**	**2 paths**			
	e.g. B1003	**e.g. B2003**	**B13 B13XT**	**B13T B13XT**	**B10 B9**	**K62**	**K55**
7.2 Reference sensitivity	1		1		1		1
7.3 Dynamic range	1		1		1	1	1
7.4 In-channel selectivity	1	1		1	2		2
7.5Adjacent channel selectivity (ACS) and narrow-band blocking	1	1		1	2		2
7.6Blocking [1)]	1	1		1	2		2
7.8 Receiver intermodulation	1	1		1	2	1	2

[1)] An additional R&S®SGS100A required for CW signal

[2)] No signal generator required

The following equipment and options are required, if **receiver characteristics tests** should be supported:

- 2x option Baseband Generator (R&S SMW-B10/B9)
- 1x option Baseband Main Module (R&S SMW-B13T/-B13XT)

- 1x option Frequency (e.g. R&S SMW-B1003)
- 1x option Frequency (e.g. R&S SMW-B2003)
- 1x option Additive White Gaussian Noise AWGN (R&S SMW-K62)
- 2x option Digital Standard EUTRA/LTE (R&S SMW-K55)
- For CW blocking interferer tests:
  – 1x R&S SMW-B0120 or
  – 1x R&S®SGS100A

8.8.2 Prior considerations

Fixed Reference Channels (FRC)

The receiver tests use fixed reference channels (FRC) as defined in TS 36.141, Annex A "Reference Measurement channels".

The following FRCs are defined for the receiver tests:

- FRC A1: A1-1 to A1-5 (QPSK)
- FRC A2: A2-1 to A2-3 (16QAM)

Refer to Table 4-14 for an overview of all supported FRC.

Channels

According to the TS 36.141, the channels to test are located in the bottom (B), middle (M) and the top (T) of the supported frequency range of the base station. See Table 8-4 for an overview of the supported frequency operating bands.

Channel Bandwidth of the LTE Interfering Signal

For all test cases using an interfering LTE signal, the bandwidth of the interfering signal shall be the same as the wanted signal, but at the most 5 MHz.

Reference Sensitivity Power Level $P_{REFSENS}$

$P_{REFSENS}$ depends on the channel bandwidth and the base station class as specified in TS 36.104, subclause 7.2.1. The Table 8-10 gives an overview of the resulting power levels for the wanted signal per test case.

Table 8-10: BS reference sensitivity levels

Channel Bandwidth, MHz	Base Station Class	Reference sensitivity power level, $P_{REFSENS}$, dBm	ACS Test Case Wanted signal mean power, dBm	Narrow-band Blocking/ Blocking/Receiver Intermodulation Test Case Wanted signal mean power, dBm
1.4	Wide Area BS	-106.8	-95.8	-100.8
	Local Area BS / Home Area BS	-98.8	-87.8	-92.8
	Medium Range BS	-101.8	-90.8	-95.8
3	Wide Area BS	-103.0	-95.0	-97.0
	Local Area BS / Home Area BS	-95.0	-87.0	-89.0
	Medium Range BS	-98.0	-90.0	-92.0
5 /10 /15 /20	Wide Area BS	-101.5	-95.5	-95.5
	Local Area BS / Home Area BS	-93.5	-87.5	-87.5
	Medium Range BS	-96.5	-90.5	-90.5

Power Settings

The "Level Reference" parameter in the "Filter/Clipping/Power Settings" dialog is automatically set to "Frame RMS Power" for FDD Duplexing Mode and to "UL Part of Frame RMS Power" for TDD Duplexing Mode.

Filter Settings

The 3GPP EUTRA/LTE specifications do not define a standardized transmit filter neither for the UE nor for the base station. Therefore, when a test case is activated, a filter type EUTRA/LTE with "Best EVM Optimization" is automatically selected.

Exceptions are the following test cases where a "Best ACP Optimization" filter is applied for shaping the interfering signal:

- Test case 7.5A: adjacent channel selectivity (ACS)
- Test case 7.5B: narrow-band blocking

8.8.3 General workflow for carrying out a receiver test

The following instruction lists the general steps for performing a BS conformance test with the help of "Test Case Wizard". Specific requirements are described together with the individual test case.

For detailed description about the configuration of the base station, refer to the corresponding description.

1. Connect the instrument and the DUT according to the corresponding test case setup.
   See also Chapter 8.4, "Standard test setups", on page 537.
2. Set the base station to the basic state
   a) Initialize the base station
   b) Set the frequency
   c) Set the base station to receive the Fixed Reference Channel (for most receiver test cases)
3. Preset the signal generator to ensure a defined instrument state.
4. Configure the test case wizard
   a) Select "Baseband Block > EUTRA/LTE > Test Case Wizard".
   b) Select a test case, e.g. "TS 36.141: 7.3 Dynamic Range".
   c) Enter additional required parameters, e.g. power class of base station.
   d) Enter the test frequency, e.g. M.
      It must be the same as the base station has been set to.
   e) Select "Apply Settings" to activate the settings.

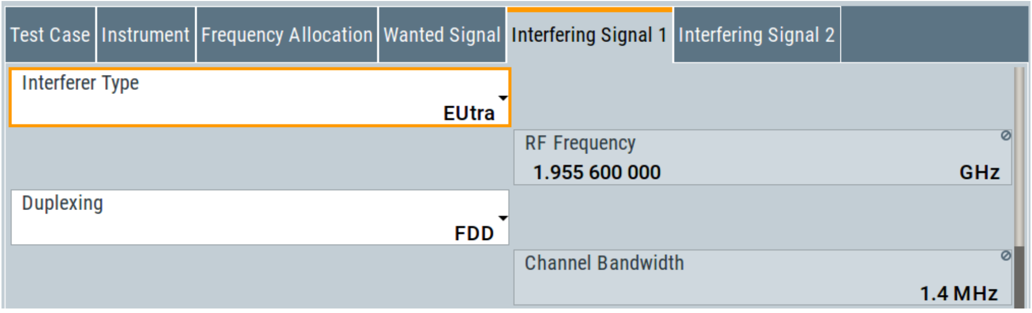
   The signal generator is now ready to start signal generation
5. Switch on RF output
6. If required, make additional settings (e.g. in the "I/Q Mod" or "RF" block) or change test case settings.
7. Start the measurement
   a) Send a start trigger impulse from the base station to the signal generator.

   The signal generator will start signal generation.
8. Calculate the result

   The base station internally calculates the BER, BLER or Pd depending on the test case. This value is compared to the required value.

8.8.4 Interfering signal settings

The following settings are available for almost all receiver tests, requiring an interfering signal (IS). Specific parameters are listed together with the description of the corresponding test case.



Interferer Type
(enabled for Blocking and Receiver Intermodulation tests)

Selects the type of the interfering signal:
- For **Blocking** tests, the interfering signal can be an in-band EUTRA/LTE signal or out-of-band CW signal.
- For **Receiver Intermodulation** tests, the first interfering signal can be an EUTRA/LTE signal or narrow-band EUTRA signal.
  The second interfering signal is always a CW signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:IFTYpe on page 1083

RF Frequency
Display the center frequency of the interfering signal.

The center frequency is calculated as follows:
- For "Frequency Allocation > Interfering Signal > At Higher Frequencies"
  "RF Frequency$_{\text{interfering signal}}$" = "RF Frequency$_{\text{wanted signal}}$" + Delta
- For "Frequency Allocation > Interfering Signal > At Lower Frequencies"
  "RF Frequency$_{\text{interfering signal}}$" = "RF Frequency$_{\text{wanted signal}}$" - Delta

Where for both cases Delta is calculated as follows:

Delta = "Channel Bandwidth$_{\text{wanted signal}}$"/2 + Offset$_{\text{interfering signal}}$

See also "RF Frequency" on page 557.

Example:

"Channel Bandwidth$_{wanted\ signal}$" = 5 MHz

"RF Frequency$_{wanted\ signal}$" = 1 950 MHz

Offset$_{interfering\ signal}$ = 2.5025 MHz

(see Table 8-13)

Delta = 5/2 + 2.5025 = 5.0025 MHz

For "Frequency Allocation > Interfering Signal > At Higher Frequencies": "RF Frequency$_{interfering\ signal}$" = 1 950 + 5.0025 = 1 955.0025 MHz

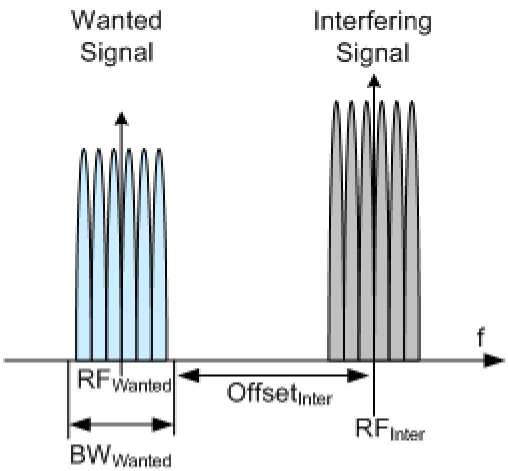


Figure 8-8: Example: Adjacent Channel Selectivity (ACS), Channel BW = 1.4 MHz

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency` on page 1084

Duplexing
Selects whether TDD or FDD duplexing mode is used.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex` on page 1082

TDD UL/DL Configuration
For TDD mode, selects the UL/DL Configuration number.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:TDDConfig` on page 1085

Signal Advance N_TA_offset
Sets the parameter $N_{TAoffset}$.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:NTAOffset` on page 1083

Channel Bandwidth
Displays the channel bandwidth of the interfering signal. The interfering signal has the same bandwidth as the wanted signal, but at the most 5 MHz.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW? on page 1081

Cell ID
Sets the Cell ID for the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CLID on page 1082
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:CLID? on page 1082

UE ID/n_RNTI
Sets the UE ID/n_RNTI for the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:UEID on page 1086
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:UEID on page 1085

Number of Resource Blocks
The number of RBs used by the LTE interfering signal is set automatically:
- For **ACS and In-channel Selectivity measurements**, the number of RBs depends on the selected channel bandwidth for the wanted signal. The bandwidth of the interfering signal is equal to the bandwidth allocated for the wanted signal, but at the most 5 MHz.
- For **Narrow-band Blocking** tests, the interfering signal is a single resource block LTE signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:NRBLock? on page 1083

Offset VRB
(Test Case 7.4 and 7.5 only)

The position of the RBs allocated by the LTE interfering signal is determined automatically, depending on the selected "Channel Bandwidth" and the RBs allocation of the wanted signal.

- For **in-channel testing**, the parameter "Offset VRB" is used to allocate the wanted and the interfering signal around the center frequency (see also Figure 8-9).
- For **ACS testing**, the "Offset VRB" is fixed to 0.
- For **narrow band blocking testing**, the "Offset VRB" is set in the way, that depending on the "Frequency Allocation" of the interfering signal, the narrow-band LTE interfering signal is allocated at the most left or the most right subcarrier in the allocated channel bandwidth

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:OVRB? on page 1084

Frequency Shift m
(Test Case 7.5 only)

By default, the narrow-band LTE interfering signal is allocated at the most left (interfering signal at higher frequencies)/ most right (interfering signal at lower frequencies) subcarrier in the allocated channel bandwidth. However, the position of the interfering signal can be set by means of the parameter "Frequency Shift m", i.e. the allocated RB can be offset to a different center frequency (see Figure 8-10).

The parameter Interfering RB Center Frequency displays the center frequency of the resource block the interfering signal is currently allocated on.

The value range of the parameter depends on the selected "Channel Bandwidth", as defined in Table 8-14.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:FRSHift` on page 1082

Interfering RB Center Frequency
(for Narrow-band Block tests only)

Displays the center frequency of the single resource block interfering signal (see also Figure 8-10).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:RBCFrequency` on page 1084

Power Level
The power level of the interfering LTE signal is set automatically depending on the selected channel bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?` on page 1084

8.8.5 Test case 7.2: reference sensitivity level

Test Purpose

To verify that at the BS Reference sensitivity level the throughput requirement shall be met for a specified reference measurement channel (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

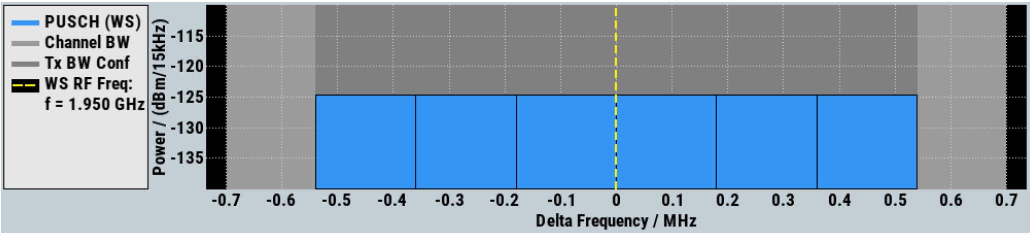
See Chapter 8.4.1, "Standard test setup - one path", on page 537

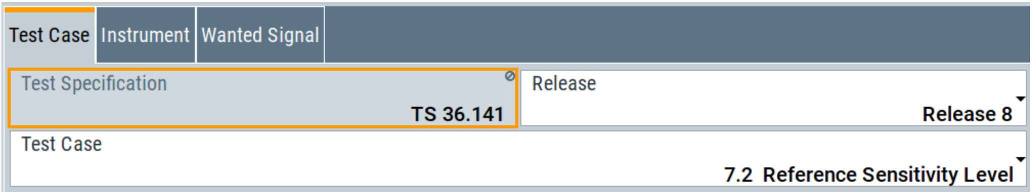
Short Description

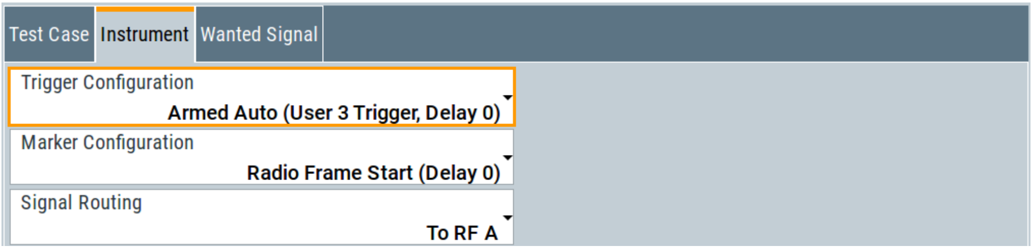
The reference sensitivity level measurement is a test case that aims to verify the Noise Figure of the receivers. The test case uses FRCs with QPSK modulation.

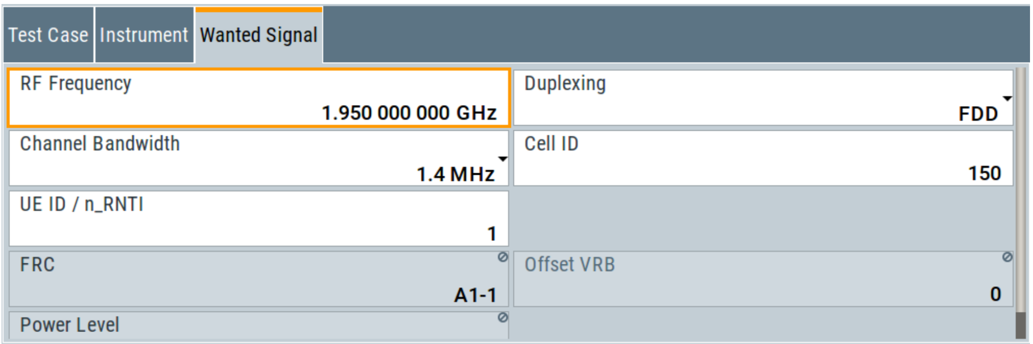
The test shall be done on three channels (B, M and T). The selected "Channel Band-width" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

For the parameter in the Table 8-10 the throughput measured shall be equal or greater than 95%.









The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

8.8.6 Test case 7.3: dynamic range

Test Purpose

To verify that at the BS receiver dynamic range, the relative throughput shall fulfil the specified limit (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

See Chapter 8.4.1, "Standard test setup - one path", on page 537

Short Description

The dynamic range test case aims to stress the receiver and measure its capability to demodulate the useful signal even in the presence of a heavy interfering signal inside the received channel bandwidth. The test case uses FRCs with 16QAM modulation. The throughput measurements are performed for different level of the wanted and the interfering AWGN signals.

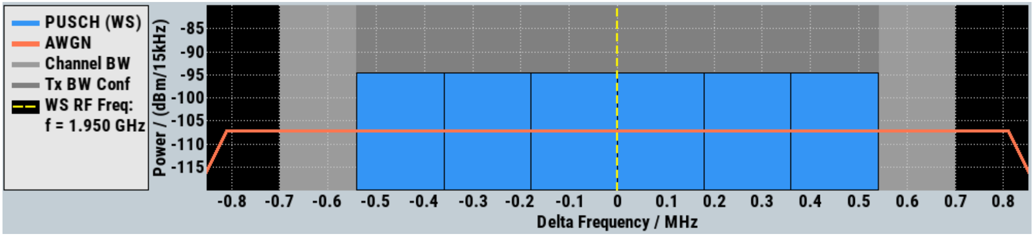
The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

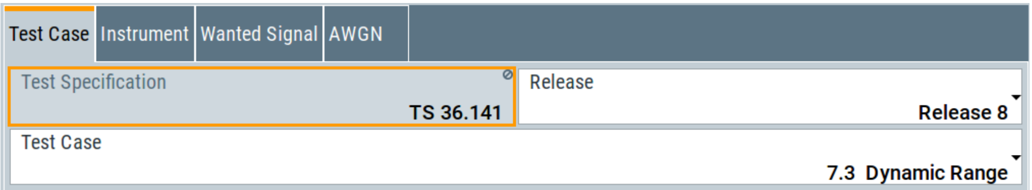
For the parameter in the Table 8-11 the throughput shall be equal or greater than 95%.

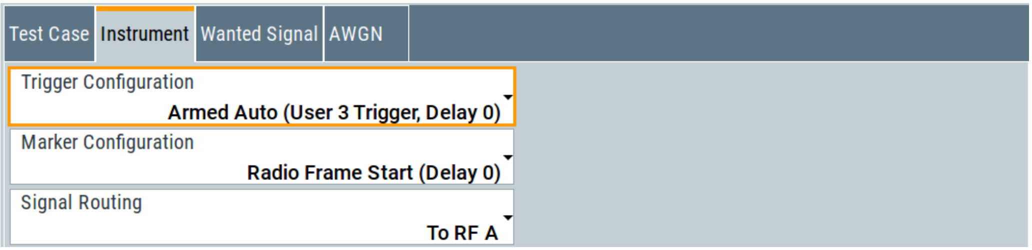
Table 8-11: Dynamic range (Wide Area BS)

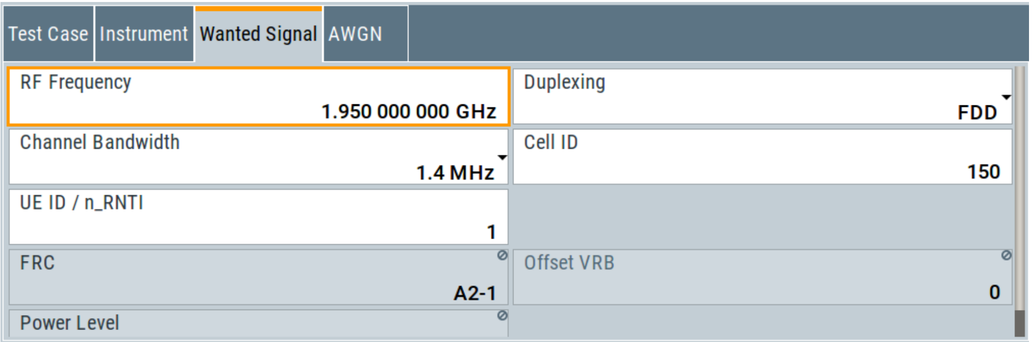
Channel Bandwidth, MHz	Reference Measurements Channel	Wanted signal mean power, dBm	Interfering signal mean power, dBm / BW_{Config}	Type of interfering signal
1.4	FRC A2-1	-76.0	-88.7	AWGN
3	FRC A2-2	-72.1	-84.7	AWGN
5	FRC A2-3	-69.9	-82.5	AWGN
10	FRC A2-3	-69.9	-79.5	AWGN
15	FRC A2-3	-69.9	-77.7	AWGN
20	FRC A2-3	-69.9	-76.4	AWGN

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.





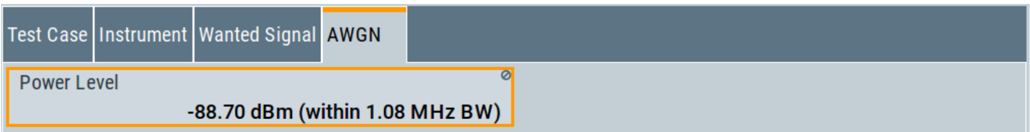




The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

AWGN Configuration
Comprises the settings of the interfering signal.



Power Level ← AWGN Configuration
Displays the power level of the AWGN signal. The value is set automatically according to Table 8-11 and depending on the selected Channel Bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel?` on page 1077

8.8.7 Test case 7.4: in-channel selectivity (ICS)

Test Purpose

The purpose of this test is to verify the BS receiver ability to suppress the IQ leakage (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

See Chapter 8.4.1, "Standard test setup - one path", on page 537.

For two paths measurements, see Chapter 8.4.2, "Standard test setup - two paths", on page 537

Short Description

In-channel selectivity (ICS) is a measure of the receiver ability to receive a "weak" wanted signal at its assigned Resource Block locations in the presence of a "strong" interfering signal. The interfering signal shall be an EUTRA/LTE signal with the same bandwidth as the wanted signal, but at the most 5 MHz. The wanted and the interfering signal are allocated around the center frequency (see Figure 8-9); to swap the position of the wanted and interfering signal, use the parameter "Frequency Allocation".

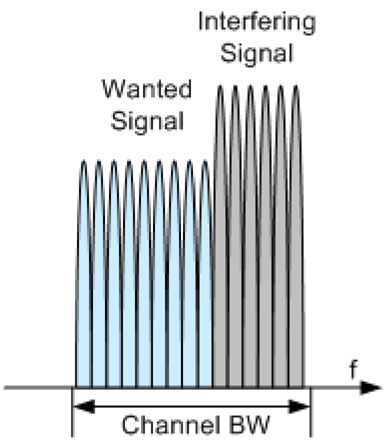


Figure 8-9: Example: In-channel selectivity (ICS), Channel BW = 3 MHz, Frequency Allocation = Lower Frequency

In a one-path instrument, the wanted and the interfering LTE signals are both generated using the same path. The interfering signal is simulated as an additional user equipment (UE). The level difference between the wanted and the interfering signals is handled in the baseband. As the interferer level is higher, it is used as a reference; the level of the wanted signal is set relatively lower to the interferer.

The test shall be done on three channels (B, M and T). The selected "Channel Bandwidth" determines the used FRC and the "Wanted Signal Power Level". For channels larger than 5 MHz not all RBs are allocated; to adjust the position of the allocated RBs within the selected channel bandwidth, use the parameter "Offset VRB".

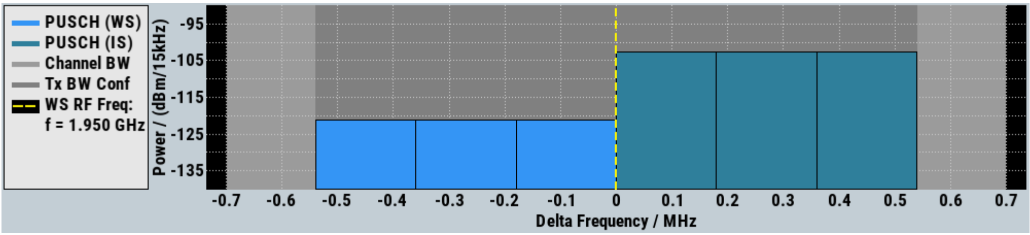
For the parameter in the Table 8-12 the throughput shall be equal or greater than 95%.

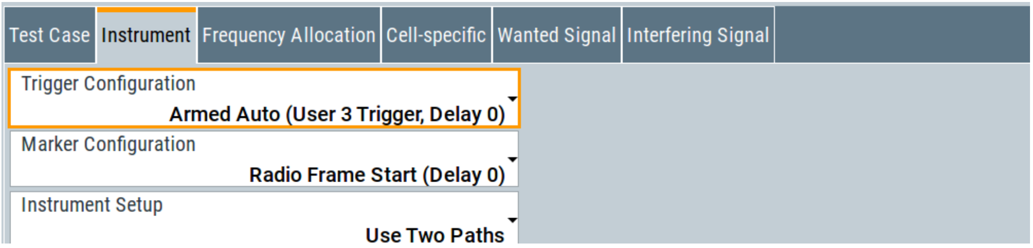
Table 8-12: In-channel selectivity (Wide Area BS)

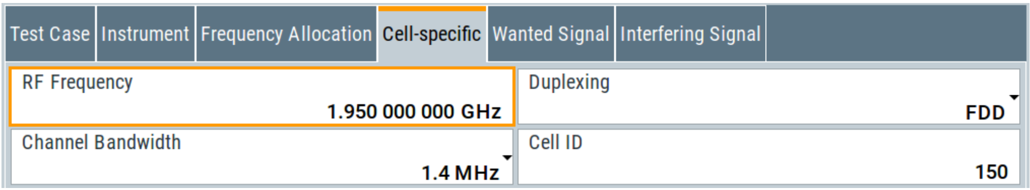
Channel Bandwidth, MHz	Reference Measurements Channel	Wanted signal mean power, dBm	Interfering signal mean power, dBm / BW_{Config}	Type of interfering signal
1.4	FRC A1-4	-105.5	-87	1.4 MHz EUTRA signal, 3 RBs
3	FRC A1-5	-100.7	-84	3 MHz EUTRA signal, 6 RBs
5	FRC A1-2	-98.6	-81	5 MHz EUTRA signal, 10 RBs
10	FRC A1-3	-97.1	-77	10 MHz EUTRA signal, 25 RBs
15	FRC A1-3	-97.1	-77	15 MHz EUTRA signal, 25 RBs*
20	FRC A1-3	-97.1	-77	20 MHz EUTRA signal, 25 RBs*

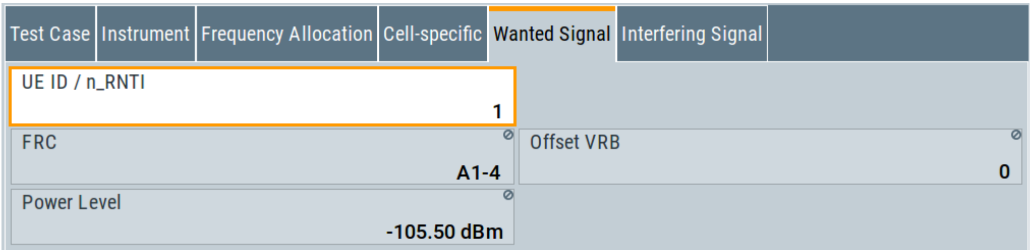
*) Wanted and interfering signal are placed adjacently around the carrier frequency

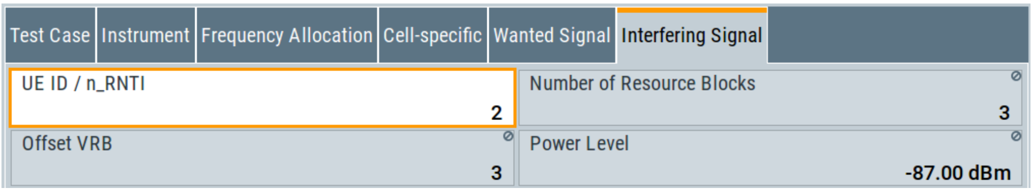
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.











The general and instrument related settings are described in Test case settings and Instrument settings

The cell-specific settings and the settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

Refer to Chapter 8.8.4, "Interfering signal settings", on page 564 for description of the corresponding settings.

8.8.8 Test case 7.5A: adjacent channel selectivity (ACS)

Test Purpose

To verify the ability of the BS receiver filter to suppress interfering signals in the channels adjacent to the wanted channel (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

See Chapter 8.4.2, "Standard test setup - two paths", on page 537

Short Description

The Adjacent Channel Selectivity (ACS) is a test case intended to verifies that a BS receiver is able to demodulate a "weak" useful signal being superimposed by a "strong" interfering signal in the adjacent channel.

The wanted signal is a reference measurement channel FRC A1. The interfering signal shall be an EUTRA/LTE signal with the same bandwidth as the wanted signal, but at the most 5 MHz and a specified center frequency offset (see Figure 8-8). The test shall be done on three channels (B, M and T).

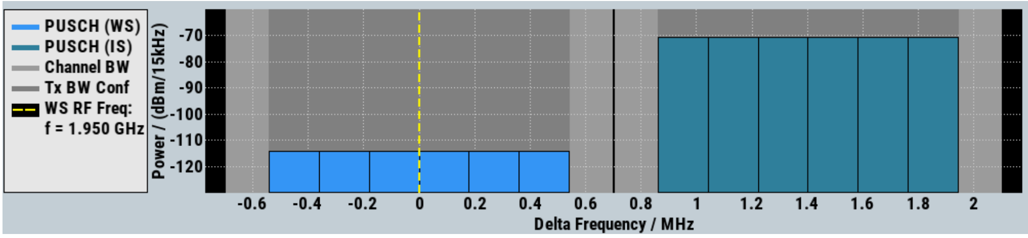
For the parameter in the Table 8-13 the throughput shall be equal or greater than 95%.

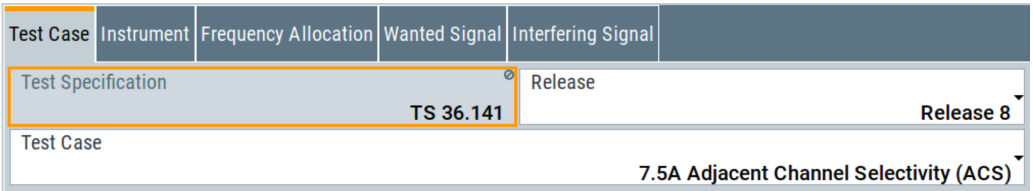
Table 8-13: Adjacent channel selectivity (Wide Area BS)

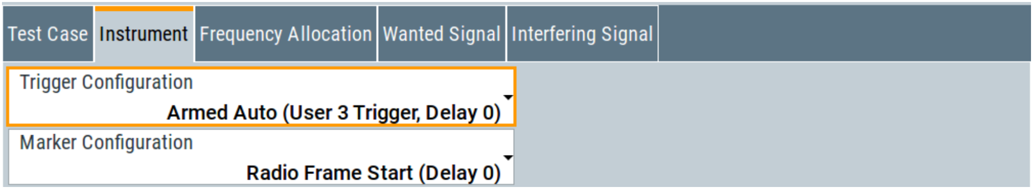
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the lower (upper) edge of the wanted signal, MHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 11dB	-52	±0.7025	1.4 MHz EUTRA signal, 3 RBs
3	$P_{REFSENS}$ + 8dB	-52	±1.5075	3 MHz EUTRA signal, 6 RBs
5	$P_{REFSENS}$ + 6dB	-52	±2.5025	5 MHz EUTRA signal, 10 RBs
10	$P_{REFSENS}$ + 6dB	-52	±2.5075	10 MHz EUTRA signal, 25 RBs
15	$P_{REFSENS}$ + 6dB	-52	±2.5125	15 MHz EUTRA signal, 25 RBs
20	$P_{REFSENS}$ + 6dB	-52	±2.5025	20 MHz EUTRA signal, 25 RBs

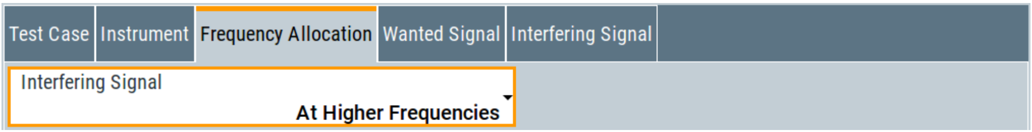
$P_{REFSENS}$ depends on the channel bandwidth and the base station class as specified in TS 36.104, subclause 7.2.1 (see Table 8-10).

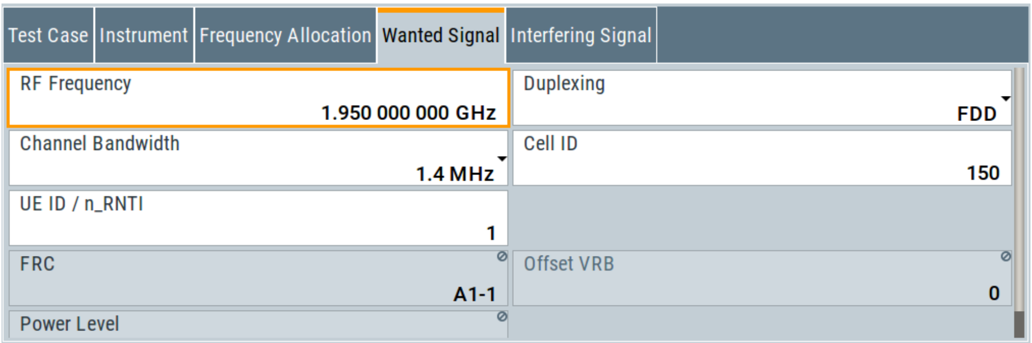
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.

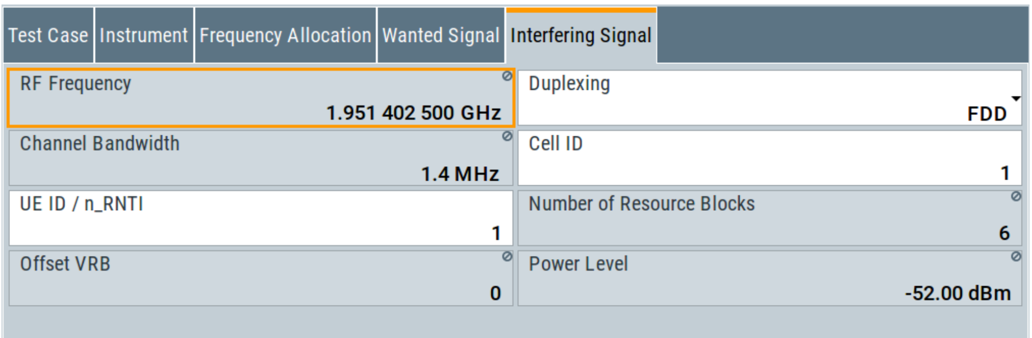












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

Refer to Chapter 8.8.4, "Interfering signal settings", on page 564 for description of the corresponding settings.

8.8.9 Test case 7.5B: narrow-band blocking

Test Purpose

To verify the ability of the BS receiver filter to suppress interfering signals in the channels adjacent to the wanted channel (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

See Chapter 8.4.2, "Standard test setup - two paths", on page 537

Short Description

The Narrow-band Blocking is a test case intended to verifies that a BS receiver is able to demodulate a "weak" useful signal being superimposed by a "strong" narrow-band interfering signal in the adjacent channel. The wanted signal is a reference measurement channel FRC A1. The interfering signal is a single resource block EUTRA/LTE signal in a channel with the same bandwidth as the wanted signal, but at the most 5 MHz. The interfering signal is located at a specified center frequency offset and the adjacently to the lower (upper) channel edge of the wanted signal (see Figure 8-10).

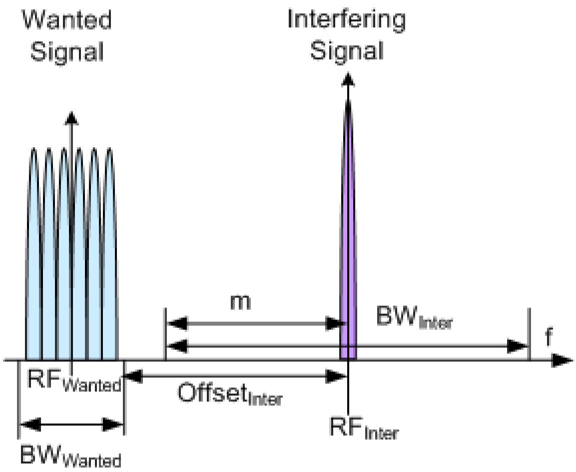


Figure 8-10: Example: Narrow-band Blocking

The test shall be done on three channels (B, M and T).

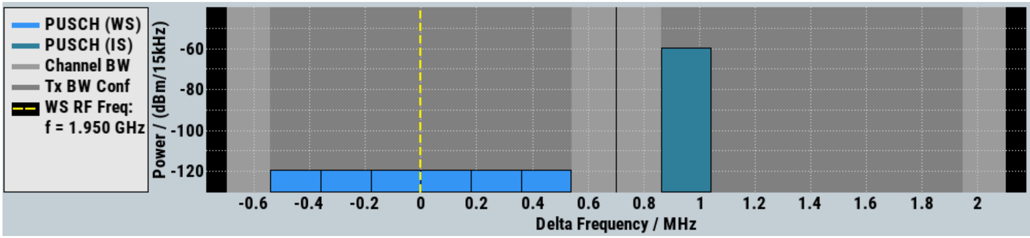
For the parameter in the Table 8-14 the throughput shall be equal or greater than 95%.

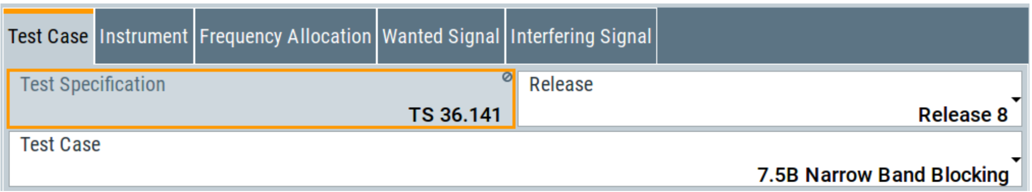
Table 8-14: Interfering signal for Narrowband blocking requirement (Wide Area BS)

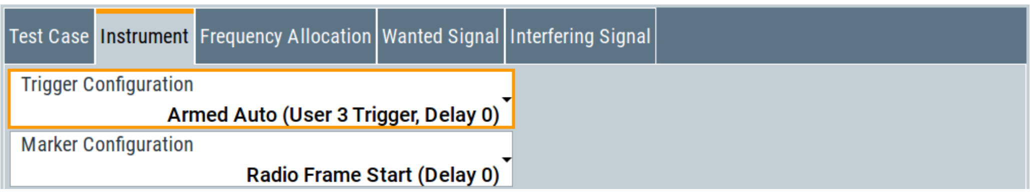
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering RB center frequency offset to the channel edge of the wanted signal, kHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-49	252.5+m*180, m=0, 1, 2, 3, 4, 5	1.4 MHz EUTRA signal, 1 RB
3			247.5+m*180, m=0, 1, 2, 3, 4, 7, 10, 13	3 MHz EUTRA signal, 1 RB
5 / 10 / 15 / 20			342.5+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz EUTRA signal, 1 RB

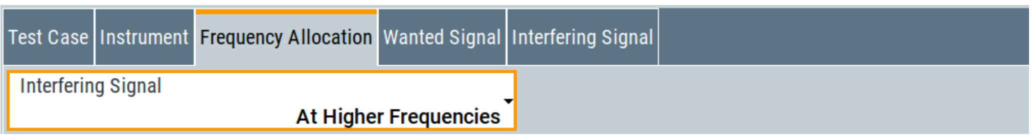
$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 8-10).

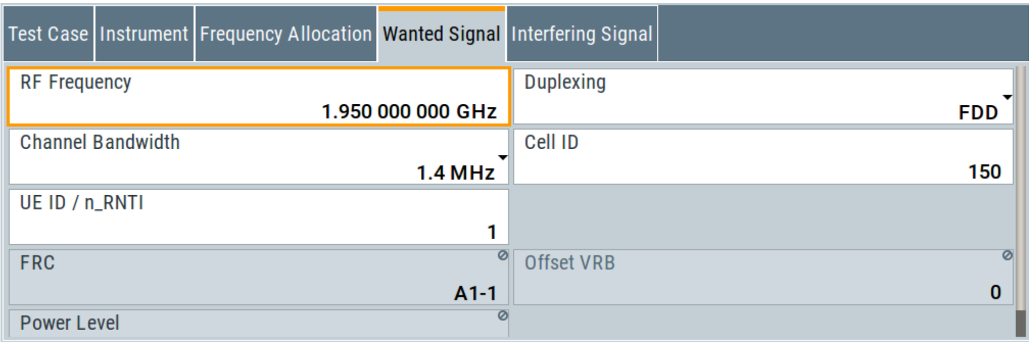
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.

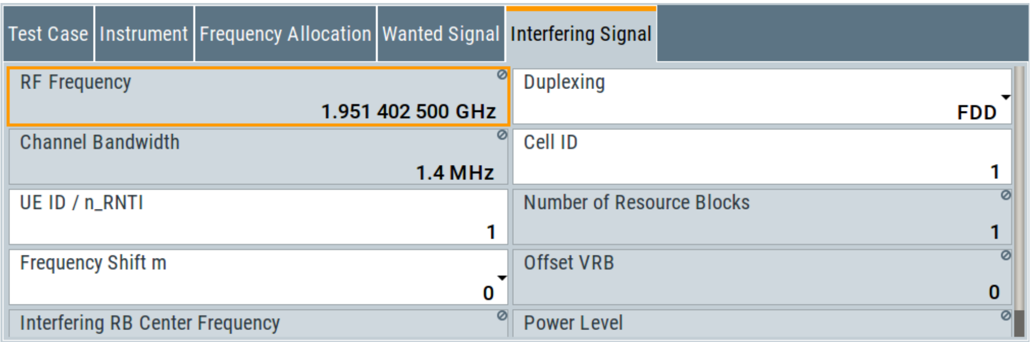












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

Refer to Chapter 8.8.4, "Interfering signal settings", on page 564 for description of the corresponding settings.

8.8.10 Test case 7.6: blocking

Test Purpose

The test stresses the ability of the BS receiver to withstand high-level interference from unwanted signals at specified frequency offsets without undue degradation of its sensitivity (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

The blocking test using a EUTRA/LTE interfering signal can be performed with one instrument, see Chapter 8.4.2, "Standard test setup - two paths", on page 537. This setup can also be used for the CW interfering signal case but only for the CW signals with up to 3 GHz or 6 GHz carrier, depending on the installed option. For tests with CW with frequency greater than 6 GHz a second signal generator is necessary, like R&S SMF for instance.

Short Description

The blocking characteristics is a test case that verifies the ability of the receiver to demodulate a wanted signal in the presence of a strong interfering signal. The test is split into two scenarios:

- Test of in-band blocking, performed with an LTE interfering signal inside the operating band (see Table 8-4), but not adjacent to the wanted signal.
- Test of out-of-band blocking, performed with a CW interfering signal with 1 MHz up to 12.750 GHz.
  There is an additional (optional) blocking requirement for co-location with other base station.

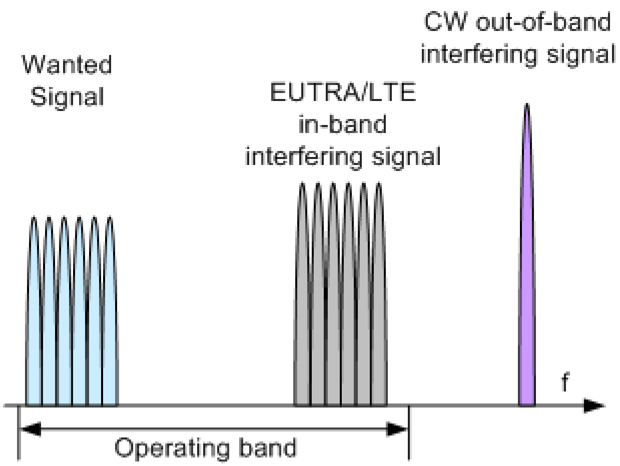


Figure 8-11: Example: Blocking

The test shall be done on one channel (M).

For the parameter in the Table 8-15 the throughput shall be equal or greater than 95%.

Table 8-15: Blocking performance requirement (Wide Area BS)

Operating Band	Center Frequency of Interfering Signal, MHz	Interfering Signal mean power, dBm	Wanted Signal mean power, dBm	Type of Interfering Signal
1-7, 9-11, 13-14, 33-40	(F_{UL_low} - 20) to (F_{UL_high} + 20)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 20) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
8	(F_{UL_low} - 20) to (F_{UL_high} + 10)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 10) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
12	(F_{UL_low} - 20) to (F_{UL_high} + 12)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	*) See Table 8-16			

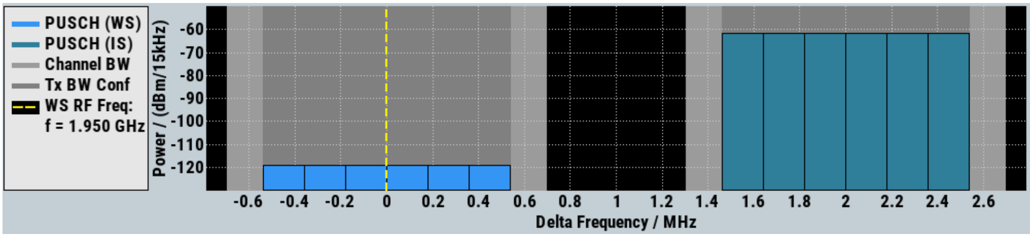
Operating Band	Center Frequency of Interfering Signal, MHz	Interfering Signal mean power, dBm	Wanted Signal mean power, dBm	Type of Interfering Signal
	1 to (F_{UL_low} - 20) (F_{UL_high} + 12) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
17	(F_{UL_low} - 20) to (F_{UL_high} + 18)	-43	$P_{REFSENS}$ + 6dB	EUTRA/LTE*
	1 to (F_{UL_low} - 20) (F_{UL_high} + 18) to 12750	-15	$P_{REFSENS}$ + 6dB	CW
	*) See Table 8-16			

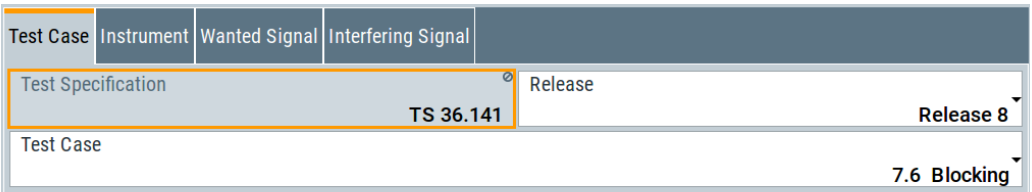
Table 8-16: EUTRA/LTE interfering signals for Blocking performance requirement

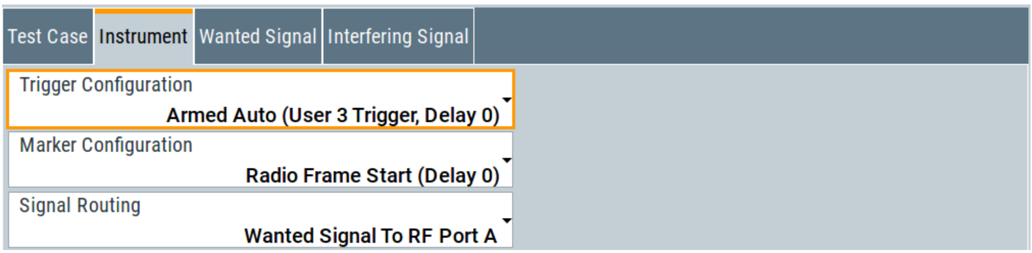
Channel Bandwidth, MHz	Interfering signal center frequency minimum offset to the lower (upper) channel edge of the wanted signal, MHz	Type of interfering signal
1.4	±2.1	1.4 MHz EUTRA signal
3	±4.5	3 MHz EUTRA signal
5 / 10 / 15 / 20	±7.5	5 MHz EUTRA signal

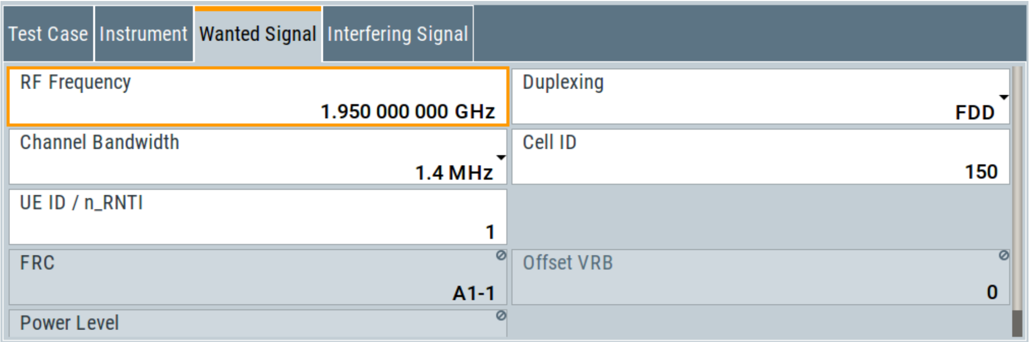
$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 8-10).

For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.





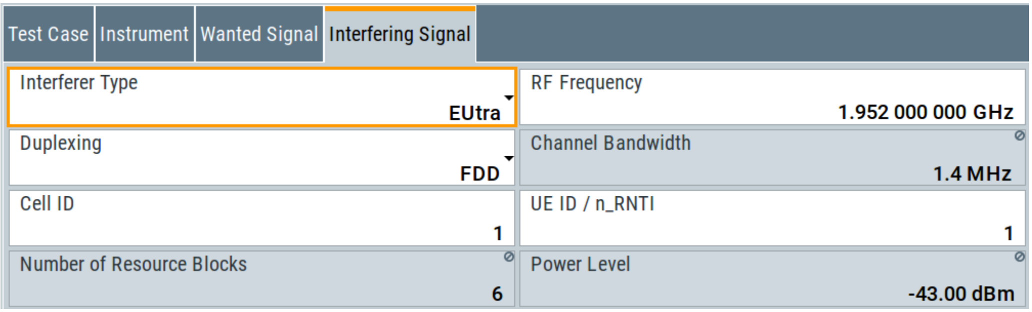




The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

Interfering Signal
The common settings of the interfering signal are described in Chapter 8.8.4, "Interfering signal settings", on page 564.



Test Requirement
For CW interfering signal, selects whether the standard out-of-band blocking requirements test is performed or the optional blocking scenario, when the BS is co-located with another BS in a different operating band.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:IS:TREQuire` on page 1085

8.8.11 Test case 7.8: receiver intermodulation

Test Purpose

The test purpose is to verify the ability of the BS receiver to inhibit the generation of intermodulation products in its non-linear elements caused by the presence of two high-level interfering signals at frequencies with a specific relationship to the frequency of the wanted signal (TS 36.141).

Required Options

See Chapter 8.8.1, "Required options", on page 561.

Test Setup

See Chapter 8.4.2, "Standard test setup - two paths", on page 537.

Short Description

The receiver intermodulation test is a test scenario with two interfering signals, one CW and one EUTRA/LTE signal. The center frequency of the interfering signals is selected so that the third and higher order mixing products falls inside of the band of the wanted signal. There is also a second narrow-band intermodulation scenario defined, where the EUTRA/LTE interfering signal is a narrow-band signal with single resource block allocation and the CW interfering signal is placed very close to the wanted one.

The test shall be done on three channels (B, M and T).

For the parameter in the Table 8-17 and Table 8-18 the throughput shall be equal or greater than 95%.

Table 8-17: Intermodulation performance requirement (Wide Area BS)

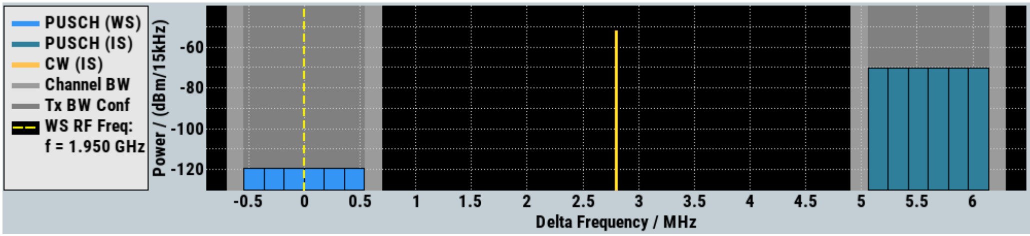
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, MHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-52	2.1	CW
	$P_{REFSENS}$ + 6dB	-52	4.9	1.4 MHz EUTRA signal
3	$P_{REFSENS}$ + 6dB	-52	4.5	CW
	$P_{REFSENS}$ + 6dB	-52	10.5	3 MHz EUTRA signal
5	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	17.5	5 MHz EUTRA signal
10	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	17.7	5 MHz EUTRA signal
15	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	18	5 MHz EUTRA signal
20	$P_{REFSENS}$ + 6dB	-52	7.5	CW
	$P_{REFSENS}$ + 6dB	-52	18.2	5 MHz EUTRA signal

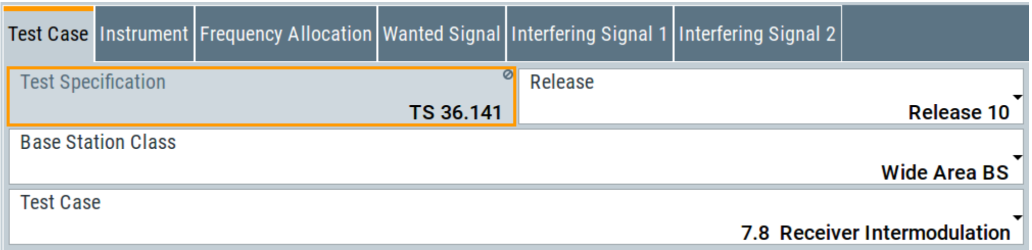
Table 8-18: Narrow-band intermodulation performance requirement (Wide Area BS)

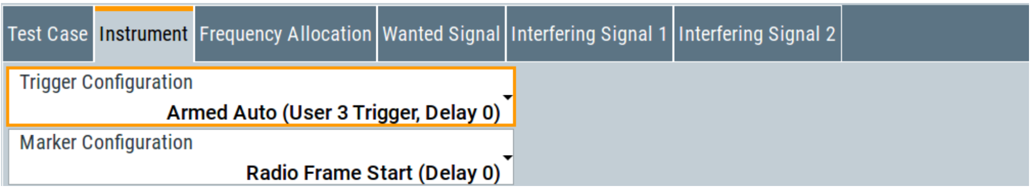
Channel Bandwidth, MHz	Wanted signal mean power, dBm	Interfering signal mean power, dBm	Interfering signal center frequency offset from the channel edge of the wanted signal, kHz	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB	-52	270	CW
	$P_{REFSENS}$ + 6dB	-52	790	1.4 MHz EUTRA signal, 1 RB
3	$P_{REFSENS}$ + 6dB	-52	275	CW
	$P_{REFSENS}$ + 6dB	-52	790	3 MHz EUTRA signal, 1 RB
5	$P_{REFSENS}$ + 6dB	-52	360	CW
	$P_{REFSENS}$ + 6dB	-52	1060	5 MHz EUTRA signal, 1 RB
10	$P_{REFSENS}$ + 6dB	-52	415	CW
	$P_{REFSENS}$ + 6dB	-52	1420	5 MHz EUTRA signal, 1 RB
15	$P_{REFSENS}$ + 6dB	-52	380	CW
	$P_{REFSENS}$ + 6dB	-52	1600	5 MHz EUTRA signal, 1 RB
20	$P_{REFSENS}$ + 6dB	-52	345	CW
	$P_{REFSENS}$ + 6dB	-52	1780	5 MHz EUTRA signal, 1 RB

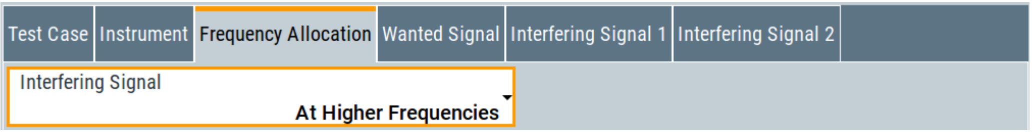
$P_{REFSENS}$ depends on the channel bandwidth as specified in TS 36.104, subclause 7.2.1 (see Table 8-10).

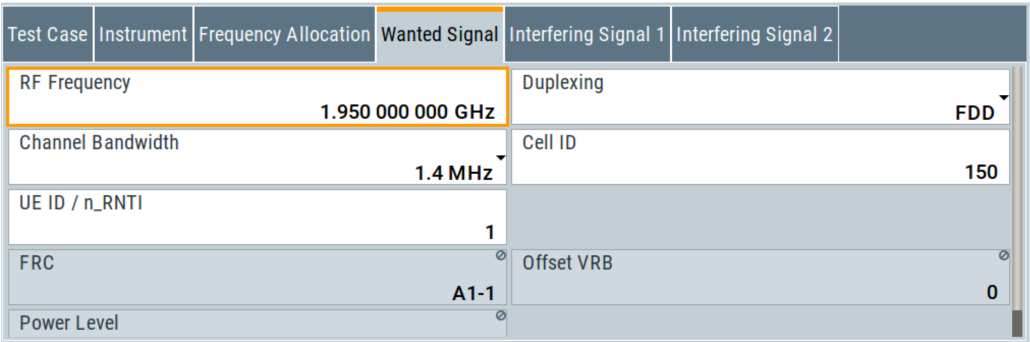
For the parameters of the other base station classes (Local Area BS, Home BS and Medium Range BS), refer to TS 36.141.

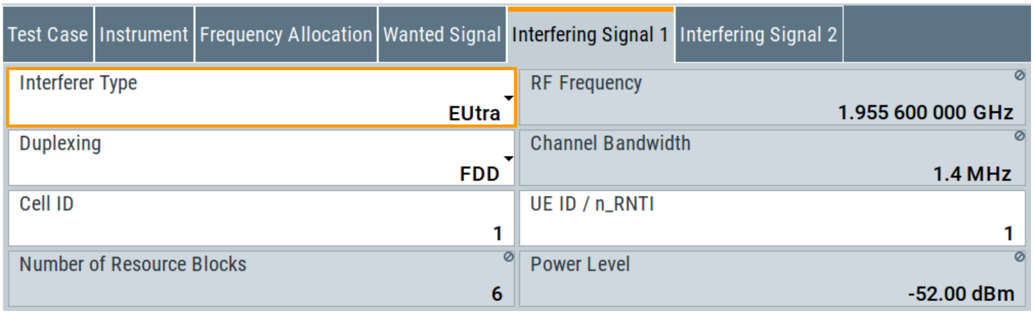


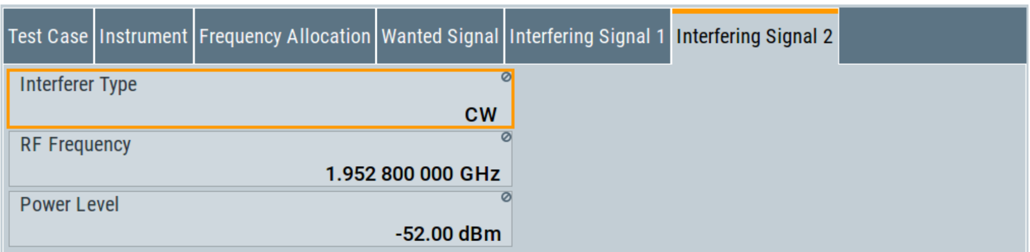

Test Case
Instrument
Frequency Allocation
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Test Specification
TS 36.141
Release
Release 10
Base Station Class
Wide Area BS
Test Case
7.8 Receiver Intermodulation


Test Case
Instrument
Frequency Allocation
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)


Test Case
Instrument
Frequency Allocation
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal
At Higher Frequencies


Test Case
Instrument
Frequency Allocation
Wanted Signal
Interfering Signal 1
Interfering Signal 2
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
Cell ID
150
UE ID / n_RNTI
1
FRC
A1-1
Offset VRB
0
Power Level


Test Case
Instrument
Frequency Allocation
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interferer Type
EUtra
RF Frequency
1.955 600 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
Cell ID
1
UE ID / n_RNTI
1
Number of Resource Blocks
6
Power Level
-52.00 dBm


Test Case
Instrument
Frequency Allocation
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interferer Type
CW
RF Frequency
1.952 800 000 GHz
Power Level
-52.00 dBm

The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

Refer to Chapter 8.8.4, "Interfering signal settings", on page 564 for description of the corresponding settings.

8.9 Performance requirements (TS 36.141, chapter 8)

The BS RF performance requirements are divided into three main groups:

- Performance requirements for PUSCH:
  - Chapter 8.9.4, "Test case 8.2.1: PUSCH in multipath fading propagation conditions", on page 593
  - Chapter 8.9.5, "Test case 8.2.2: UL timing adjustment", on page 595
  - Chapter 8.9.6, "Test case 8.2.3: HARQ-ACK multiplexed on PUSCH", on page 600
  - Chapter 8.9.7, "Test case 8.2.4: high-speed train conditions", on page 602
  - Chapter 8.9.8, "Test case 8.2.6: PUSCH in multipath fading propagation with synchronous interference", on page 606
  - Chapter 8.9.9, "Test case 8.2.6A: PUSCH in multipath fading propagation with asynchronous interference", on page 608
  - Chapter 8.9.10, "Test case 8.2.7: PUSCH in multipath fading propagation for coverage enhancement", on page 610
  - Chapter 8.9.11, "Test case 8.2.9: type b for PUSCH in multipath fading propagation conditions", on page 612
  - Chapter 8.9.26, "Test case 8.5.1: performance requirements for NPUSCH", on page 646
  - Chapter 8.9.27, "Test case 8.5.2: ACK missed detection for NPUSCH format 2", on page 648
- Performance requirements for PUCCH:
  - Chapter 8.9.12, "Test case 8.3.1: ACK missed detection for single user PUCCH format 1a", on page 615
  - Chapter 8.9.13, "Test case 8.3.2: CQI performance requirements for PUCCH format 2", on page 617
  - Chapter 8.9.14, "Test case 8.3.3: ACK missed detection for multi-user PUCCH format 1a", on page 619
  - Chapter 8.9.15, "Test case 8.3.4: ACK missed detection for PUCCH format 1b, channel selection", on page 623
  - Chapter 8.9.16, "Test case 8.3.5: ACK missed detection for PUCCH format 3", on page 625
  - Chapter 8.9.17, "Test case 8.3.6: NACK to ACK detection for PUCCH format 3", on page 628

- Performance requirements for PRACH:

8.9.1 Required options

The table on Figure 8-12 lists the required options for performing test cases according to TS 36.141, Chapter 8.

Chapter in TS 36.141	Test case	Hardware options: RF path: A	Hardware options: RF path: B	Hardware options: Baseband: 1 path	Hardware options: Baseband: 2 paths	BB Generator	Fading Simulator	Software options: AWGN	Dyn. Fading	MIMO Fad./Rout	Multiple entities	LTE: Rel. 8	LTE: Rel. 9	LTE: Rel. 10	LTE: Rel. 13 - 15	Closed loop BS Test	NB-IoT: Rel. 13	NB-IoT: Rel. 15	Remark
		B10x	B20x	B13	B13T/B13XT	B10/B9	B14/B15	K62	K71	K74	K76	K55	K84	K85	K119	K69	K115	K145	
8.2.1	Perf. requirements of PUSCH in multipath fading propagation (on single ant. port)	1	1	-	1	1(2)	2(4)	2	-	(1)	-	1	-	-	-	1	-	-	2, 4, or 8 RX antennas 1)
8.2.2	Perf. requirements for UL timing adjustments	1	1	-	1	2	2	2	1	1	-	2	-	-	-	1	-	-	2 RX antennas
8.2.3	Perf. requirements for HARQ-ACK multiplexed on PUSCH	1	1	-	1	1	2	2	-	-	-	1	-	-	-	-	-	-	2 RX antennas
8.2.4	Perf. requirements for High Speed Train conditions	1	(1)	1	(1)	1	1(2)	1(2)	1	-	-	1	-	-	-	1	-	-	1 or 2 RX antennas
8.2.6	PUSCH in multipath fading propagation with synchronous interference	1	1	-	1	2	2	2	1	1	1	2	-	-	2	1	-	-	2, 4, or 8 RX antennas 1)
8.2.6A	PUSCH in multipath fading propagation with asynchronous interference	1	1	-	1	2	2	2	1	1	1	2	-	-	2	1	-	-	2, 4, or 8 RX antennas 1)
8.2.7	PUSCH in multipath fading propagation for coverage enhancement	1	1	-	1	1	2	2	1	(1)	-	1	-	-	1	1	-	-	2 RX antennas
8.2.9	Type B for PUSCH in multipath fading propagation conditions	1	1	-	1	2	2	2	1	1	1	2	-	-	2	2	-	-	2 or 4 RX antennas 1)
8.3.1	ACK missed detection for single user PUCCH format 1a (on single ant. port)	1	1	-	1	1(2)	2(4)	2	-	(1)	-	1	-	-	-	-	-	-	2 or 4 RX antennas 1)
8.3.2	CQI perf. requirements for PUCCH format 2 (on single ant. port)	1	1	-	1	1	2	2	-	-	-	1	-	-	-	-	-	-	2 RX antennas
8.3.3	ACK missed detection for multi user PUCCH format 1a	1	1	-	1	2	4	2	-	1	-	2	-	-	-	-	-	-	All signals with one SMW
8.3.4	ACK missed detection for PUCCH format 1b with channel selection	1	1	-	1	1	2(4)	2	-	(1)	-	1	-	-	-	-	-	-	2 or 4 RX antennas 1)
8.3.5	ACK missed detection for PUCCH format 3	1	1	-	1	1	2(4)	2	-	(1)	-	1	-	1	-	-	-	-	2 or 4 RX antennas 1)
8.3.6	NACK to ACK detection for PUCCH format 3	1	1	-	1	1	2(4)	2	-	(1)	-	1	-	1	-	-	-	-	2 or 4 RX antennas 1)
8.3.7	ACK missed detection for PUCCH format 1a transmission on 2 ant. ports	1	1	-	1	2	2(4)	2	-	(1)	-	2	-	2	-	-	-	-	2 or 4 RX antennas 1)
8.3.8	CQI perf. requirements for PUCCH format 2 transmission on 2 ant. ports	1	1	-	1	2	2	2	-	-	-	2	-	2	-	-	-	-	2 RX antennas
8.3.9	CQI perf. requirements for PUCCH format 2 with DTX detection	1	1	-	1	1(2)	2	2	-	-	-	1(2)	-	-	-	-	-	-	2 RX antennas
8.3.10	ACK missed detection for PUCCH format 1a for coverage enhancements	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2 RX antennas
8.3.11	CQI performance for PUCCH format 2 for coverage enhancements	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2, 4, or 8 RX antennas 1)
8.3.12	ACK missed detection for PUCCH format 4	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2, 4, or 8 RX antennas 1)
8.3.13	ACK missed detection for PUCCH format 5	1	1	-	1	1	2	2	-	(1)	-	1	-	-	1	-	-	-	2, 4, or 8 RX antennas 1)
8.4.1	PRACH False Alarm Probability and Missed Detection	1	1	-	1	1(2)	2(4)	2	-	(1)	-	1	-	-	-	-	-	-	2 or 4 RX antennas 1)
8.5.1	Performance requirements for NPUSCH	1	1	-	1	1	2	2	-	(1)	-	-	-	-	-	1	1	-	2 RX antennas
8.5.2	ACK missed detection for NPUSCH format 2	1	1	-	1	1	2	2	-	(1)	-	-	-	-	-	-	1	-	2 RX antennas
8.5.3	Performance requirements for NPRACH	1	1	-	1	1	2	2	-	(1)	-	-	-	-	-	-	1	-	2 RX antennas

Figure 8-12: Performance requirements testing with R&S SMW: Required options

1) = Tests cases with more than 2 RX require additional RF upconverters. For example, 2xR&S®SGS100A or up to 6xR&S®SGT100A + 2xR&S SMW-K18

The following equipment and options are required to support **all performance requirements tests**:

- 2x option Baseband Generator (R&S SMW-B10)
- 1x option Baseband Main Module (R&S SMW-B13T)
- 1x option Frequency (e.g. R&S SMW-B1003)
- 1x option Frequency (e.g. R&S SMW-B2003)
- 4x option Fading Simulator (R&S SMW-B14)
- 1x option Fading Simulator Extension (R&S SMW-K71)
- 1x option MIMO Fading and Routing (R&S SMW-K74)
- 2 option Additive White Gaussian Noise AWGN (R&S SMW-K62)
- 2x option Digital Standard EUTRA/LTE (R&S SMW-K55)
- 2x option Digital Standard EUTRA/LTE Release 10 (LTE-Advanced) (R&S SMW-K85)
- 1x option LTE closed loop BS Test (R&S SMW-K69)
- For tests cases with more than 2 RX:
  – 2xR&S®SGS100A or

– Up to 6xR&S®SGT100A + 2xR&S SMW-K18

8.9.2 Prior considerations

Fixed Reference Channels (FRC)

The receiver tests use fixed reference channels (FRC) as defined in TS 36.141, Annex A "Reference Measurement Channels".

The following FRCs are defined for the performance tests:

- FRC A3: A3-1 to A3-7 (QPSK)
- FRC A4: A4-1 to A4-8 (16QAM)
- FRC A5: A5-1 to A5-7 (64QAM)
- FRC A7: A7-1 to A7-6 (16QAM for UL timing adjustment)
- FRC A8: A8-1 to A8-6 (QPSK for UL timing adjustment)

Refer to Table 4-14 for an overview of all supported FRC.

Channels

According to TS 36.141, the channels to test are located in the bottom (B), middle (M) and the top (T) of the supported frequency range of the BS. See Table 8-4 for an overview of the supported frequency operating bands.

Power Settings

The "Level Reference" parameter in the "Filter/Clipping/Power Settings" dialog is automatically set to "UL Part of Frame RMS Power".

Filter Settings

The 3GPP EUTRA/LTE specifications do not define a standardized transmit filter for both, the UE and the base station. Therefore, when a test case is activated, a filter type EUTRA/LTE with "Best EVM Optimization" is automatically selected.

AWGN Power Level

The performance requirements tests are performed for a given SNR. The AWGN power level is set per channel bandwidth and test case, according to Table 8-19.

Table 8-19: AWGN power level

Channel bandwidth, MHz	AWGN power level PUSCH tests	AWGN power level PUCCH and PRACH tests
1.4	-92.7 dBm / 1.08 MHz	-98.7 dBm / 1.08 MHz
3	-88.7 dBm / 2.7 MHz	-85.7 dBm / 2.7 MHz
5	-86.5 dBm / 4.5 MHz	-83.5 dBm / 4.5 MHz

Channel bandwidth, MHz	AWGN power level PUSCH tests	AWGN power level PUCCH and PRACH tests
10	-83.5 dBm / 9 MHz	-80.5 dBm / 9 MHz
15	-81.7 dBm / 13.5 MHz	-78.7 dBm / 13.5 MHz
20	-80.4 dBm / 18 MHz	-77.4 dBm / 18 MHz

SNR Correction Factor

The SNR correction factor is applied for **FRCs with not fully allocated RBs** and is calculated as follows:

$SNR_{CorrectionFactor}$= 10*$\log_{10}$(#Allocated RBs/#Possible RBs), dB

Table 8-20: SNR Correction Factor

Channel Band-width, MHz	#Possible RBs	$SNR_{CorrectionFactor}$, dB For FRC A3-1, A4-1, A4-2 and A5-1 with 1 allocated RB	$SNR_{CorrectionFactor}$, dB PRACH Burst Format 0 to 3	$SNR_{CorrectionFactor}$, dB PRACH Burst For-mat 4
1.4	6	-7.78	-0.13	-0.15
3	15	-11.76	-4.11	-4.13
5	25	-13.98	-6.33	-6.35
10	50	-16.99	-9.34	-9.36
15	75	-18.75	-11.10	-11.13
20	100	-20.00	-12.34	-12.37

The wanted signal power level is calculated according to the following formula:

Power $Level_{WantedSignal}$ = Power $Level_{AWGN}$ + SNR + $SNR_{CorrectionFactor}$

Example: Test Case 8.2.1

"Channel Bandwidth" = 1.4 MHz

"Number of Rx Antennas" = 2

"Cyclic Prefix" = Normal

"Propagation Conditions" = EVA 5Hz

"FRC" = A3-1

"Fraction of maximum throughput" = 30%

According to Table 8-22 the SNR = -2.1 dB

According to Table 8-20 the $SNR_{CorrectionFactor}$ = -7.78 dB

According to Table 8-19 the Power $Level_{AWGN}$ = -92.7 dBm

Power $Level_{WantedSignal}$ = Power $Level_{AWGN}$ + SNR + $SNR_{CorrectionFactor}$ = -92.7 - 2.1 - 7.78 = -102.6 dB

HARQ-Feedback

Some of the performance requirements test cases require a feedback signal from the base station. The R&S SMW equipped with the option R&S SMW-K69 is able to perform HARQ retransmissions and/or timing shifts according to the 3GPP specification.

Refer to Chapter 5, "Real-time feedback for closed loop BS tests", on page 341 for explanation of the scope of this feature and for detailed description of the different feedback modes.

8.9.3 Realtime feedback configuration, AWGN and propagation condition settings

Realtime Feedback Configuration

Comprises the settings of the realtime feedback message and the feedback line.

Realtime Feedback Mode ← Realtime Feedback Configuration

Determines the feedback mode.

"Binary ACK/ NACK"
The ACK/NACK feedback is implemented as low/high voltage level on the feedback line connector.
Timing adjustments feedback is not supported in this mode.

"Serial/Serial 3x8"
ACK/NACK feedback and timing adjustments feedback are implemented by a serial protocol.
In "Serial 3x8" mode, a serail command consists of three serial packets.
See Chapter 5.2.2, "Serial modes", on page 344.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:MODE on page 1088

Connector ← Realtime Feedback Configuration

Determines the feedback line connector.

"Global (User 6)"
The following settings apply:
- "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Global"
- "Global Connector Settings > User 6 > Direction > Input" and "User 6 > Signal > Feedback"

"Local (TM3)"
The following settings apply:
- "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Local"
- "Local Connector Settings > T/M 3 > Direction > Input" and "T/M 3 > Signal > Feedback"

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONNector on page 1087

Additional User Delay ← Realtime Feedback Configuration
Determines the point in time when the feedback can be sent to the instrument.

For more information, see Chapter 5.3, "Timing aspects", on page 349.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:AUSDelay` on page 1087

Baseband Selector ← Realtime Feedback Configuration
("Serial" and "Serial 3x8" mode only)

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured for a specific baseband unit, the baseband unit listens only to serial commands containing the selector n.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSelector` on page 1087

Serial Rate ← Realtime Feedback Configuration
(Serial and Serial 3x8 mode only)

Determines the bit rate of the serial transmission. Possible rates are 115.2 kbps, 1.6 Mbps and 1.92 Mbps.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:SERRate` on page 1088

ACK Definition ← Realtime Feedback Configuration
("Binary ACK/NACK" mode only)

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:RTF:ACKDefinition` on page 1086

AWGN Configuration
Comprises the settings of the AWGN signal.

Power Level ← AWGN Configuration
Displays the AWGN power level. The value is determined according to Table 8-19 by the selected channel bandwidth.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel?` on page 1077

Propagation Conditions
Selects a predefined multipath fading propagation conditions. The settings of the fading simulator are adjusted according to the corresponding channel model as defined in TS 36.141, Annex B.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PROCondition` on page 1095

8.9.4 Test case 8.2.1: PUSCH in multipath fading propagation conditions

Test Purpose

The test verifies the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

Short Description

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The throughput is measured by the base station under test and is expressed as a fraction of maximum throughput for the FRC. HARQ retransmissions are assumed.

The characteristics of the wanted signal are adjusted according to the pre-defined FRC and the test parameter given in Table 8-21.

Table 8-21: Test parameters for testing PUSCH

Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)

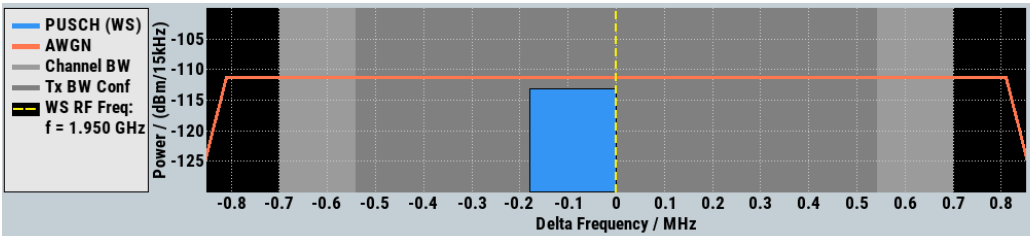
The Table 8-22 shows an example of the test requirements (channel bandwidth 1.4 MHz). Similar requirements exist for the different FRCs, channel bandwidths and antenna configurations. Refer to TS 36.141 for a detailed description of all test requirements.

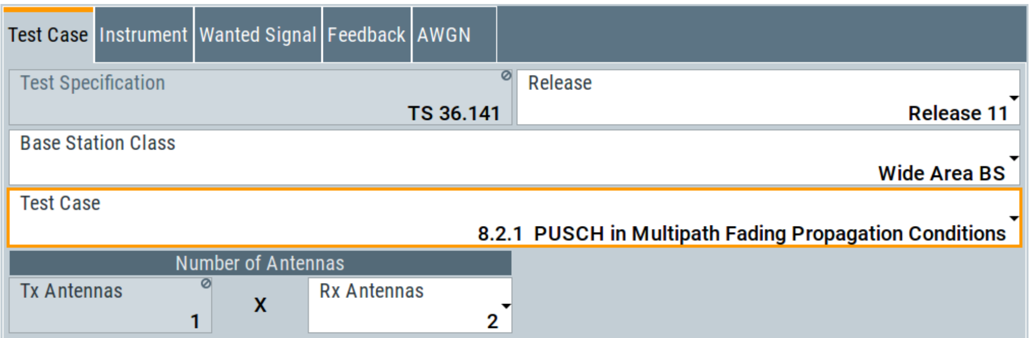
Table 8-22: Test requirements for PUSCH, 1.4 MHz Channel Bandwidth (Number Tx Antennas = 1)

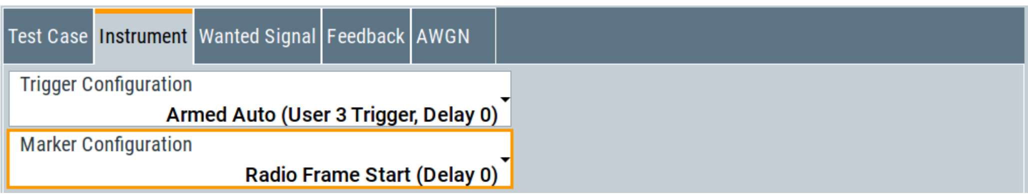
Cyclic prefix	Propagation conditions	FRC	Fraction of maximum throughput, %	SNR, dB 2 RX antennas	SNR, dB 4 RX antennas
Normal	EPA 5Hz	A3-2	30 70	-3.5 0.7	-6.0 -2.5
		A4-3	70	11.2	7.7
		A5-2	70	18.3	15.0

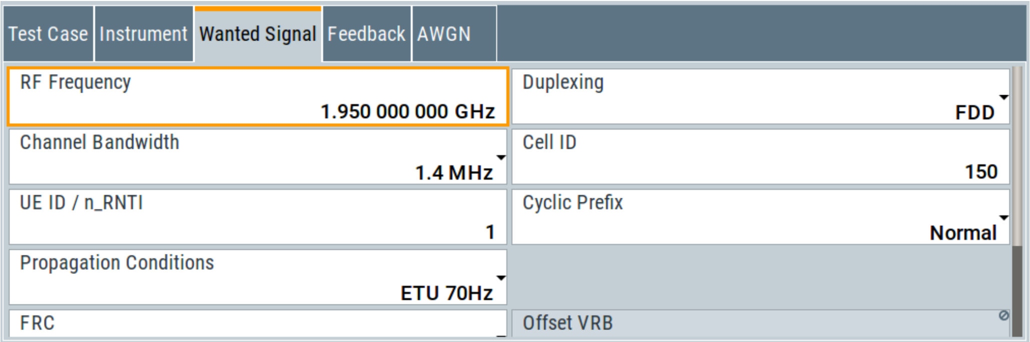
Cyclic prefix	Propagation conditions	FRC	Fraction of maximum throughput, %	SNR, dB 2 RX antennas	SNR, dB 4 RX antennas
	EVA 5Hz	A3-1	30 70	-2.1 2.4	-4.4 -0.7
		A4-1	30 70	5.0 11.9	1.9 8.4
		A5-1	70	19.2	16.0
	EVA 70Hz	A3-2	30 70	-3.3 1.3	-5.7 -2.1
		A4-3	30 70	4.6 12.5	1.4 8.9
	ETU 70Hz*	A3-1	30 70	-1.6 3.5	-4.2 -0.4
	ETU 300Hz*	A3-1	30 70	-1.6 3.5	-4.0 0.0
Extended	ETU 70Hz*	A4-2	30 70	5.4 14.1	2.2 10.5

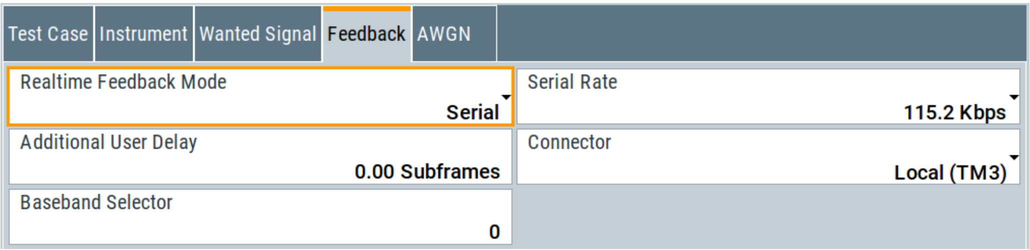
*) Not applicable for Local Area BS and Home BS.

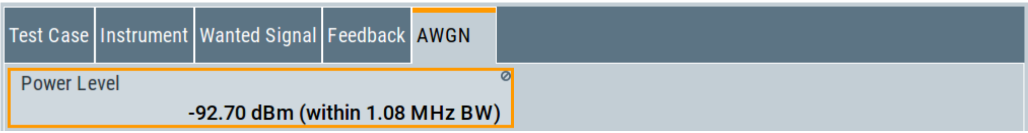












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 8.9.3, "Realtime feedback configuration, AWGN and propagation condition settings", on page 591.

Fraction of Max. Throughput

Selects the fraction of maximum throughput.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:FMTHroughput` on page 1092

8.9.5 Test case 8.2.2: UL timing adjustment

Test Purpose

The test verifes the receiver’s ability to achieve throughput measured for the moving UE at given SNR under moving propagation conditions (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

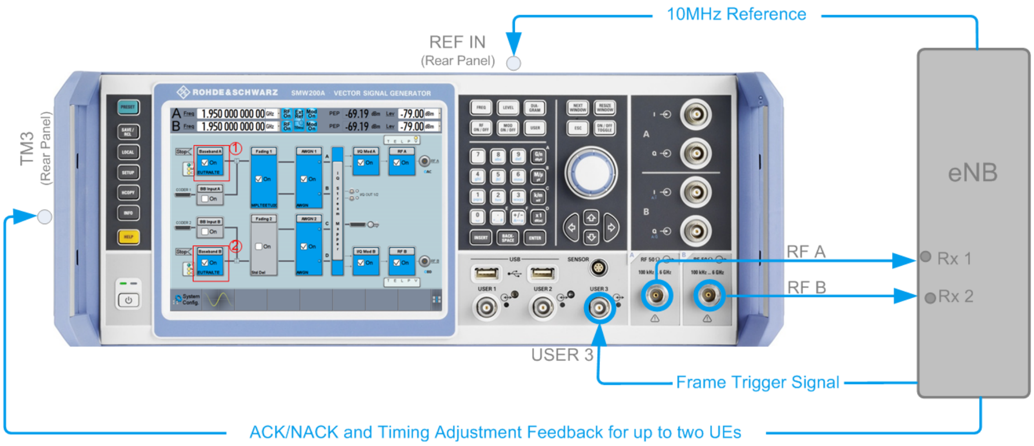


Figure 8-13: Test Setup for test case 8.2.2 "UL Timing Adjustment"

1 = Baseband A generates the signal of the moving UE
2 = Baseband B generates the signal of the stationary UE

Short Description

For the UL timing adjustment test, the signal generator generated the signal of two user equipment (UEs). Path A generates the signal of a moving UE and path B the signal of the stationary one. The throughput is measured by the base station under test.

The performance requirement of PUSCH is expressed as 70% of maximum throughput for the FRC measured for the moving UE at given SNR (see Table 8-24). HARQ retransmissions are assumed. The transmission of the sounding reference signal SRS is optional (see "Transmit SRS" on page 599).

Two moving propagation scenarios are defined; tests with scenario 2 are optional. For detailed description of the moving propagation conditions, refer to the description user manual "Fading Simulator".

The characteristics of the wanted signal (transmitted by moving UE) are adjusted according to the pre-defined FRC and the test parameter given in Table 8-23.

Table 8-23: Test parameters for testing UL timing adjustment

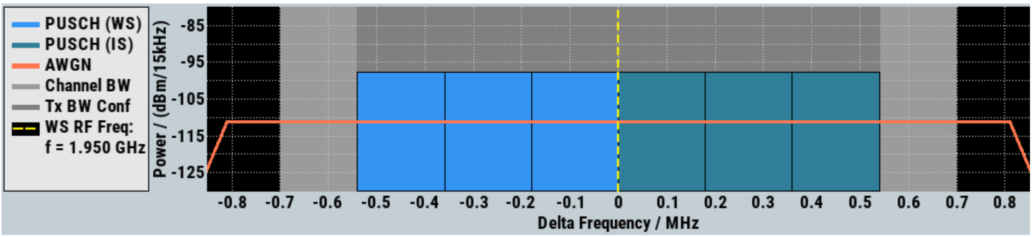
Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)

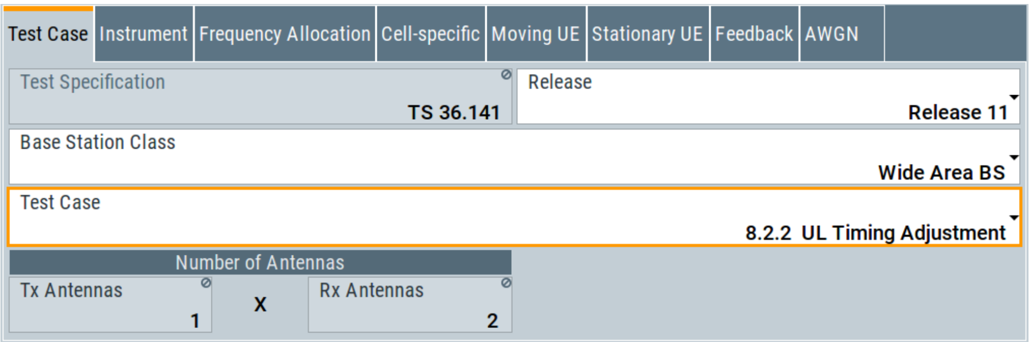
Parameter	Value
Subframes in which PUSCH is transmitted	• For FDD: Subframe #0, #2, #4, #6, and #8 in radio frames • For TDD: Subframe #2, #3, #7, #8 in each radio frame
Subframes in which SRS is transmitted (SRS transmission is optional)	• For FDD: Subframe #1 in radio frames • For TDD: UpPTS in each radio frame

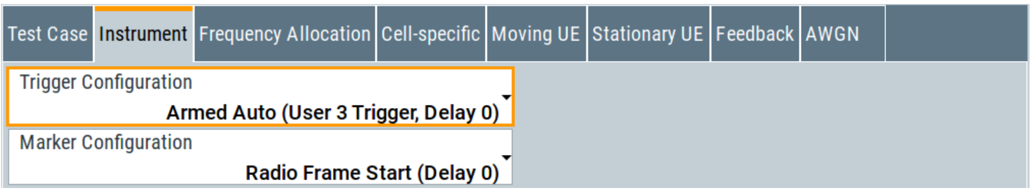
The Table 8-24 shows the test requirements. The test is performed with two Rx antennas and a normal cyclic prefix.

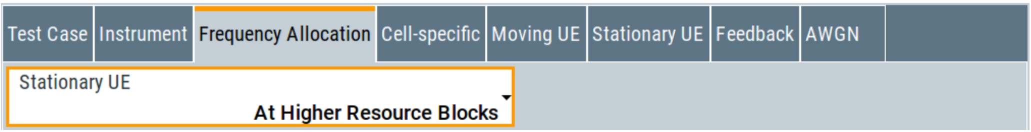
Table 8-24: Test requirements for UL timing adjustment (two Rx antennas and normal cyclic prefix)

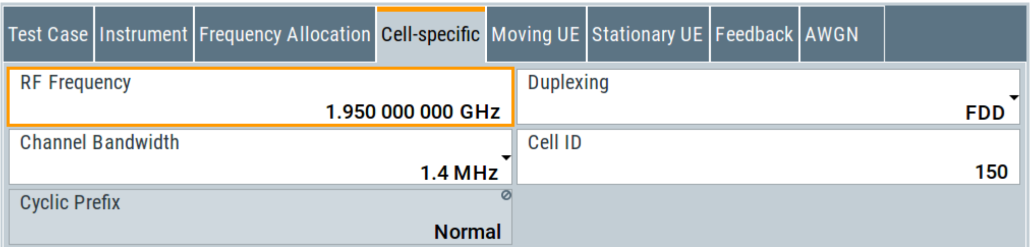
Channel Bandwidth, MHz	Moving propagation conditions	FRC	SNR, dB
1.4	Scenario 1 Scenario 2	A7-1 A8-1	13.7 -1.6
3	Scenario 1 Scenario 2	A7-2 A8-2	14.0 -1.2
5	Scenario 1 Scenario 2	A7-3 A8-3	13.8 -1.3
10	Scenario 1 Scenario 2	A7-4 A8-4	14.4 -1.5
15	Scenario 1 Scenario 2	A7-5 A8-5	14.6 -1.5
20	Scenario 1 Scenario 2	A7-6 A8-6	14.5 -1.5

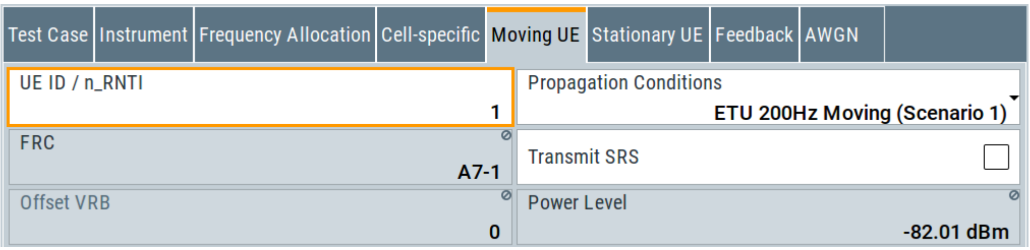


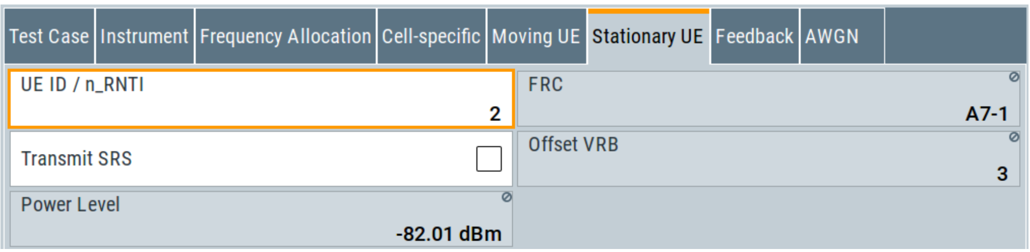

Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
Test Specification
TS 36.141
Release
Release 11
Base Station Class
Wide Area BS
Test Case
8.2.2 UL Timing Adjustment
Number of Antennas
Tx Antennas
1
X
Rx Antennas
2

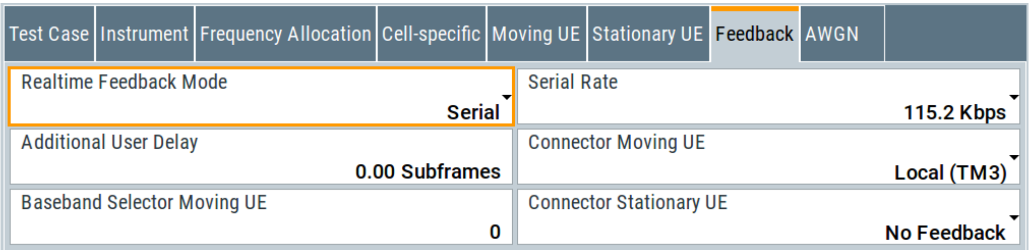

Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)

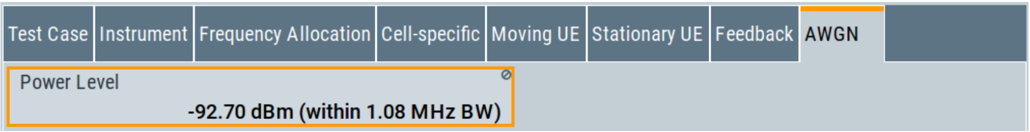

Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
Stationary UE
At Higher Resource Blocks


Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
Cell ID
150
Cyclic Prefix
Normal


Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
UE ID / n_RNTI
1
Propagation Conditions
ETU 200Hz Moving (Scenario 1)
FRC
A7-1
Transmit SRS
Offset VRB
0
Power Level
-82.01 dBm


Test Case
Instrument
Frequency Allocation
Cell-specific
Moving UE
Stationary UE
Feedback
AWGN
UE ID / n_RNTI
2
FRC
A7-1
Transmit SRS
Offset VRB
3
Power Level
-82.01 dBm





The general and instrument related settings are described in Test case settings and Instrument settings

The cell-specific settings and the settings of the moving UE are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 8.9.3, "Realtime feedback configuration, AWGN and propagation condition settings", on page 591.

UE ID/n_RNTI
Sets the UE ID/n_RNTI.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:MUE:UEID on page 1096
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:UEID on page 1096

Transmit SRS
Enables/disables the transmission of the SRS.

The SRS transmission is optional for this test case.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:MUE:TSRS on page 1086
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:TSRS on page 1086

Offset VRB
Displays the number of RB with that the allocated RB are shifted.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:MUE:OVRB on page 1094
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:OVRB on page 1094

Connector Moving UE/Stationary UE
Determines the feedback line connector.

"Global (User 6)" (will be supported in future firmware release)

The following settings apply:
- "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Global"
- "Global Connector Settings > User 6 > Direction > Input" and "User 6 > Signal > Feedback"

"Local (TM3)" The following settings apply:
- "EUTRA/LTE > User Equipment > Realtime Feedback > Connector > Local"
- "Local Connector Settings > T/M 3 > Direction > Input" and "T/M 3 > Signal > Feedback"

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONMue on page 1087
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONSue on page 1087

Baseband Selector Moving UE
("Serial" and "Serial 3x8" mode only)

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific baseband unit, the baseband unit listens only to serial commands containing the selector n.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSMue on page 1087
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSSue on page 1087

8.9.6 Test case 8.2.3: HARQ-ACK multiplexed on PUSCH

Test Purpose

The test verifies the receiver's ability to detect HARQ-ACK information multiplexed on PUSCH under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

See Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

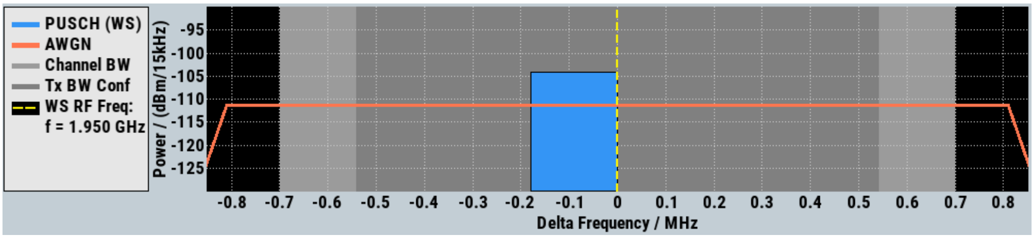
Short Description

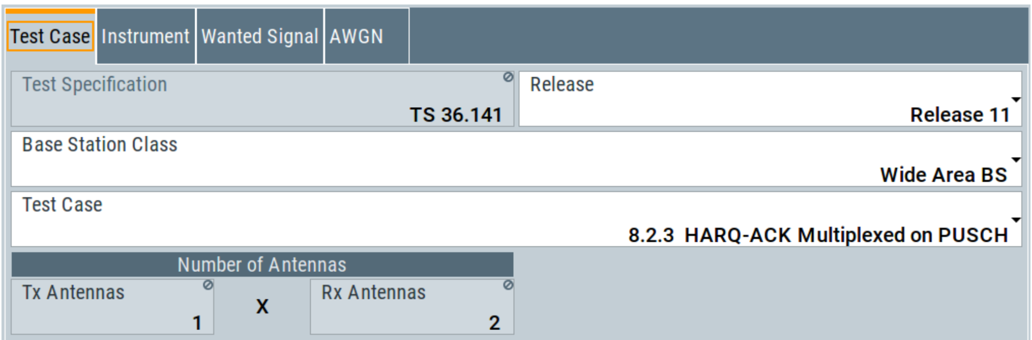
The performance requirement of HARQ-ACK multiplexed on PUSCH is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

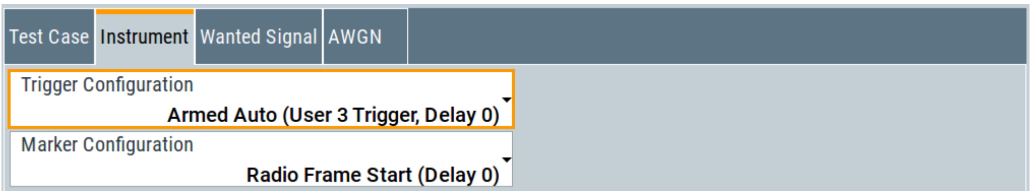
The Table 8-25 shows the test requirements. The tests are performed with two Rx antennas, normal cyclic prefix and propagation condition ETU70.

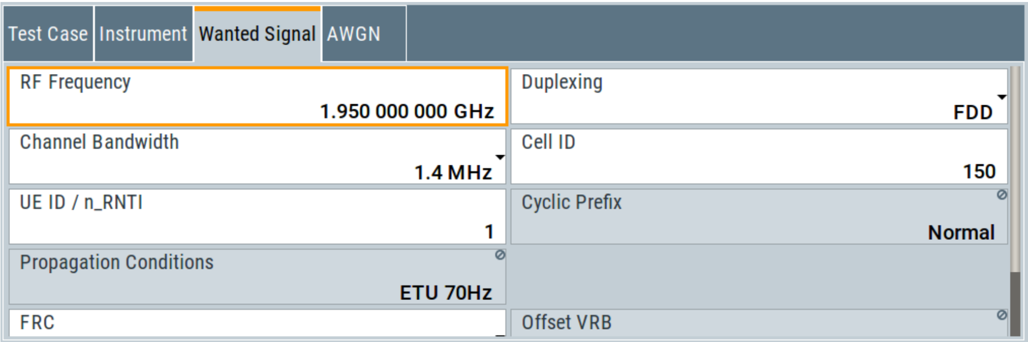
Table 8-25: Test requirements for HARQ-ACK multiplexed on PUSCH (two Rx antennas, normal cyclic prefix and propagation condition ETU70)

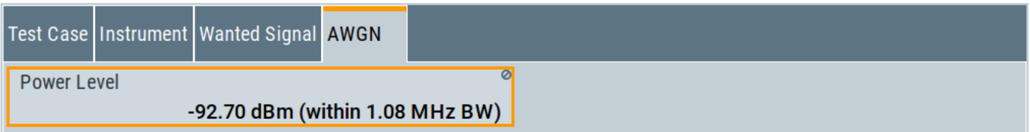
Channel Bandwidth, MHz	FRC	Index HARQ Offset	SNR, dB
1.4	A3-1 A4-3	8 5	7.2 14.4
3	A3-1 A4-4	8 5	7.2 13.5
5	A3-1 A4-5	8 5	7.1 13.1
10	A3-1 A4-6	8 5	7.2 12.9
15	A3-1 A4-7	8 5	7.3 12.7
20	A3-1 A4-8	8 5	7.1 12.6











The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

8.9.7 Test case 8.2.4: high-speed train conditions

Test Purpose

The test verifies the receiver's ability to achieve throughput under High-Speed Train conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

See Chapter 8.4.3, "Test setup - diversity measurements", on page 538 and Chapter 8.4.1, "Standard test setup - one path", on page 537 (additionally, a feedback line is required).

Short Description

The performance requirement is determined by a minimum throughput for a given SNR. The requirement throughput is expressed as 30% and 70% of the maximum throughput for the FRC (see Table 8-26). HARQ retransmission is assumed. The tests are performed with one or two Rx antennas, normal cyclic prefix and propagation condition HST.

The test is optional.

The characteristics of the wanted signal are adjusted according to the pre-defined FRC and the test parameter given in Table 8-27.

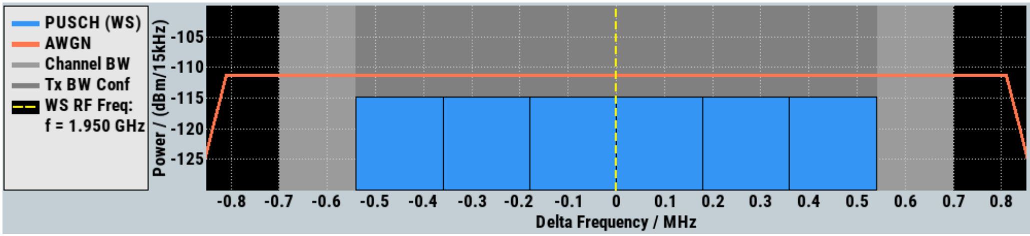
Table 8-26: Test parameters for High-Speed Train conditions

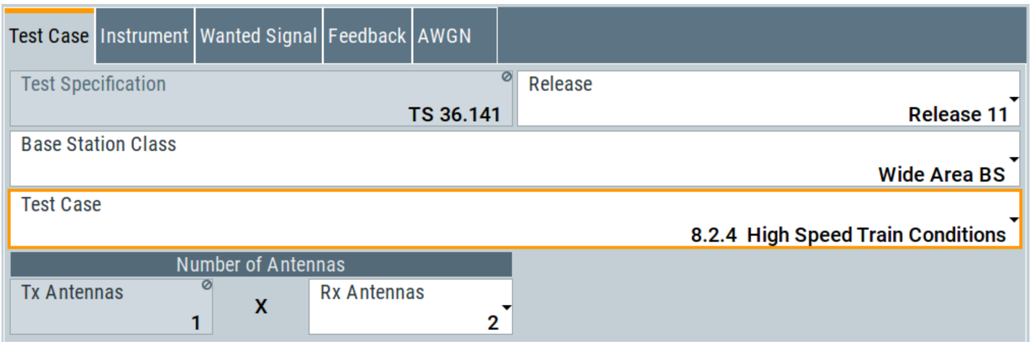
Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)
Subframes in which PUSCH is transmitted	For FDD: ● Subframe #0 and #8 in radio frames for which SFN mod 4 = 0 ● Subframe #6 in radio frames for which SFN mod 4 = 1 ● Subframe #4 in radio frames for which SFN mod 4 = 2 ● Subframe #2 in radio frames for which SFN mod 4 = 3 For TDD: ● Subframe #2 in each radio frames
Subframes in which PUCCH is transmitted *	For FDD: ● Subframe #5 in radio frames For TDD: ● Subframe #3 in each radio frame
*) The configuration of PUCCH (format 2) is optional; The SNR values per antenna are set to [-4.5 dB and -1.5 dB] for Scenario 1 and 3.	

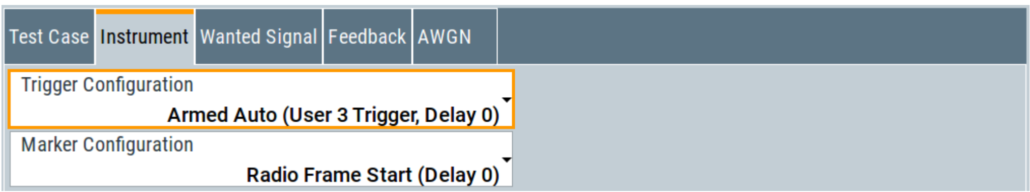
Table 8-27: Test requirements for High-Speed Train conditions

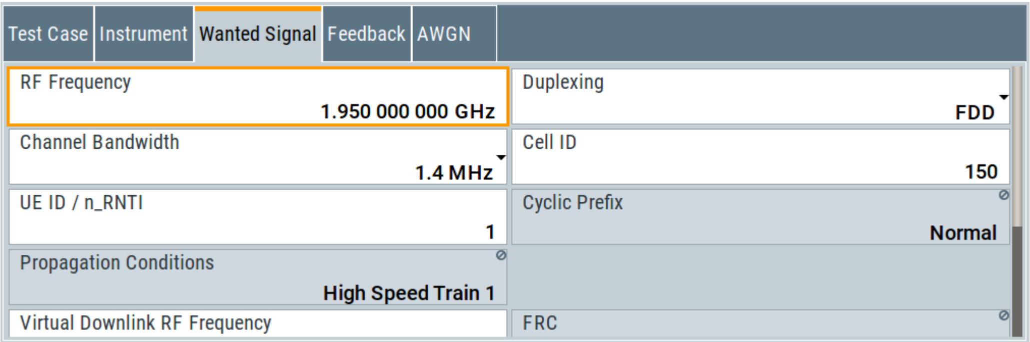
Channel Band-width, MHz	FRC	Number of RX antennas	Propagation conditions	Fraction of maximum throughput, %	SNR, dB
1.4	A3-2	1	HST Scenario 3	30 70	-1.2 2.2
		2	HST Scenario 1	30 70	-3.6 -0.3
3	A3-3	1	HST Scenario 3	30 70	-1.8 1.9
		2	HST Scenario 1	30 70	-4.2 -0.7
5	A3-4	1	HST Scenario 3	30 70	-2.3 1.6
		2	HST Scenario 1	30 70	-4.8 -1.1
10	A3-5	1	HST Scenario 3	30 70	-2.4 1.5

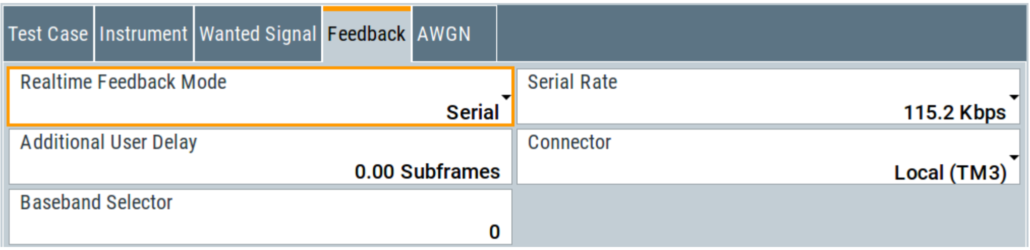
Channel Band-width, MHz	FRC	Number of RX antennas	Propagation conditions	Fraction of maximum throughput, %	SNR, dB
		2	HST Scenario 1	30 70	-5.1 -1.2
15	A3-6	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-4.9 -1.1
20	A3-7	1	HST Scenario 3	30 70	-2.4 1.5
		2	HST Scenario 1	30 70	-5.0 -1.1

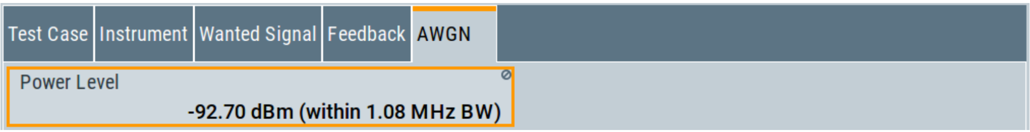












The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings, the AWGN configuration, and the realtime feedback configuration refer to Chapter 8.9.3, "Realtime feedback configuration, AWGN and propagation condition settings", on page 591.

Virtual Downlink RF Frequency

In *high-speed train BS tests*, the DL signal itself already contains a Doppler shift. The UE synchronizes on this shifted DL frequency. The simulated UL signal contains a Doppler shift, too.

The resulting Doppler shift is then based *on both*, the UL and the DL frequency.

- This parameter "Virtual Downlink RF Frequency" defines the downlink frequency F_{DL}.
  For HST BS tests, enter the F_{DL} as defined in the specification. The value is used by the calculation of the UL Doppler shift.
- The uplink RF frequency F_{UL} is set with the parameter RF Frequency.

For more information on the Doppler shift calculation and the high-speed train conditions:

See user manual R&S®SMW-B14/-K71/-K72/-K73/-K74/-K75/-K820/-K821/-K822/-K823 Fading Simulation.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:VDRFrequency` on page 1096

Additionally Configure PUCCH
Enables the optional transmission of PUCCH format 2.

The settings are configured according to Table 8-27; the PUCCH Power Level is calculated automatically.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ACPucch` on page 1090

Power Level (PUSCH)
Displays the resulting PUSCH power level.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPS?` on page 1094

PUCCH Power Level
(enabled for activated optional transmission of PUCCH format 2)

Displays the resulting PUCCH power level.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPC?` on page 1094

8.9.8 Test case 8.2.6: PUSCH in multipath fading propagation with synchronous interference

Test Purpose

The test verifies the receiver's ability to achieve throughput on the wanted signal at the presence of one or two dominant interferers (TS 36.141 Enhanced performance requirements type A of PUSCH in multipath fading propagation conditions with synchronous interference).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

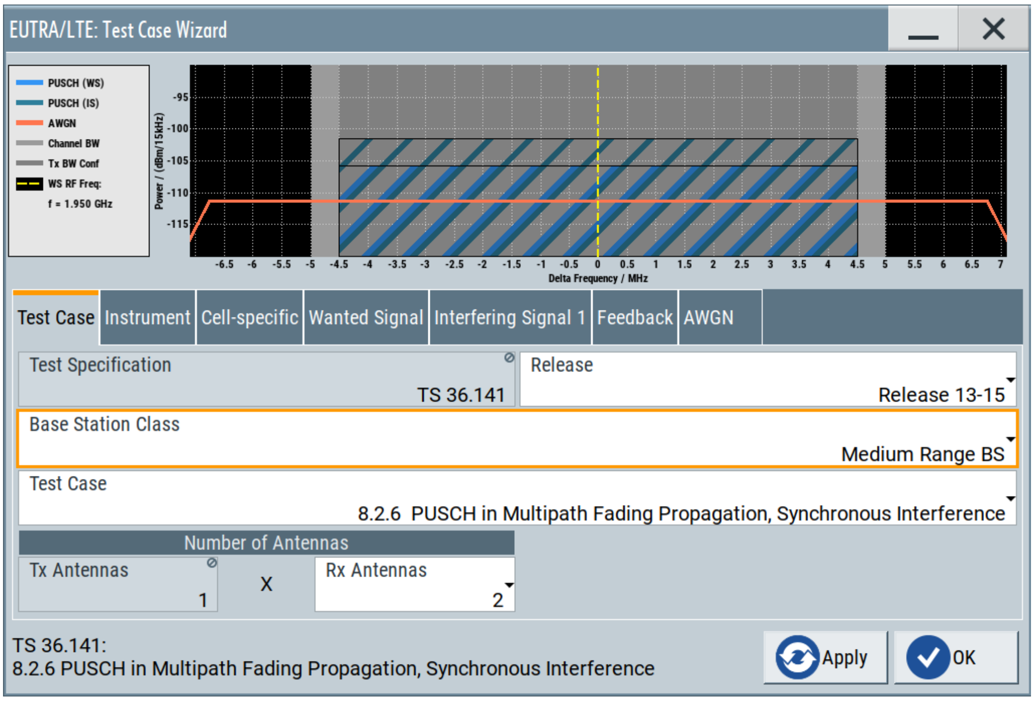
Test Setup

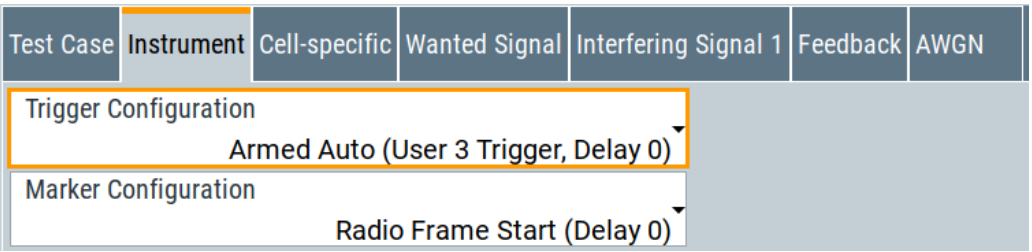
The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

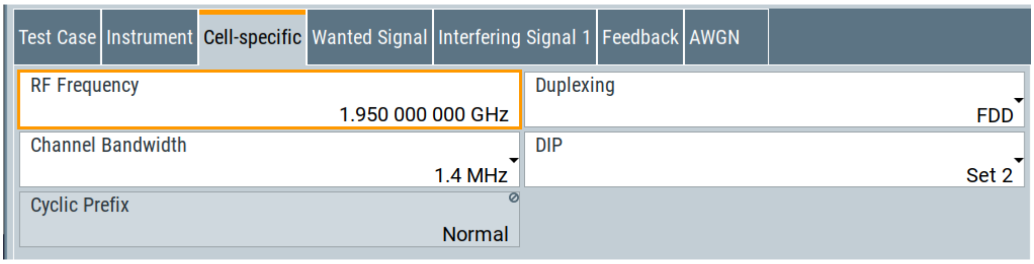
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539.

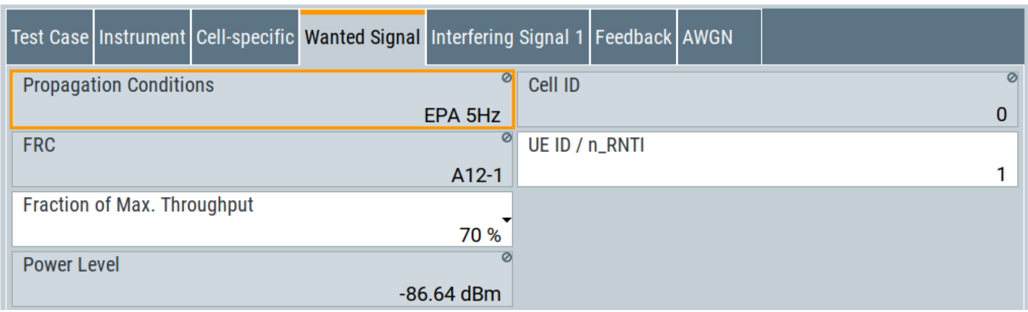
Short Description

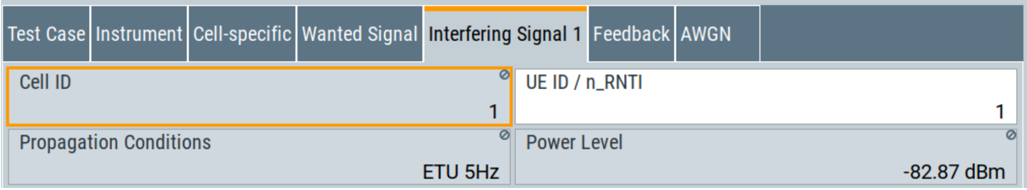
The test verifies the enhanced performance requirement type A of PUSCH determined by a minimum required throughput for a given SINR

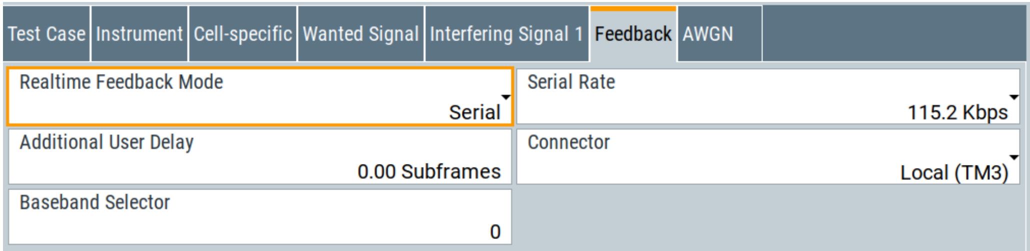

EUTRA/LTE: Test Case Wizard
PUSCH (WS)
PUSCH (IS)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
f = 1.950 GHz
Power / (dBm/15kHz)
Delta Frequency / MHz
Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Feedback
AWGN
Test Specification
TS 36.141
Release
Release 13-15
Base Station Class
Medium Range BS
Test Case
8.2.6 PUSCH in Multipath Fading Propagation, Synchronous Interference
Number of Antennas
Tx Antennas
1
x
Rx Antennas
2
TS 36.141:
8.2.6 PUSCH in Multipath Fading Propagation, Synchronous Interference
Apply
OK

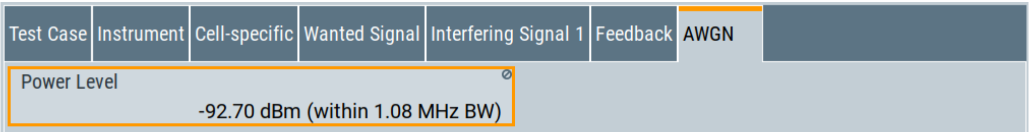

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Feedback
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Feedback
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
DIP
Set 2
Cyclic Prefix
Normal


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Feedback
AWGN
Propagation Conditions
EPA 5Hz
Cell ID
0
FRC
A12-1
UE ID / n_RNTI
1
Fraction of Max. Throughput
70 %
Power Level
-86.64 dBm







8.9.9 Test case 8.2.6A: PUSCH in multipath fading propagation with asynchronous interference

Test Purpose

The test verifies the enhanced performance requirement type A of PUSCH determined by a minimum required throughput for a given SINR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

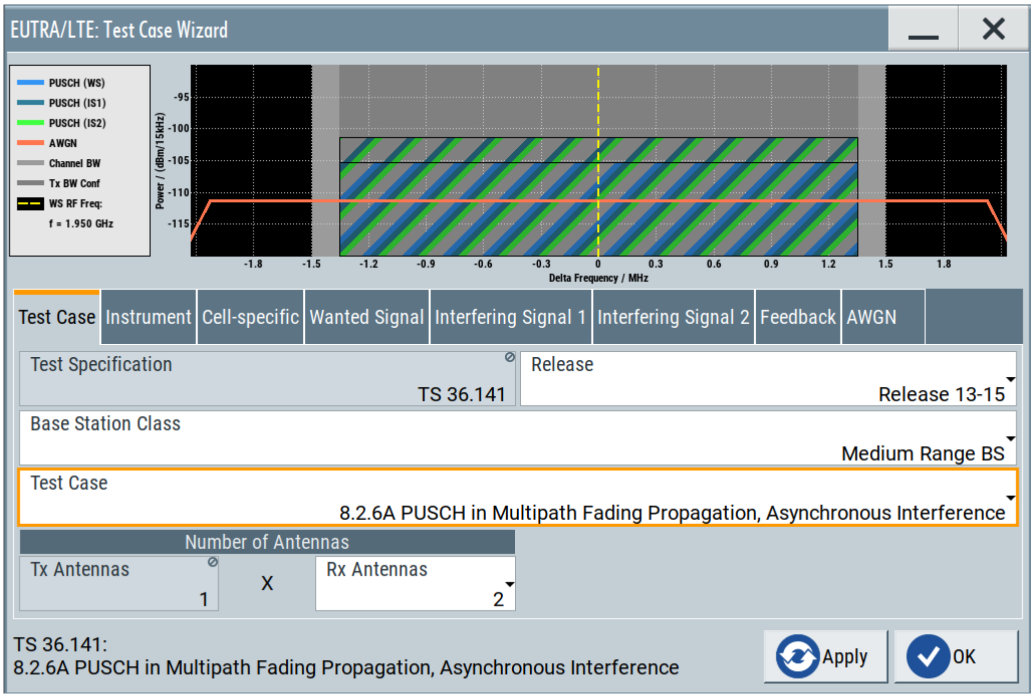
Test Setup

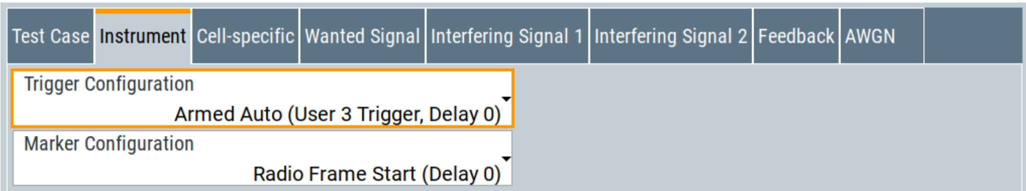
The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

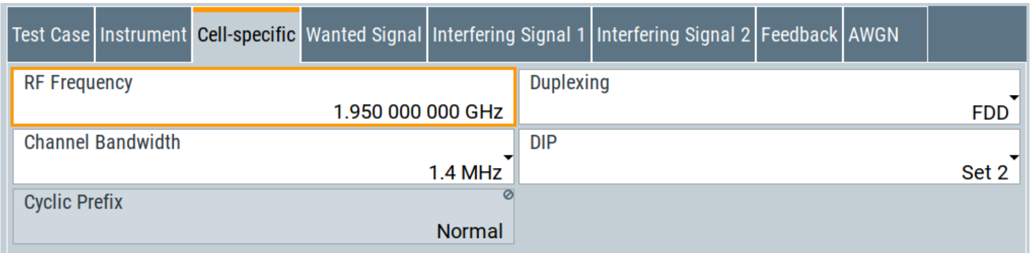
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539.

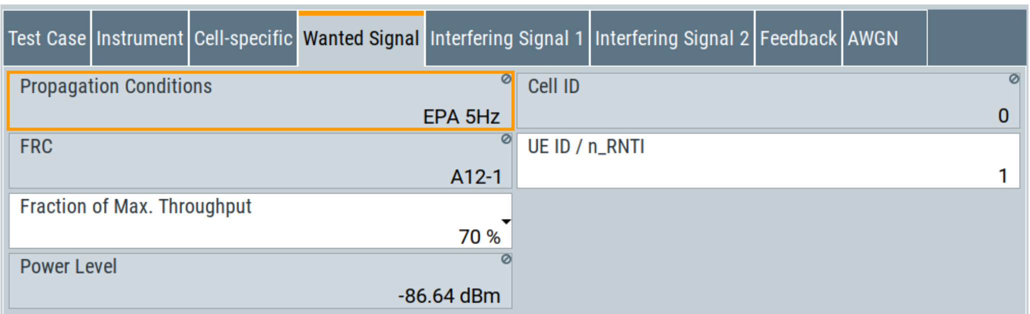
Short Description

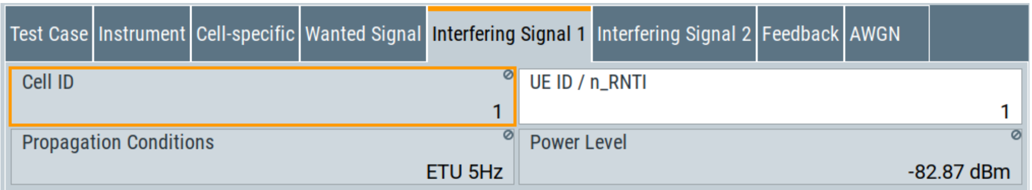
The test verifies the demodulation performance when the wanted PUSCH signal in the serving cell is interfered by PUSCH of two interferers from the same interfering cell.

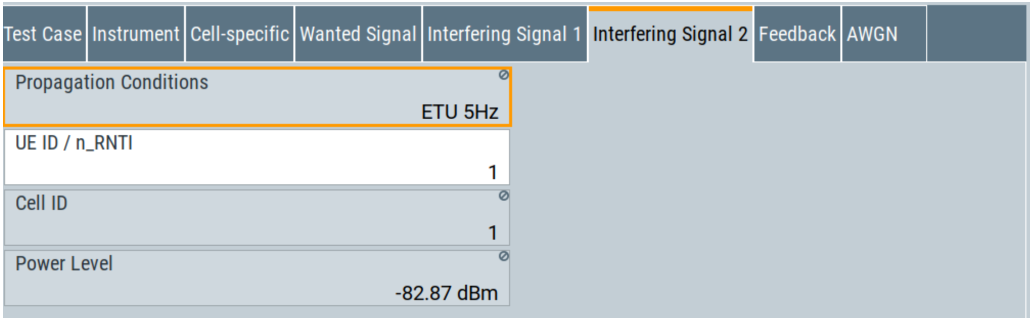

EUTRA/LTE: Test Case Wizard
PUSCH (WS)
PUSCH (IS1)
PUSCH (IS2)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
f = 1.950 GHz
Power / (dBm/15kHz)
Delta Frequency / MHz
Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Feedback
AWGN
Test Specification
TS 36.141
Release
Release 13-15
Base Station Class
Medium Range BS
Test Case
8.2.6A PUSCH in Multipath Fading Propagation, Asynchronous Interference
Number of Antennas
Tx Antennas
1
X
Rx Antennas
2
TS 36.141:
8.2.6A PUSCH in Multipath Fading Propagation, Asynchronous Interference
Apply
OK

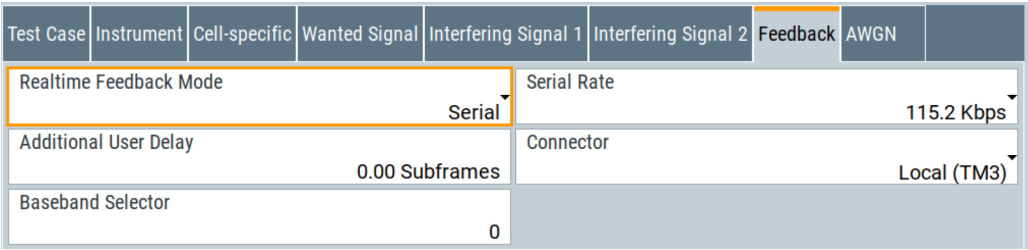

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Feedback
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)

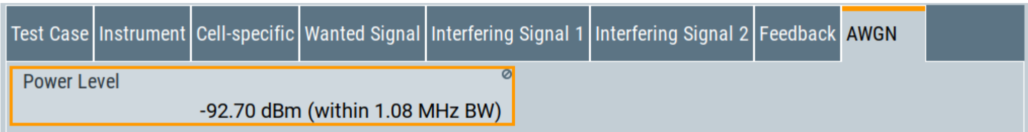

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Feedback
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
DIP
Set 2
Cyclic Prefix
Normal


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Feedback
AWGN
Propagation Conditions
EPA 5Hz
Cell ID
0
FRC
A12-1
UE ID / n_RNTI
1
Fraction of Max. Throughput
70 %
Power Level
-86.64 dBm









8.9.10 Test case 8.2.7: PUSCH in multipath fading propagation for coverage enhancement

Test Purpose

The test verifies the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR. (TS 36.141 Performance requirements of PUSCH in multipath fading propagation conditions transmission on single antenna port for coverage enhancement).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

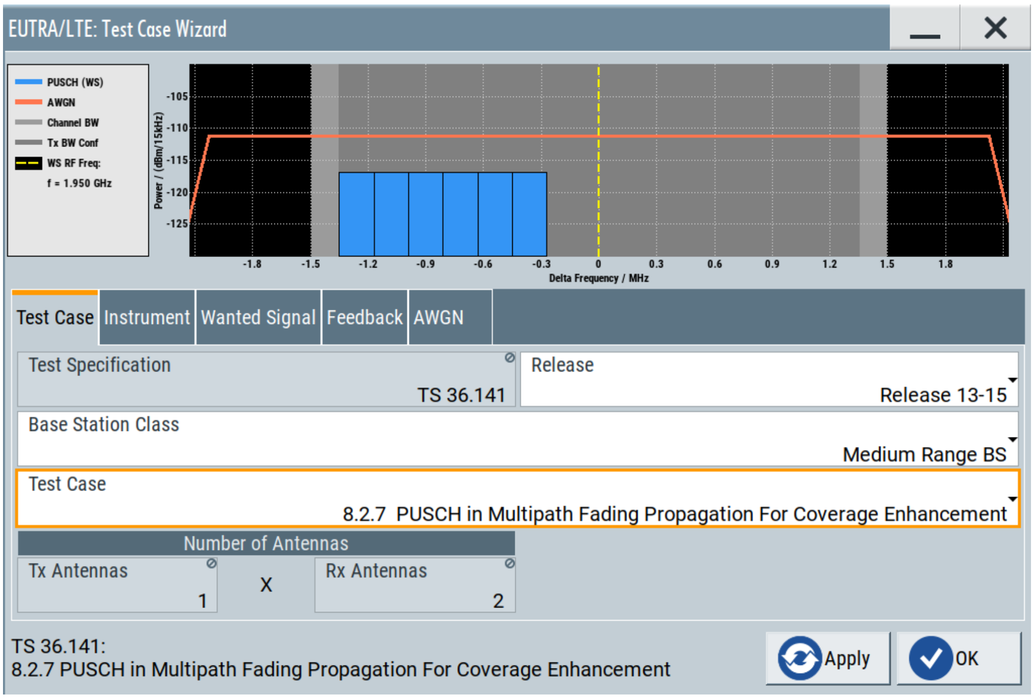
Test Setup

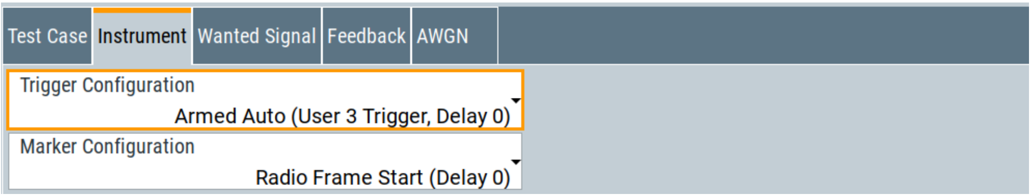
The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

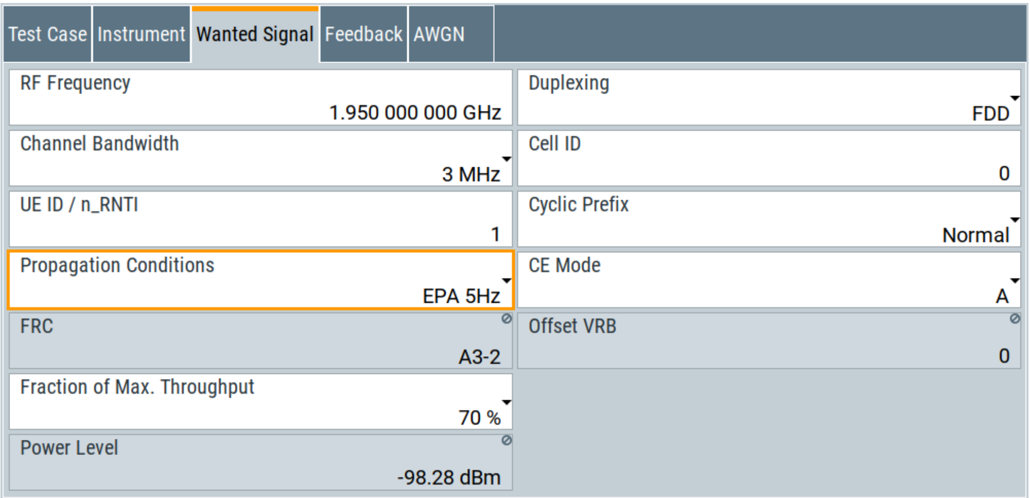
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539.

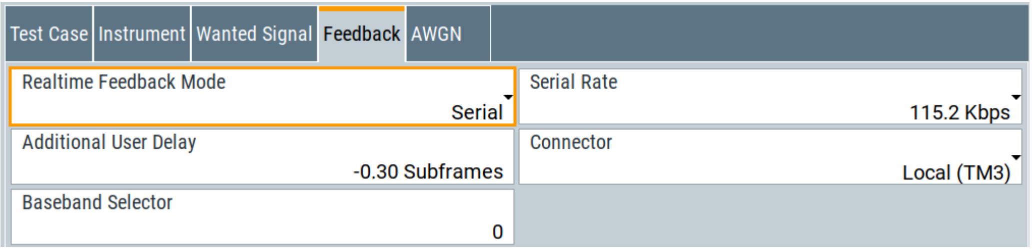
Short Description

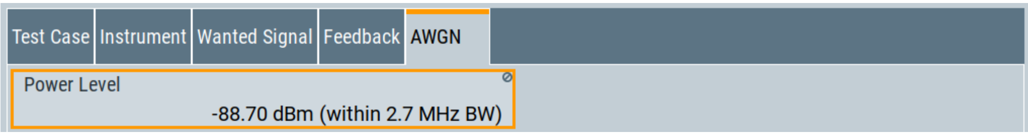
The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in Annex A of TS 36.141. The performance requirements assume HARQ retransmissions.











8.9.11 Test case 8.2.9: type b for PUSCH in multipath fading propagation conditions

Test Purpose

The test veriefies the receiver's ability to achieve throughput on the wanted signal at the presence of one inter-cell interferer, under multipath fading propagation conditions for a given SINR (TS 36.141 Enhanced performance requirements type B of PUSCH in multipath fading propagation conditions).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

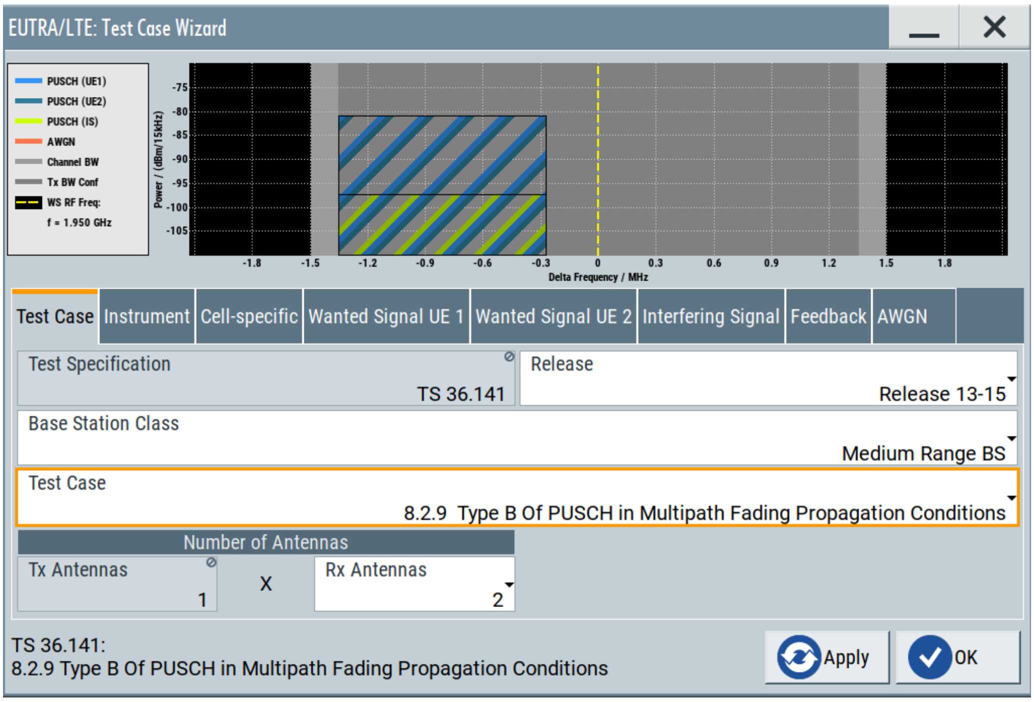
Test Setup

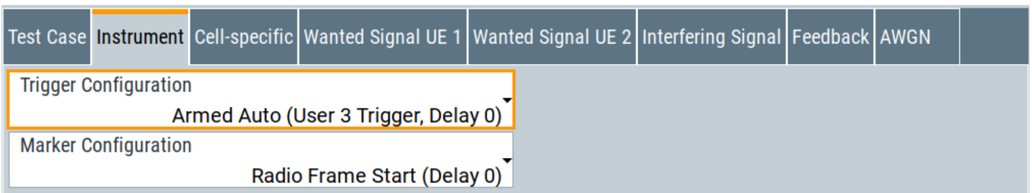
The test setup for PUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

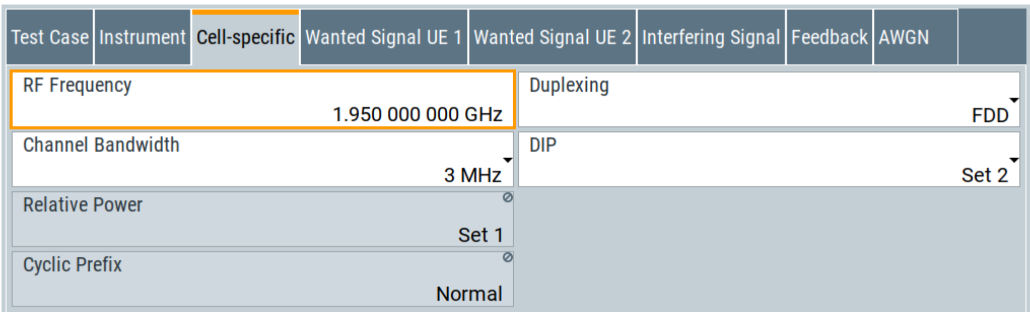
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539.

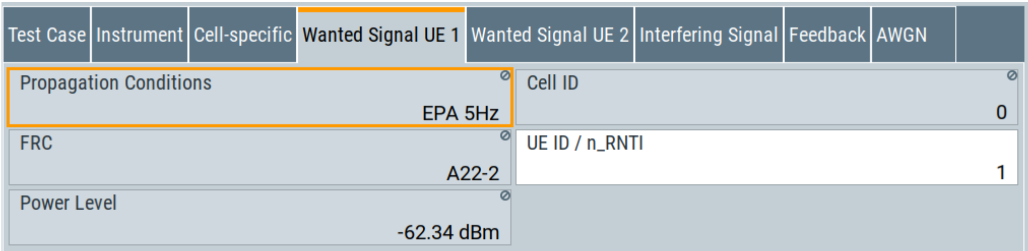
Short Description

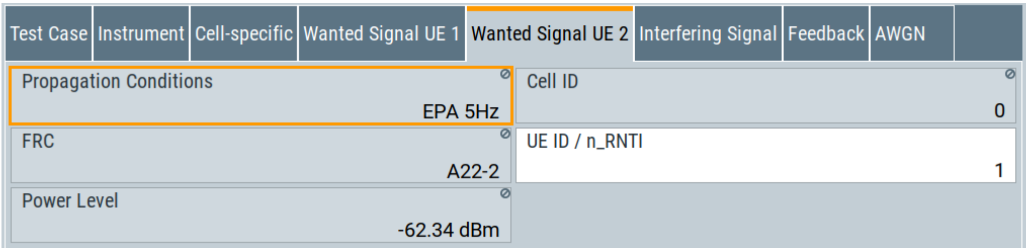
The enhanced performance requirement type B of PUSCH is determined by a minimum required throughput for a given SINR. The required throughput is expressed as a fraction of maximum sum throughput of all the co-scheduled intra-cell UEs for the FRCs listed in Annex A of TS 36.141. The performance requirements assume HARQ retransmissions.

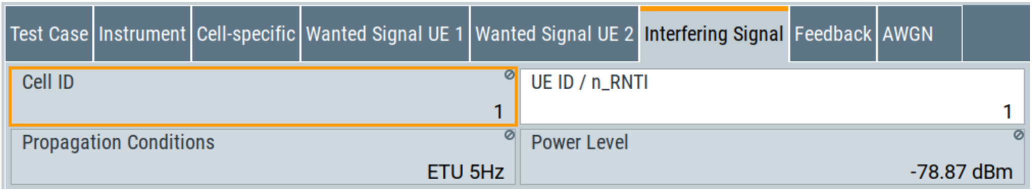


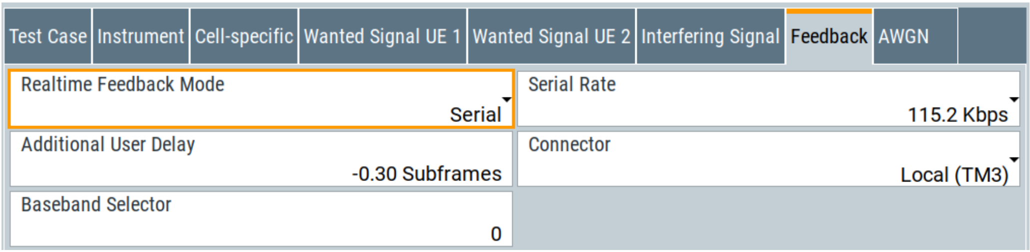












FRC
Queries the intra cell fixed reference channel used for UE wanted signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:INTRacell:UE<ch>:FRC?` on page 1089

Power Level
Queries the intra cell power level used for UE wanted signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:INTRacell:UE<ch>:PLEVel?`
on page 1089

UE ID / n_RNTI
Sets the intra cell UE ID/n_RNTI for UE wanted signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:INTRacell:UE<ch>:UEID on page 1089

8.9.12 Test case 8.3.1: ACK missed detection for single user PUCCH format 1a

Test Purpose

The test shall verify the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

Short Description

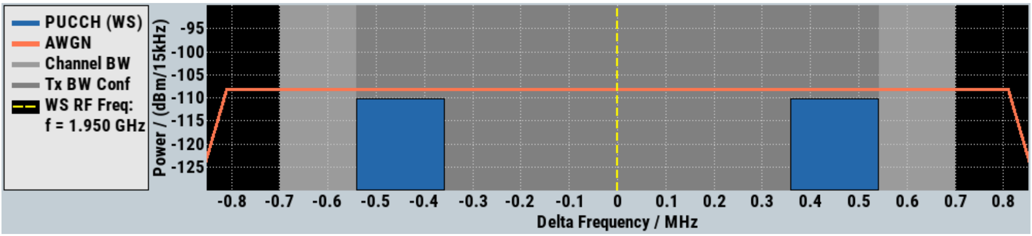
The performance requirement of single user PUCCH for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

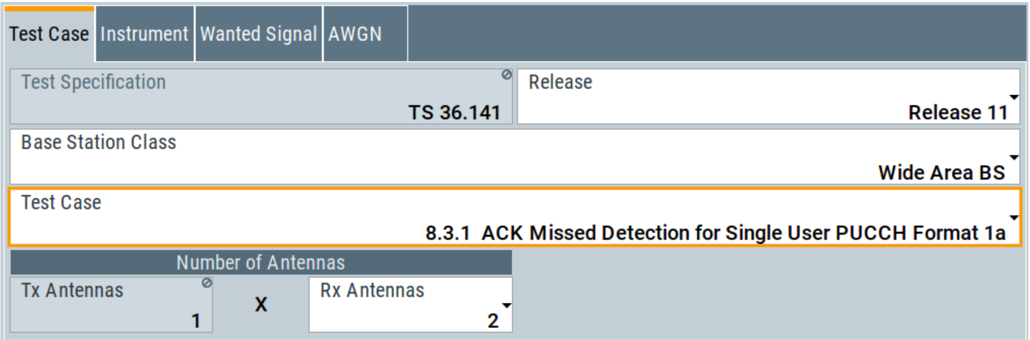
The Table 8-28 shows the test requirements for two and four Rx antennas.

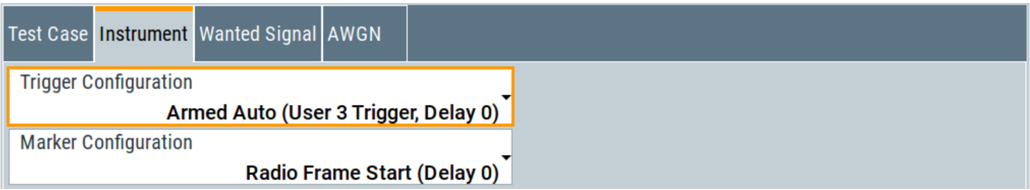
Table 8-28: Required SNR for single user PUCCH format 1a demodulation tests

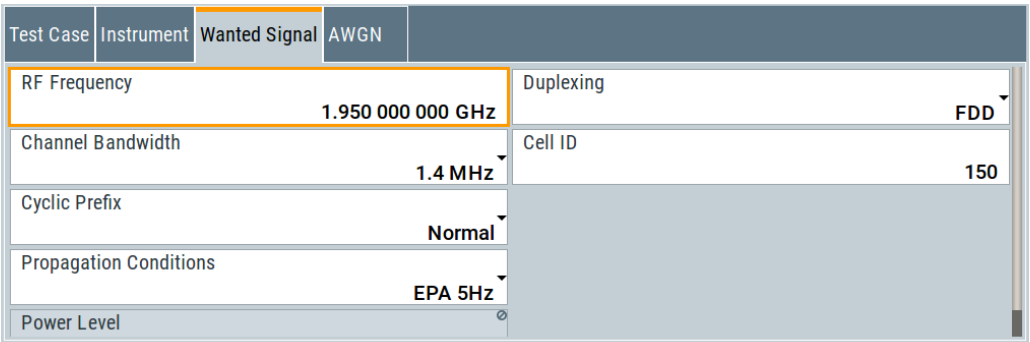
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5	-1.9	-3.3	-4.2	-4.8	-4.7	-4.5
		EVA 5	-3.9	-4.5	-4.5	-4.4	-4.5	-4.5
		EVA 70	-4.3	-4.6	-4.6	-4.5	-4.6	-4.5
		ETU 300	-4.4	-4.5	-4.3	-4.4	-4.6	-4.6
	Extended	ETU 70	-3.6	-3.7	-3.5	-3.7	-3.6	-3.7
4	Normal	EPA 5	-7.3	-7.8	-8.1	-8.3	-8.3	-8.4
		EVA 5	-8.2	-8.5	-8.5	-8.2	-8.3	-8.3
		EVA 70	-8.3	-8.4	-8.4	-8.2	-8.4	-8.2

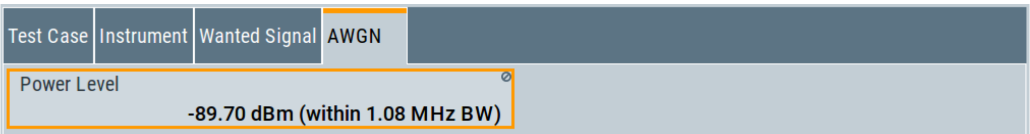
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
		ETU 300	-8.1	-8.3	-8.1	-8.1	-8.3	-8.2
	Extended	ETU 70	-7.3	-7.5	-7.3	-7.5	-7.4	-7.4











The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

8.9.13 Test case 8.3.2: CQI performance requirements for PUCCH format 2

Renamed Test Case

In TS 36.141 versions prior to version 8.9.0 this test case was called "CQI missed detection for PUCCH format 2".

Test Purpose

The test verifies the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

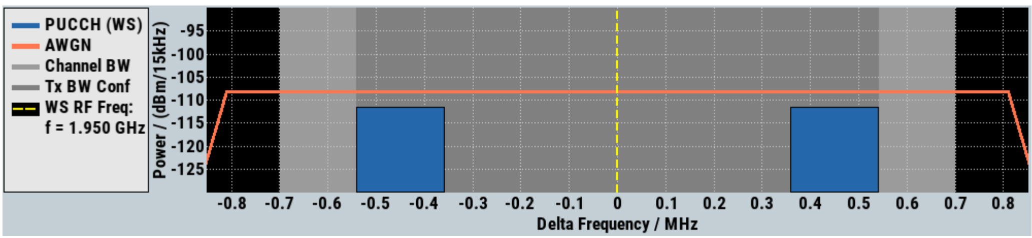
See Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

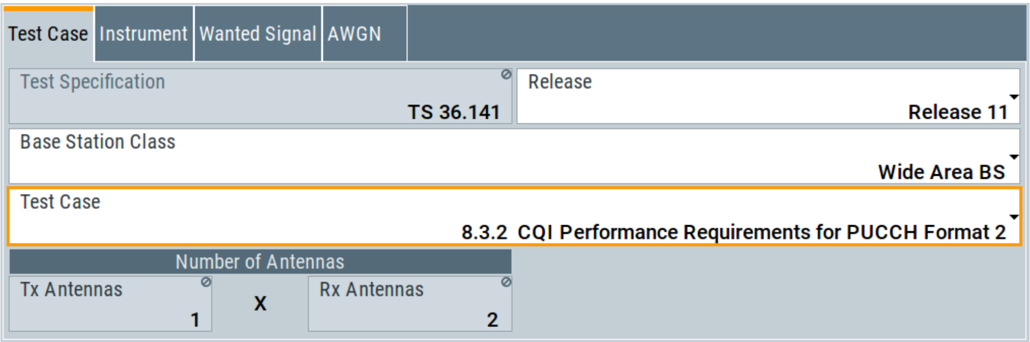
Short Description

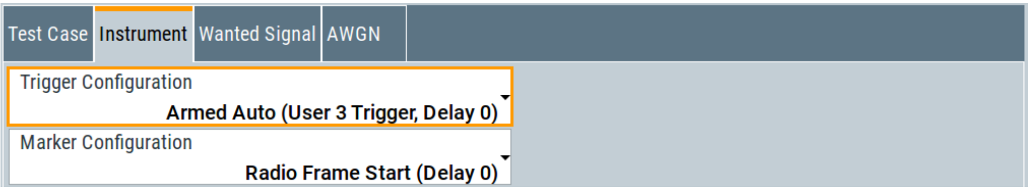
The performance requirement of PUCCH for CQI is determined by the BLER probability of detection of CQI. The performance is measured by the required SNR at BLER equal to 1%.

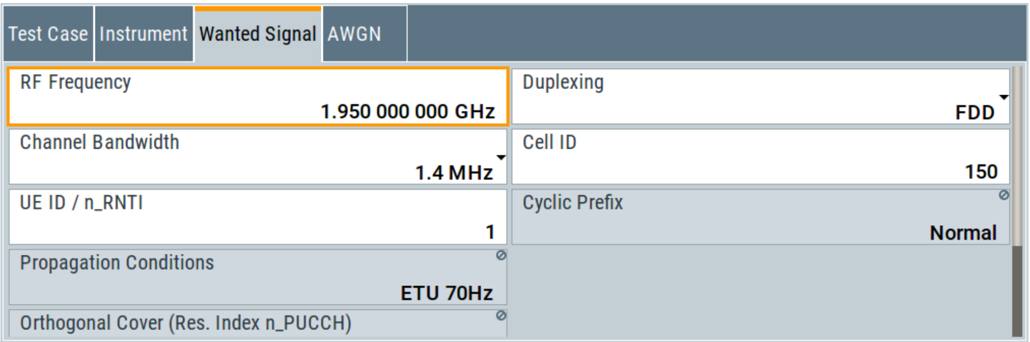
Table 8-29: Required SNR for PUCCH format 2 demodulation tests

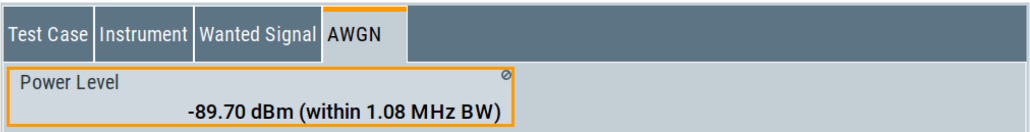
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	ETU70	-3.3	-3.8	-3.6	-3.8	-3.8	-3.8











The general and instrument related settings are described in Test case settings and Instrument settings

The settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

8.9.14 Test case 8.3.3: ACK missed detection for multi-user PUCCH format 1a

Test Purpose

The test verifies the receiver's ability to detect ACK on the wanted signal at presence of three interfering signals under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup requires a two-path instrument, synchronized via a reference frequency (see Figure 8-14). The base station provides its frame trigger signal to the signal generators.

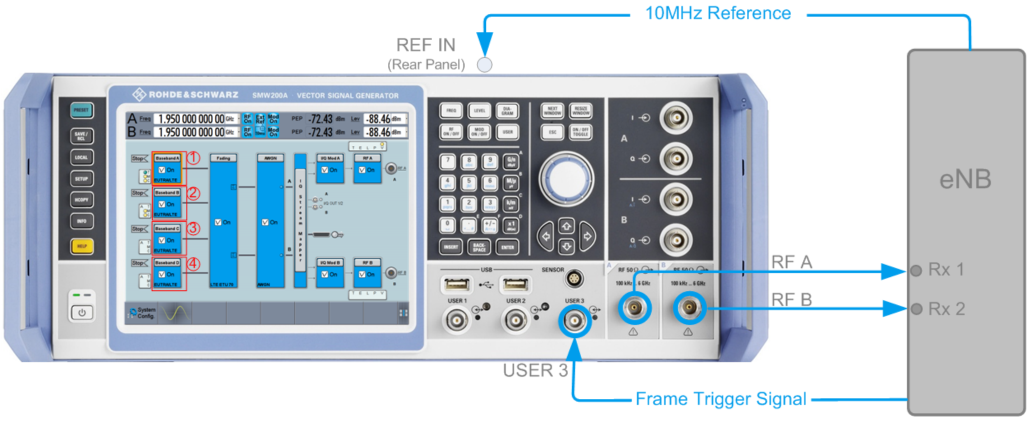


Figure 8-14: Test Setup for test case 8.3.3 "ACK missed detection for multi-user PUCCH format 1a"

1 = Baseband A generates the wanted UE signal
2 = Baseband B generates the interferer 1 signal
3 = Baseband C generates the interferer 2 signal
4 = Baseband D generates the interferer 3 signal

Short Description

The performance is measured on the wanted signal by the required SNR at probability of detection equal to or greater than 0.99. The probability of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

Multi-user PUCCH test is performed only for 2 Rx antennas, Normal CP and for ETU70 propagation conditions (see Table 8-30). ACK/NAK repetitions are disabled for PUCCH transmission.

Table 8-30: Required SNR for multi-user PUCCH demodulation tests

Number of RX antennas	Cyclic Prefix	Propagation Conditions	Chan. BW 1.4MHz	Chan. BW 3MHz	Chan. BW 5MHz	Chan. BW 10MHz	Chan. BW 15MHz	Chan. BW 20MHz
2	Normal	ETU70	-3.5	-3.8	-3.8	-4.0	-4.0	-3.8

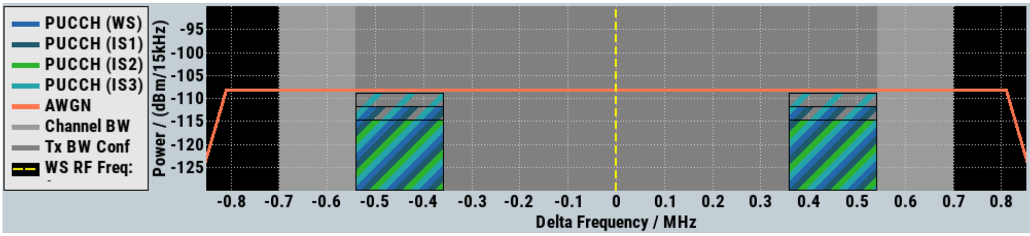
In multi-user PUCCH test, four signals are configured: one wanted signal and three interferers, which are transmitted via separate fading paths using relative power settings as defined in Table 8-31.

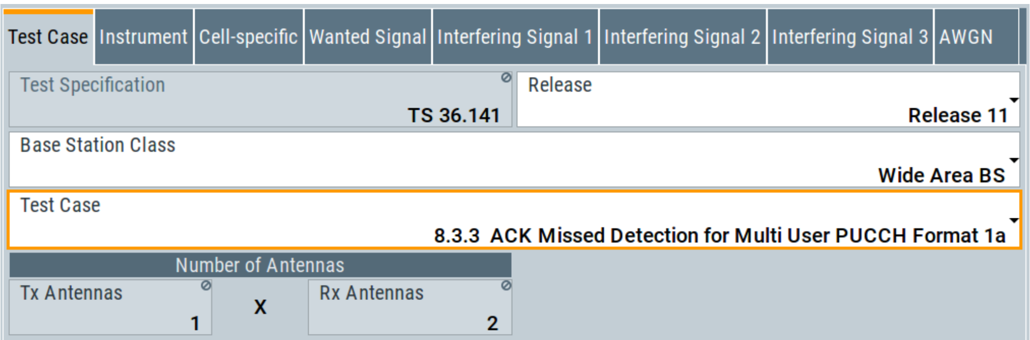
Table 8-31: Test parameters for multi-user PUCCH case

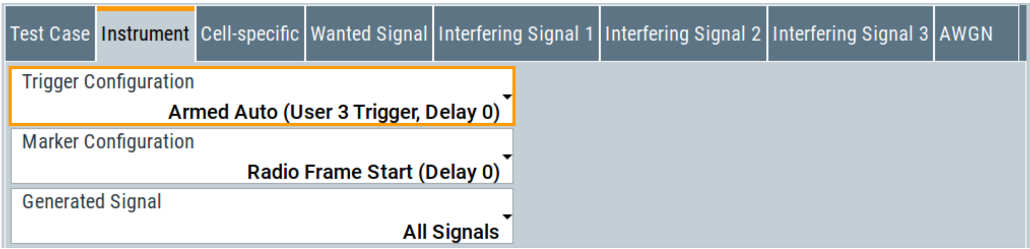
	Cyclic shift index (δ =0)	Orthogonal cover index	RS orthogonal cover / ACK/NACK orthogonal cover	Relative power, dB	Relative timing, ns
Tested signal	4	0	2	-	-
Interferer 1	2	0	1	0	0
Interferer 2	3	1	7	-3	0
Interferer 3	4	2	14	3	0

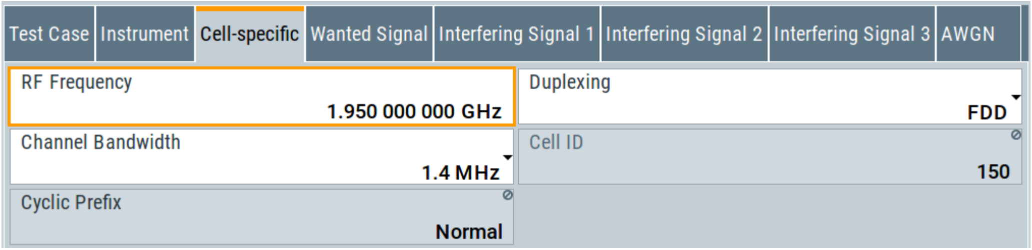
Presented resource index mapping for orthogonal cover and cyclic shift indices are for the first slot of the subframe. All above listed signals are transmitted on the same PUCCH resources, with different PUCCH channel indices as defined in Table 8-31.

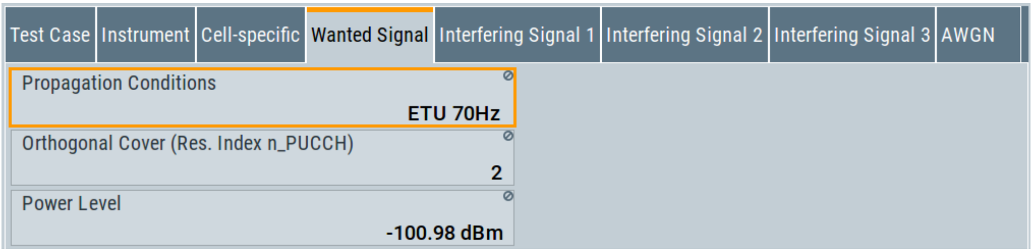
In the multi-user PUCCH test, the Test Case Wizard also sets the "Number of Cyclic Shifts" for the mixed format resource block (N_cs^(1)) to 0 and the cyclic shift increment (Delta_shift^PUCCH) to 2, as specified in TS 36.141.

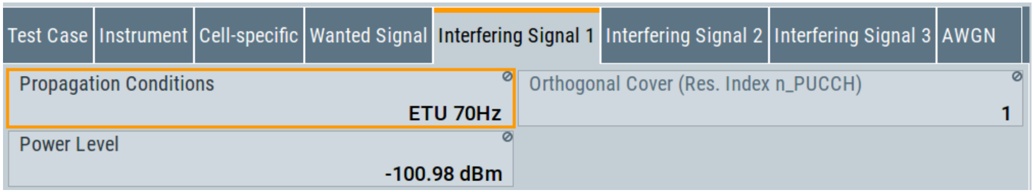


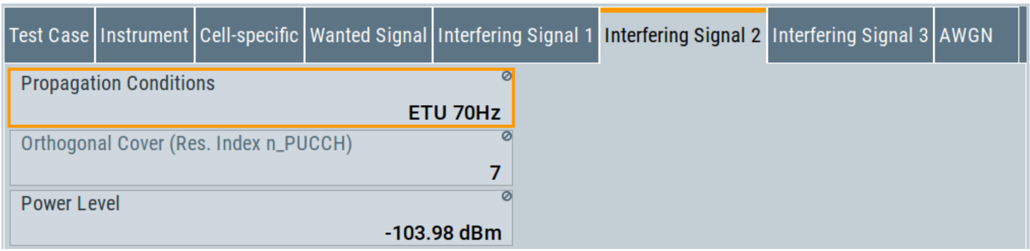


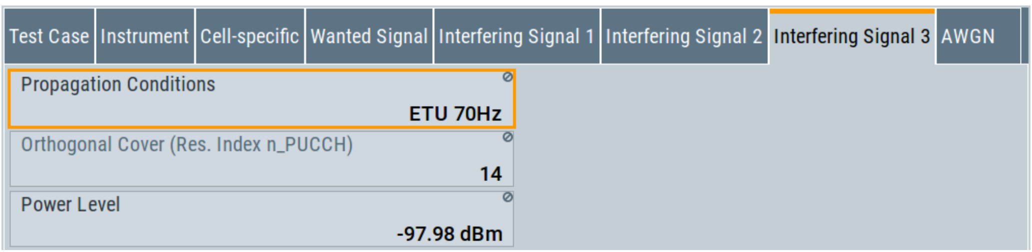

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)
Generated Signal
All Signals

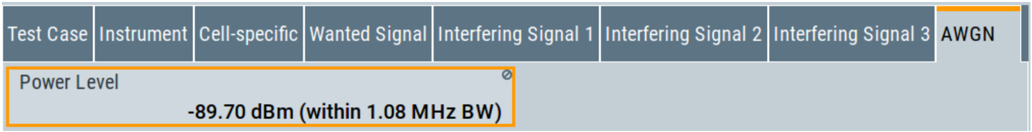

Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
1.4 MHz
Cell ID
150
Cyclic Prefix
Normal


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Propagation Conditions
ETU 70Hz
Orthogonal Cover (Res. Index n_PUCCH)
2
Power Level
-100.98 dBm


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Propagation Conditions
ETU 70Hz
Orthogonal Cover (Res. Index n_PUCCH)
1
Power Level
-100.98 dBm


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Propagation Conditions
ETU 70Hz
Orthogonal Cover (Res. Index n_PUCCH)
7
Power Level
-103.98 dBm


Test Case
Instrument
Cell-specific
Wanted Signal
Interfering Signal 1
Interfering Signal 2
Interfering Signal 3
AWGN
Propagation Conditions
ETU 70Hz
Orthogonal Cover (Res. Index n_PUCCH)
14
Power Level
-97.98 dBm



The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

In the instrument, the power level of the interferer 3 is used as a reference, i.e. the power level of the wanted signal and the interferer 1 is 3 dB lower and the power level of the interferer 2 is 6 dB lower than the reference.

Generated Signal
Determines which signals are generated by the instrument. The R&S SMW can generate all required signals out of one box.

In test setup with two instruments, the first R&S SMW should generate the "Wanted Signal, Interferer 1 and AWGN" signal and the second R&S SMW, the signal of "Interferers 2 and 3".

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:GS:GENSignals on page 1078

Propagation Conditions
Displays the propagation conditions of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS:PRCOndition? on page 1095
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PRCOndition? on page 1095
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PRCOndition? on page 1095

Orthogonal Cover (Res. Index n_PUCCH) / Orthogonal Cover (Res. Index n_PUCCH) Port 0/1
Displays the used resource index n_PUCCH.

The value is set automatically according to the RS orthogonal cover in Table 8-31.

In test case 8.3.9, the number of ports is set with the selected Number of Tx Antennas.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover? on page 1093
[:SOURce<hw>]:BB:EUTRa:TCW:IS:ORTCover? on page 1093
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:ORTCover? on page 1093
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:ORTCover? on page 1093
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]? on page 1093

Interferer Type
Displays the type of the interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:IFTYpe? on page 1083

RF Frequency
Displays the center frequency of interfering signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:RFFRequency on page 1084

Power Level
Displays the power level of the interfering signals.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PLEVel? on page 1084
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PLEVel? on page 1084

8.9.15 Test case 8.3.4: ACK missed detection for PUCCH format 1b, channel selection

Test Purpose

The test verifies the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

This test case is applicable to all BS.

The instrument generates a signal with 4 encoded ACK/NACK bits per subframe (AAAA).

Short Description

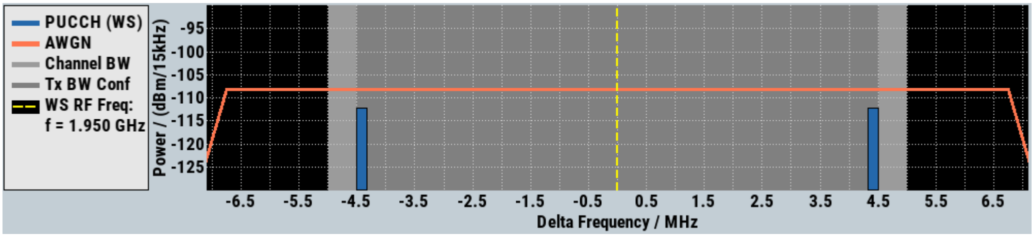
The performance requirement of PUCCH format 1b with Channel Selection for ACK missed detection is determined by:

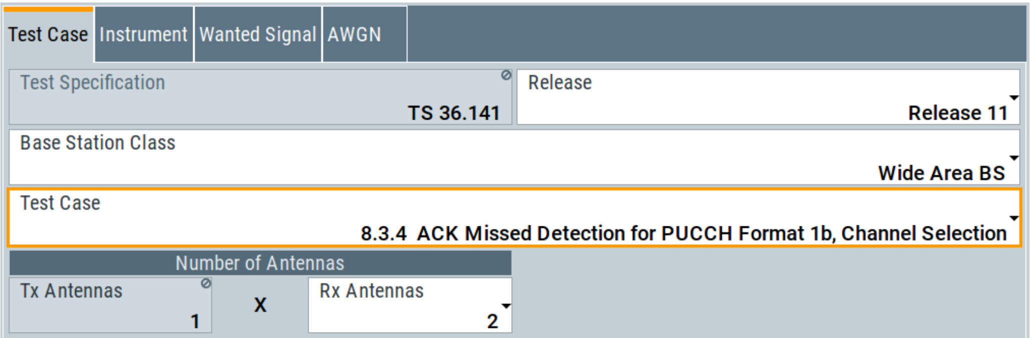
- The probability of false detection of the ACK
- The probability of detection of ACK

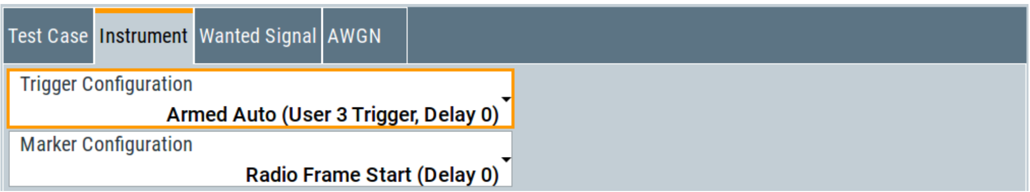
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

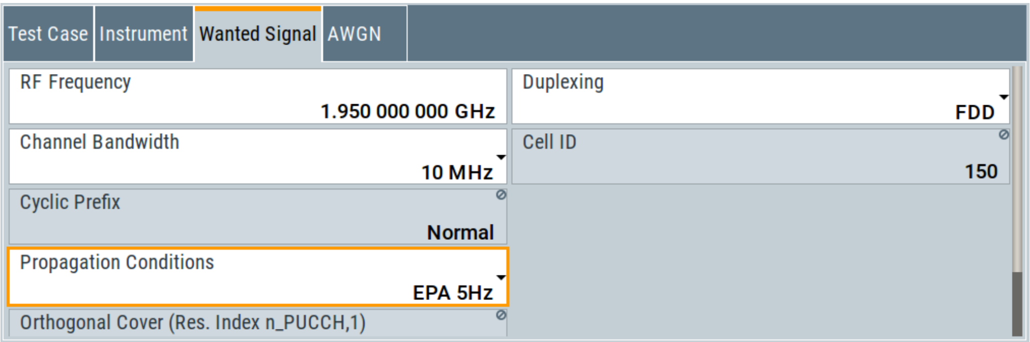
Table 8-32: Required SNR for PUCCH format 1b with channel Selection demodulation tests (Number of Tx antennas = 1)

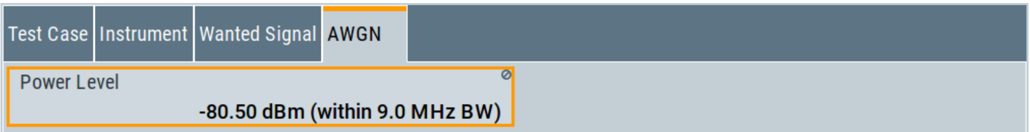
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-3.9	-4.0	-4.0
	Normal	EVA 70 Low	-	-3.7	-3.9	-3.9
4	Normal	EPA 5 Low	-	-7.8	-7.9	-8.0
	Normal	EVA 70 Low	-	-7.7	-7.9	-7.9











The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

8.9.16 Test case 8.3.5: ACK missed detection for PUCCH format 3

Test Purpose

The test verifies the receiver’s ability to detect ACK bits under codeword's from applicable codebook being randomly selected, multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

This test case is applicable to all BS.

The instrument generates the required signal with 4 or 16 encoded ACK/NACK bits (AN bits) per subframe, as defined with the parameter Number of ACK/NACK bits.

ACK/NACK repetition is disabled for PUCCH transmission. Random codewords selection is assumed.

Short Description

The performance requirement of PUCCH format 3 for ACK missed detection is determined by:

- The probability of false detection of the ACK
- The probability of detection of ACK

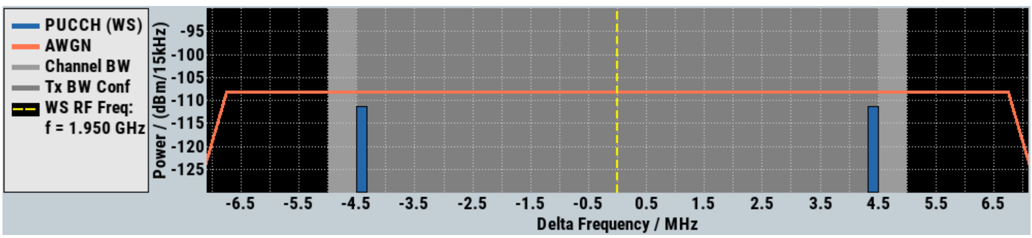
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

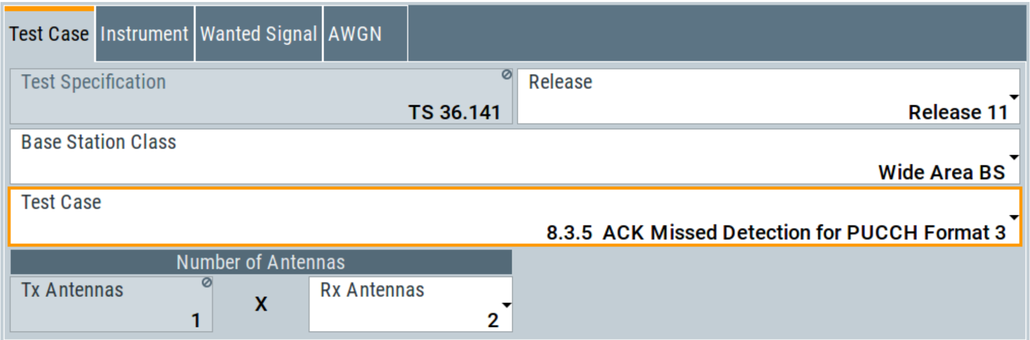
Table 8-33: Required SNR for PUCCH format 3 demodulation tests, 4AN bits (Number of Tx antennas = 1)

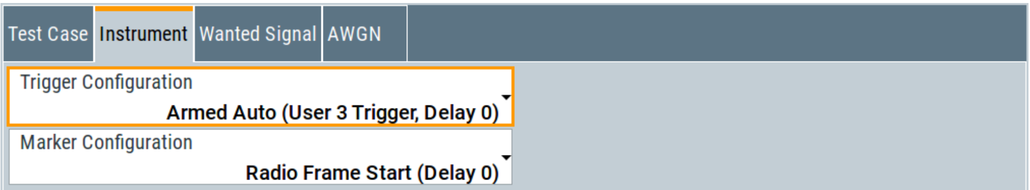
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	-3.1	-3.2	-3.2
	Normal	EVA 70 Low	-	-2.9	-3.0	-3.1
4	Normal	EPA 5 Low	-	-6.7	-6.8	-6.9
	Normal	EVA 70 Low	-	-6.6	-6.7	-6.7

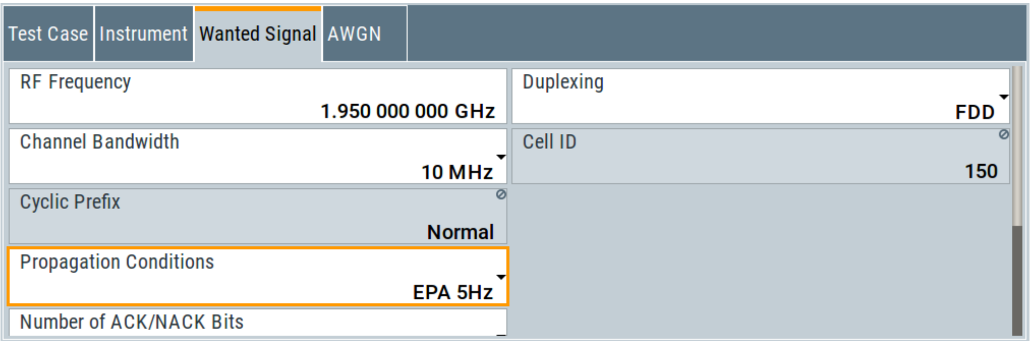
Table 8-34: Required SNR for PUCCH format 3 demodulation tests, 16AN bits (Number of Tx antennas = 1)

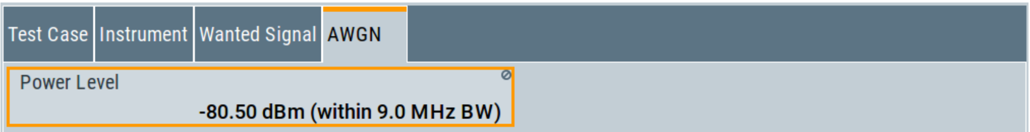
Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW= 1.4MHz BW= 3MHz BW= 5MHz	BW= 10MHz	BW= 15MHz	BW= 20MHz
2	Normal	EPA 5 Low	-	-0.7	-0.6	-0.6
	Normal	EVA 70 Low	-	-0.2	-0.3	-0.3
4	Normal	EPA 5 Low	-	-4.7	-4.7	-4.8
	Normal	EVA 70 Low	-	-4.4	-4.5	-4.5











The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

Number of ACK/NACK bits

Determines the number of encoded AN bits per subframe.

"4" Applicable for TDD and FDD (see Duplexing)

"16" Applicable for TDD

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANBits` on page 1090

ACK/NACK + SR Pattern

Displays the used ACK/NACK + SR pattern, depending on the selected Number of ACK/NACK bits.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANPattern?` on page 1090

8.9.17 Test case 8.3.6: NACK to ACK detection for PUCCH format 3

Test Purpose

The test verifies the receiver's ability not to falsely detect NACK bits, transmitted in codeword randomly selected from applicable codebook, as ACK bits under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

This test case is applicable to all BS.

The instrument generates the required signal with 16 encoded ACK/NACK bits (AN bits) per subframe.

ACK/NACK repetition is disabled for PUCCH transmission. Random codewords selection is assumed.

Short Description

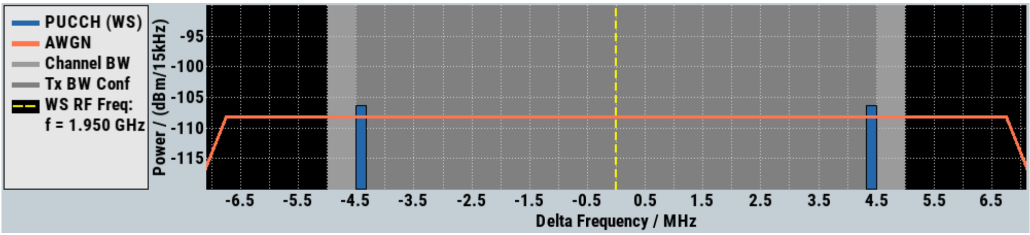
The performance requirement of PUCCH format 3 for NACK to ACK detection is determined by:

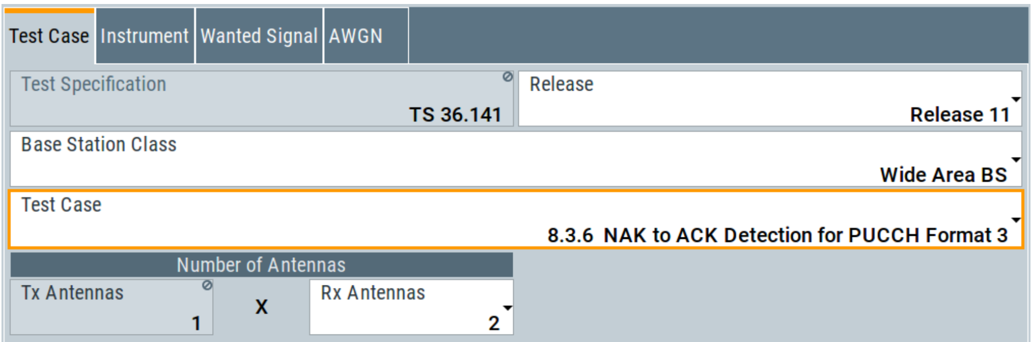
- The probability of false detection of the ACK
- The probability of detection of ACK

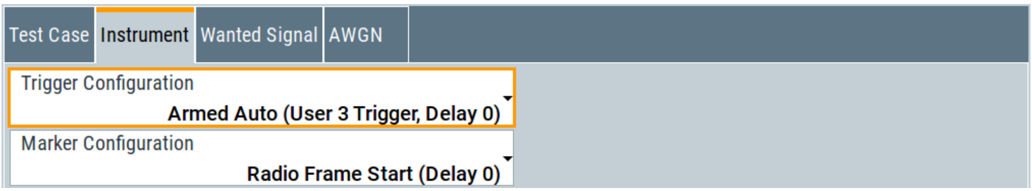
The performance is measured on the wanted signal by the required SNR at probability of detection equal to 0.99. The fraction of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

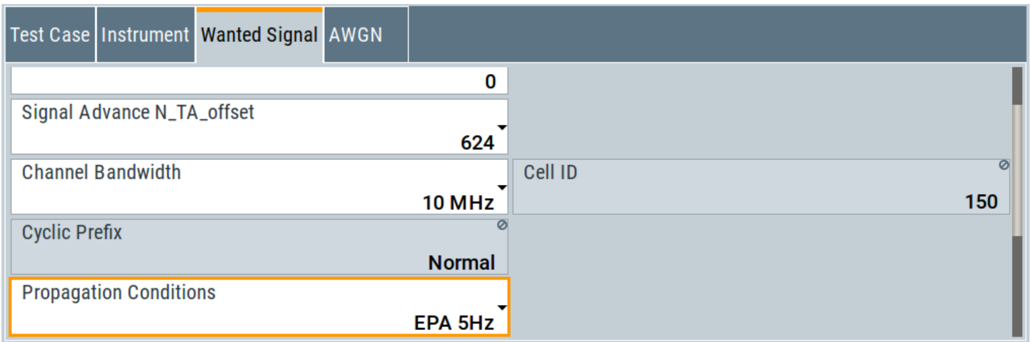
Table 8-35: Required SNR for PUCCH format 3 demodulation tests, 16AN bits (Number of Tx antennas = 1)

Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz BW=3MHz BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
2	Normal	EPA 5 Low	-	2.0	2.2	-2.1
	Normal	EVA 70 Low	-	2.7	2.5	-2.5
4	Normal	EPA 5 Low	-	-2.5	-2.7	-2.9
	Normal	EVA 70 Low	-	-2.3	-2.5	-2.6









The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

8.9.18 Test case 8.3.7: ACK missed detection for PUCCH format 1a transmission on two antenna ports

Test Purpose

The test verifies the receiver's ability to detect ACK on the wanted signal at presence of three interfering signals under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup requires a two-path instrument, synchronized via a reference frequency (see Figure 8-14). The base station provides its frame trigger signal to the signal generators.

Short Description

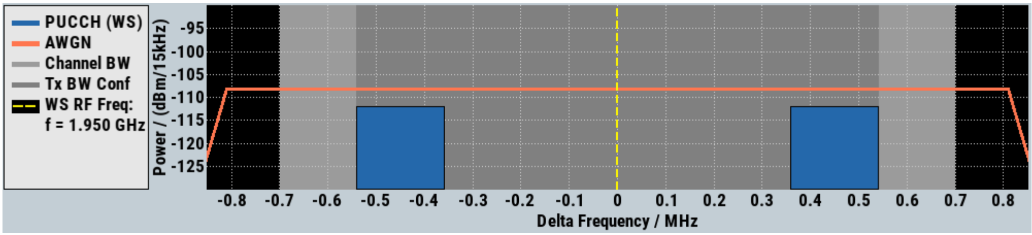
The performance is measured on the wanted signal by the required SNR at probability of detection equal to or greater than 0.99. The probability of false detection of the ACK shall be 0.01 or less. The statistics are kept by the base station under test.

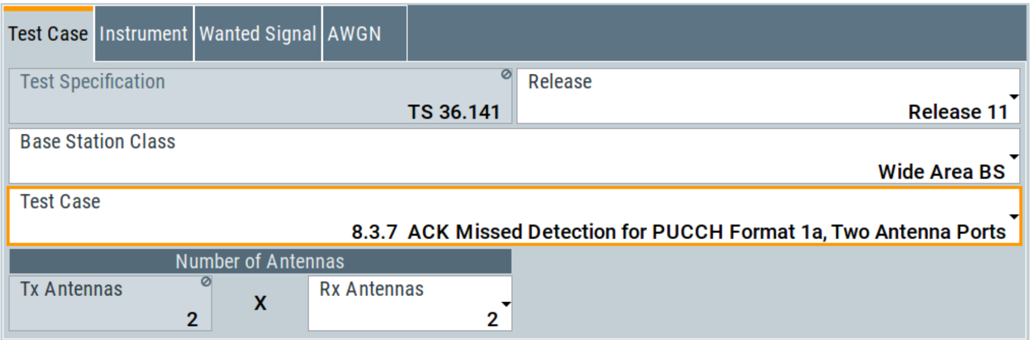
Multi-user PUCCH test is performed for 2 and 4 Rx antennas and Normal CP (see Table 8-30). ACK/NAK repetitions are disabled for PUCCH transmission.

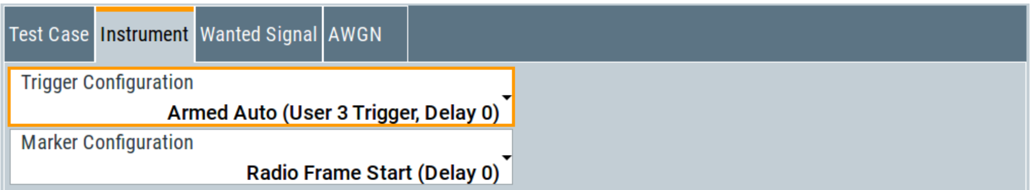
Table 8-36: Required SNR for multi-user PUCCH demodulation tests

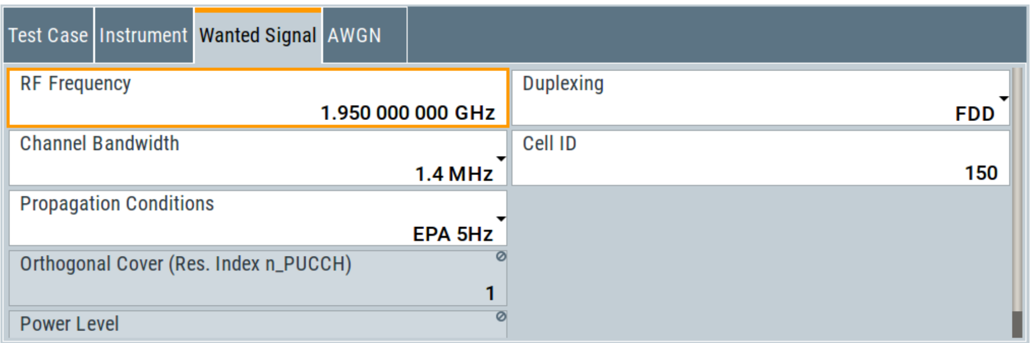
Number of RX antennas	Cyclic Prefix	Propagation Conditions	Chan. BW 1.4MHz	Chan. BW 3MHz	Chan. BW 5MHz	Chan. BW 10MHz	Chan. BW 15MHz	Chan. BW 20MHz
2	Normal	EPA 5	-3.8	-4.1	-5.6	-5.7	-5.7	-5.9
		ETU70	-5.0	-5.1	-5.6	-5.1	-5.6	-5.6

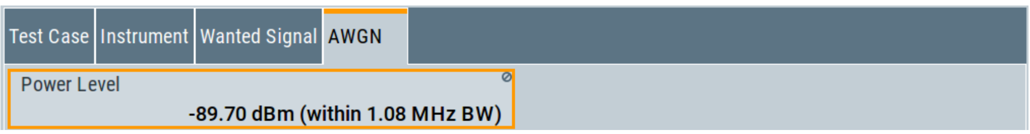
Number of RX antennas	Cyclic Prefix	Propagation Conditions	Chan. BW 1.4MHz	Chan. BW 3MHz	Chan. BW 5MHz	Chan. BW 10MHz	Chan. BW 15MHz	Chan. BW 20MHz
4	Normal	EPA 5	-7.7	-7.7	-8.5	-8.7	-8.7	-8.7
		ETU70	-8.2	-8.4	-8.5	-8.5	-8.6	-8.7











8.9.19 Test case 8.3.8: CQI performance requirements for PUCCH format 2 transmission on two antenna ports

Test Purpose

The test verifies the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

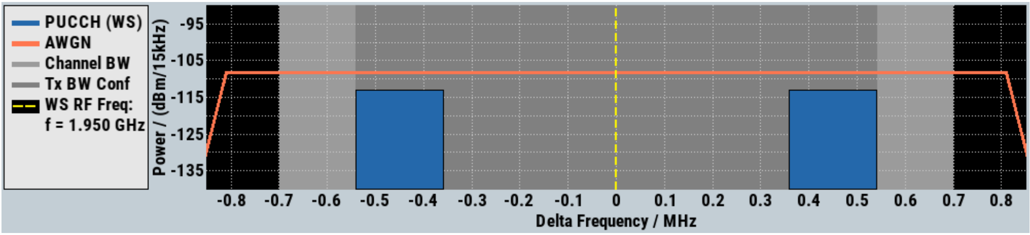
See Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

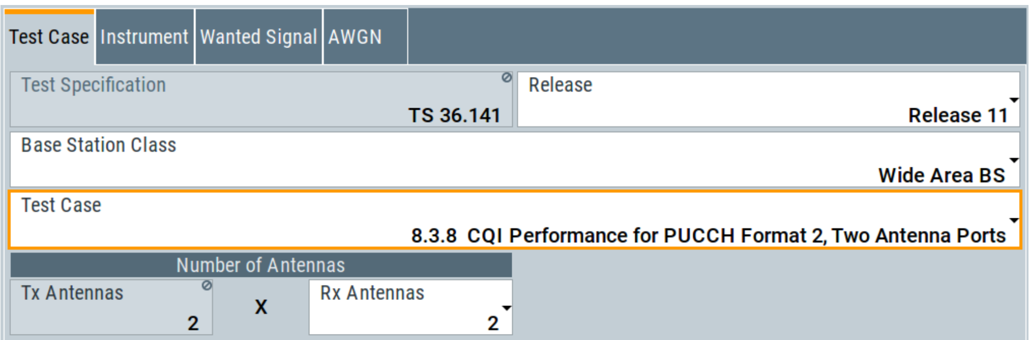
Short Description

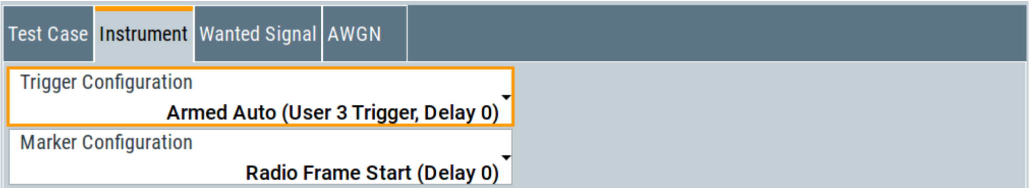
The performance requirement of PUCCH format 2 for CQI is determined by the block error probability (BLER) of CQI. The performance is measured by the required SNR at BLER equal to 1%.

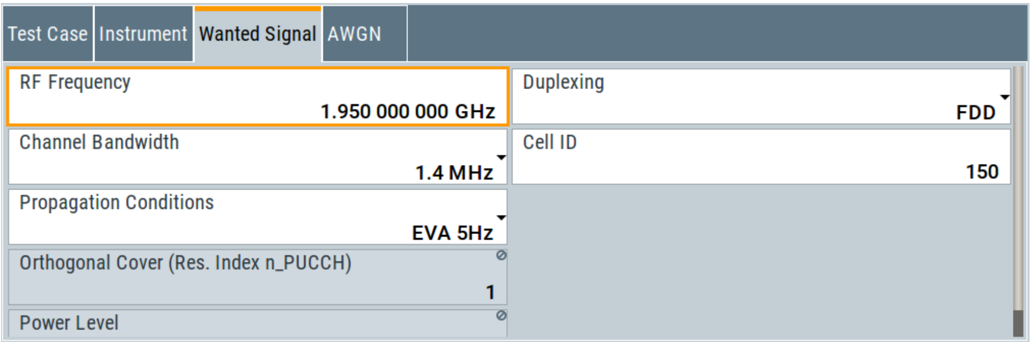
Table 8-37: Required SNR for PUCCH format 2 demodulation tests

Number of TX antennas	Number of RX antennas	Cyclic Prefix	Propagation Conditions	BW=1.4MHz	BW=3 MHz	BW=5 MHz	BW=10 MHz	BW=15 MHz	BW=20 MHz
2	2	Normal	EVA 5 Low	-4.9	-4.8	-5.1	-5.0	-5.1	-5.1









8.9.20 Test case 8.3.9: CQI performance for PUCCH format 2 with DTX detection

Test Purpose

The test verifies the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

This test case is optional and applicable to a BS supporting PUCCH format 2 with DTX.

Short Description

The performance requirement of PUCCH format 2 for CQI detection is determined by the block error probability (BLER) of CQI.

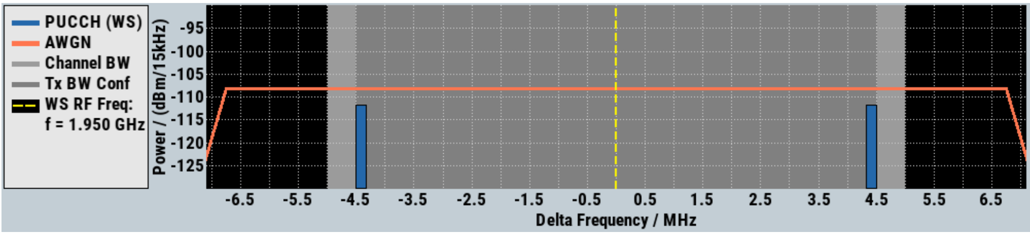
The performance is measured on the wanted signal by the required SNR at BLER of 1%.

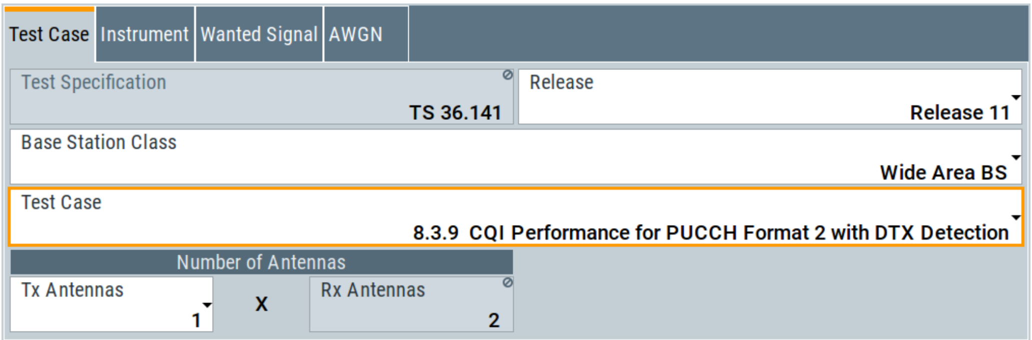
Table 8-38: Required SNR for PUCCH format 2 demodulation tests with DTX detection (Number of Rx antennas = 2)

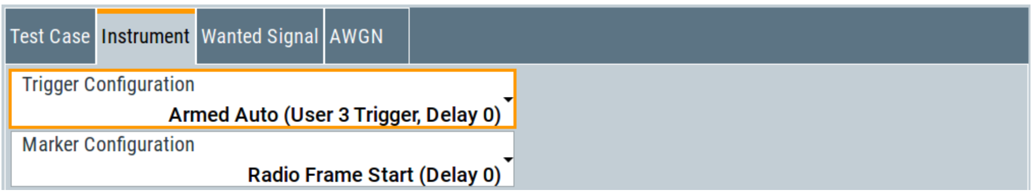
Number of TX antennas	Cyclic Prefix	Propaga-tion Con-ditions	BW=1.4 MHz	BW=3MHz	BW=5MHz	BW=10MHz	BW=15MHz	BW=20MHz
1	Normal	EVA 5* Low	-3.1	-3.4	-3.8	-3.4	-3.6	-3.6
		ETU 70** Low	-3.1	-3.4	-3.2	-3.5	-3.3	-3.5
2		EVA 5 Low	-4.5	-4.4	-4.7	-4.6	-4.5	-4.7

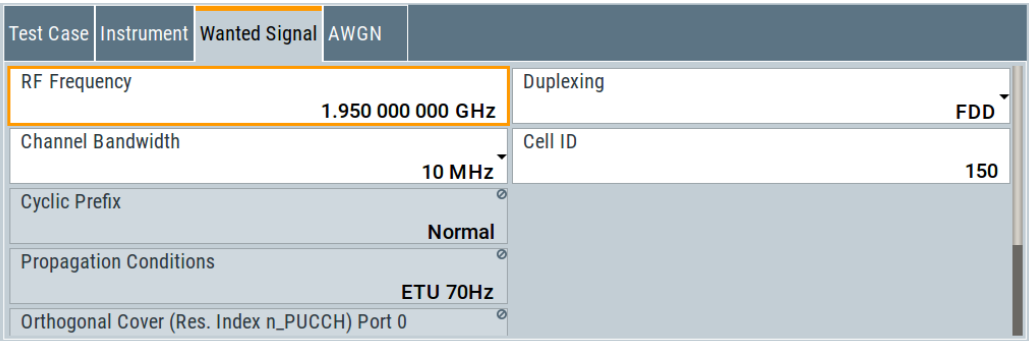
*) Not applicable for Wide Area BS and Medium Range BS

**) Not applicable for Local Area BS and Home BS









The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

Orthogonal Cover (Res. Index n_PUCCH) Port 0/1

Displays the used resource index n_PUCCH for port 0 and port 1 respectively.

The number of ports is set with the selected Number of Tx Antennas.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]? on page 1093

CQI Pattern Port 0/1 (bin)

Sets the CQI pattern per enabled port.

The number of ports is set with the selected Number of Tx Antennas.

Remote command:

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CQIPattern:PORT<ch0> on page 1091

8.9.21 Test case 8.3.10: ACK missed detection for PUCCH format 1a for coverage enhancements

Test Purpose

The test verifies the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR (TS 36.141 ACK missed detection for PUCCH format 1a transmission on single antenna port for coverage enhancement).

Required Options

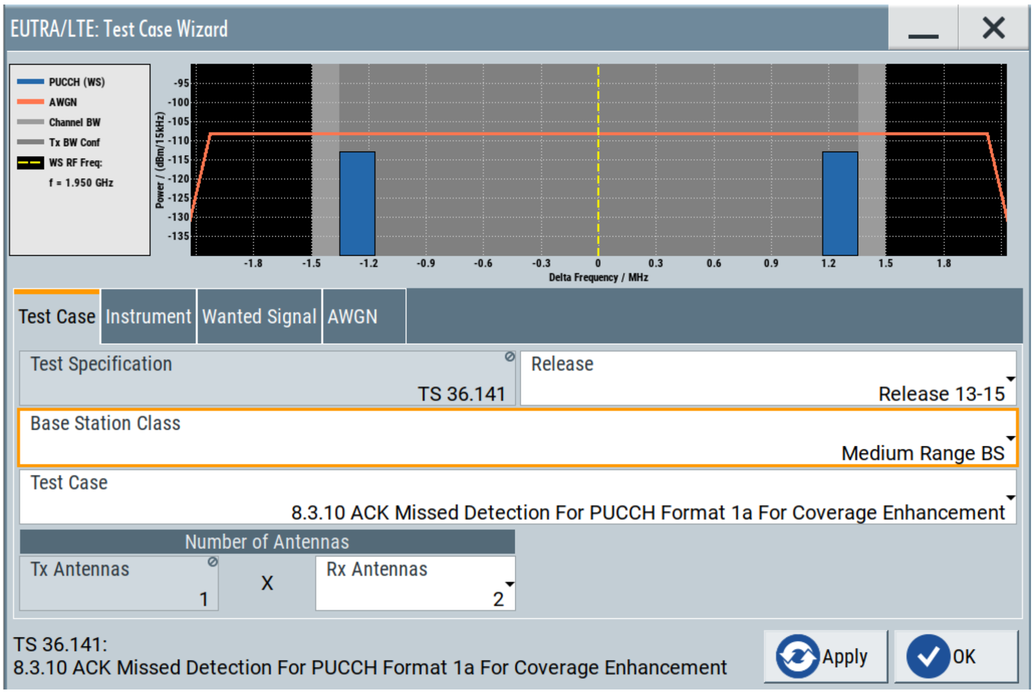
See Chapter 8.9.1, "Required options", on page 587.

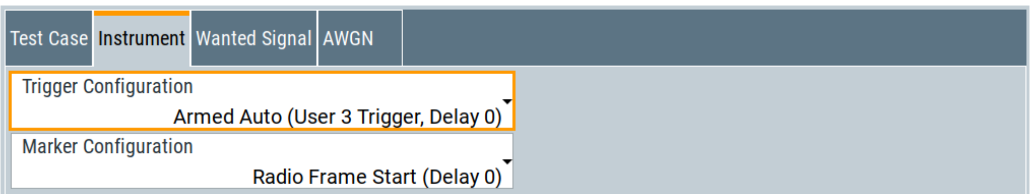
Test Setup

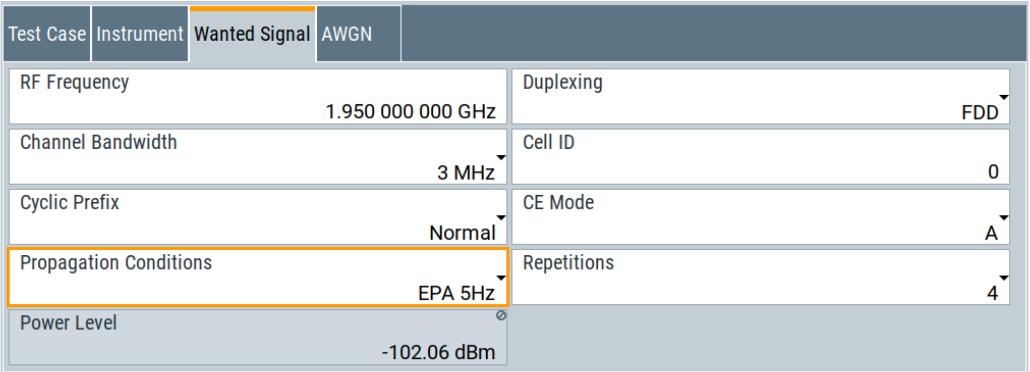
See Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

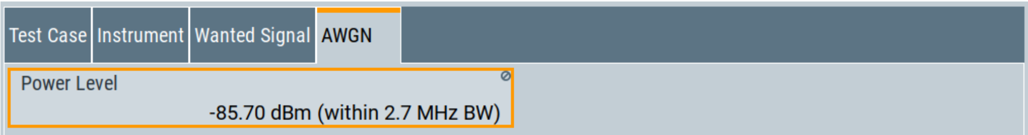
Short Description

The performance requirement of PUCCH for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK must be 0.01 or less.









8.9.22 Test case 8.3.11: CQI performance for PUCCH format 2 for coverage enhancements

Test Purpose

The test verifies the receiver's ability to detect CQI under multipath fading propagation conditions for a given SNR (TS 36.141 CQI performance requirements for PUCCH format 2 transmission on single antenna port for coverage enhancement).

Required Options

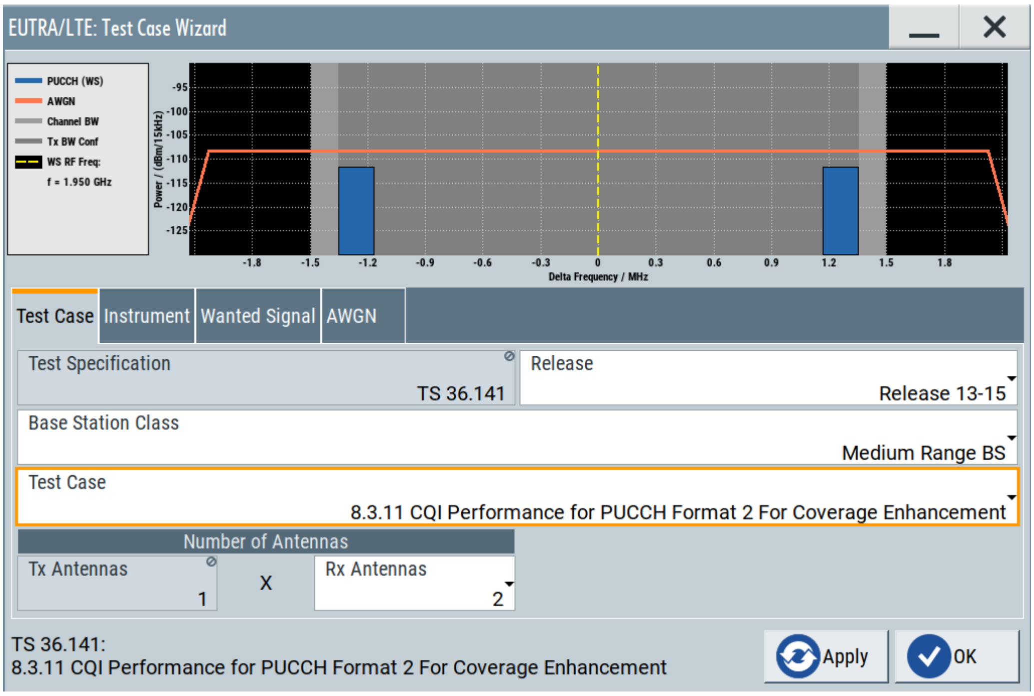
See Chapter 8.9.1, "Required options", on page 587.

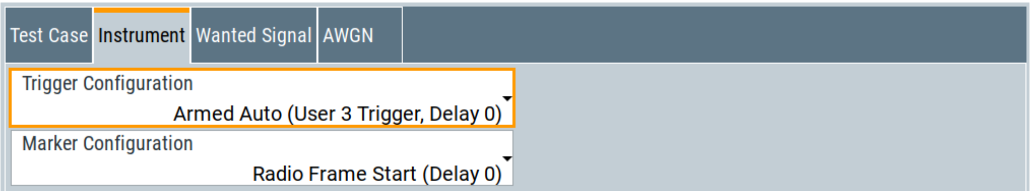
Test Setup

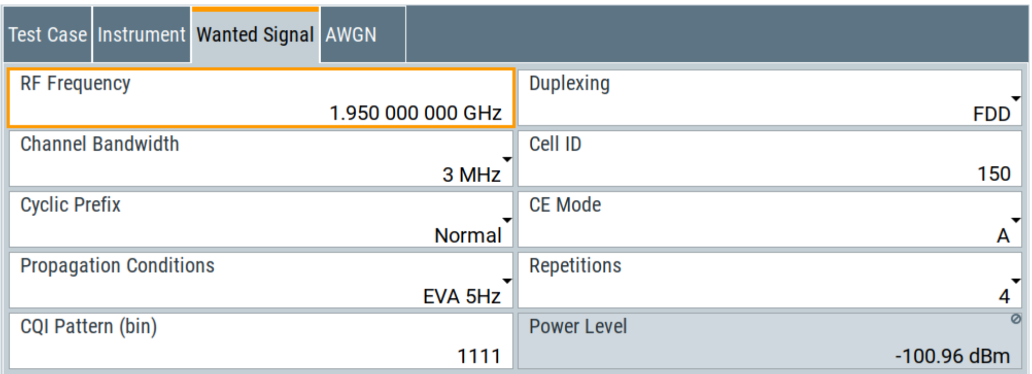
See Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

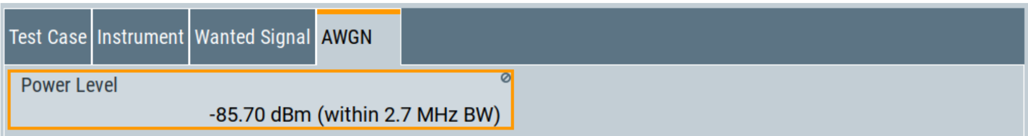
Short Description

The performance requirement of PUCCH format 2 for CQI is determined by the block error probability (BLER) of CQI. The performance is measured by the required SNR at BLER of 1%.


EUTRA/LTE: Test Case Wizard
PUCCH (WS)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
f = 1.950 GHz
Power / (dBm/15kHz)
Delta Frequency / MHz
Test Case
Instrument
Wanted Signal
AWGN
Test Specification
TS 36.141
Release
Release 13-15
Base Station Class
Medium Range BS
Test Case
8.3.11 CQI Performance for PUCCH Format 2 For Coverage Enhancement
Number of Antennas
Tx Antennas
1
X
Rx Antennas
2
TS 36.141:
8.3.11 CQI Performance for PUCCH Format 2 For Coverage Enhancement
Apply
OK


Test Case
Instrument
Wanted Signal
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)


Test Case
Instrument
Wanted Signal
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
3 MHz
Cell ID
150
Cyclic Prefix
Normal
CE Mode
A
Propagation Conditions
EVA 5Hz
Repetitions
4
CQI Pattern (bin)
1111
Power Level
-100.96 dBm


Test Case
Instrument
Wanted Signal
AWGN
Power Level
-85.70 dBm (within 2.7 MHz BW)

8.9.23 Test case 8.3.12: ACK missed detection for PUCCH format 4

Test Purpose

The test verifies the receiver's ability to detect ACK bits in codeword's from applicable codebook being randomly selected, under multipath fading propagation conditions for a given SNR (TS 36.141 ACK missed detection for PUCCH format 4).

Required Options

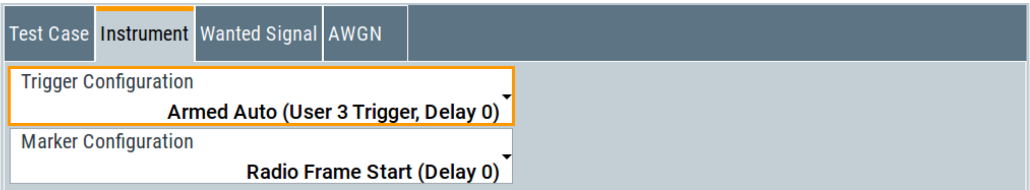
See Chapter 8.9.1, "Required options", on page 587.

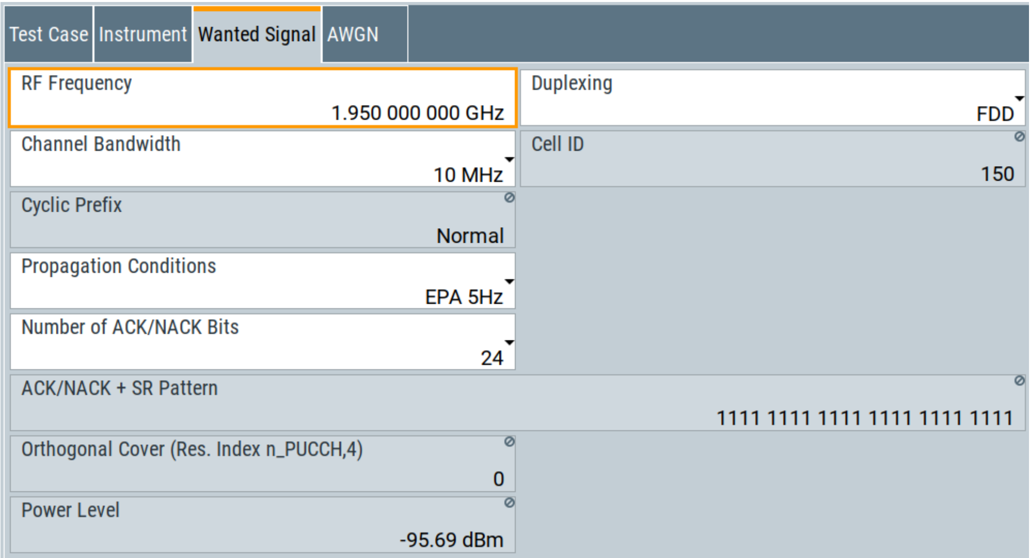
Test Setup

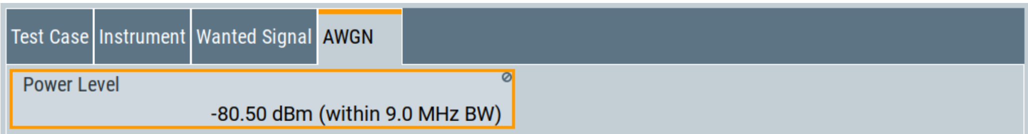
The test setup requires a two-path instrument, synchronized via a reference frequency (see Figure 8-14). The base station provides its frame trigger signal to the signal generators.

Short Description

The performance requirement of PUCCH format 4 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK must be 0.01 or less.







8.9.24 Test case 8.3.13: ACK missed detection for PUCCH format 5

Test Purpose

The test verifies the receiver's ability to detect ACK bits in codeword's from applicable codebook being randomly selected, under multipath fading propagation conditions for a given SNR (TS 36.141 ACK missed detection for PUCCH format 5).

Required Options

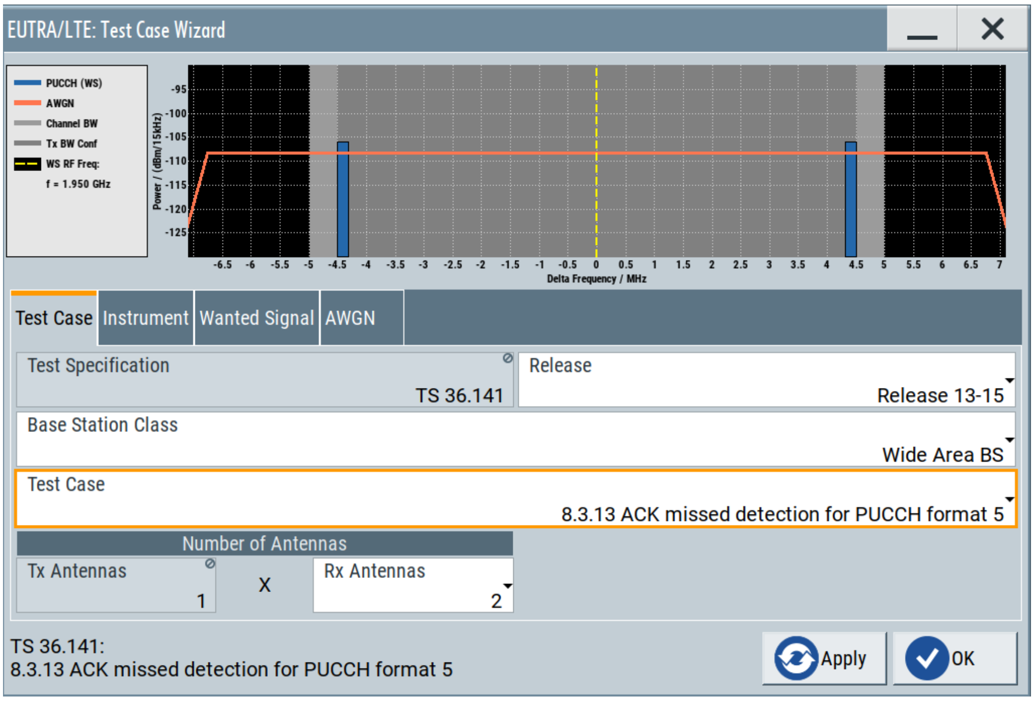
See Chapter 8.9.1, "Required options", on page 587.

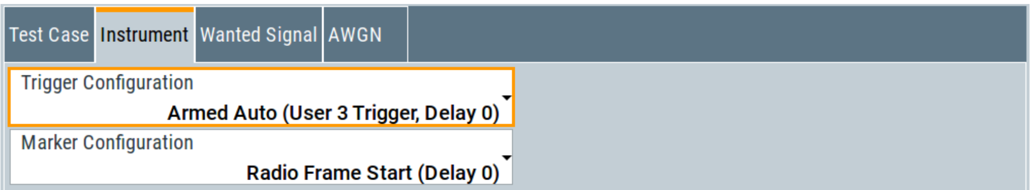
Test Setup

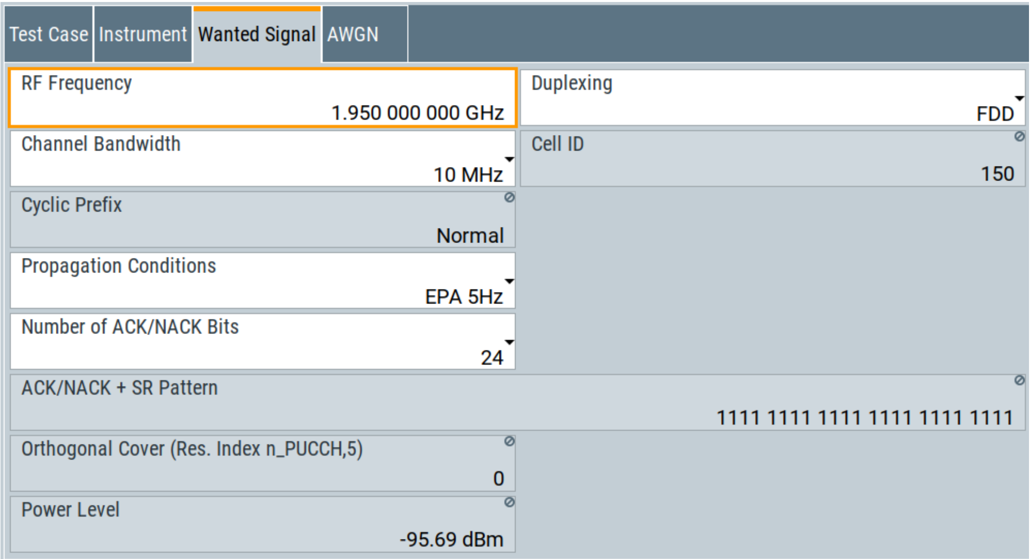
The test setup requires a two-path instrument, synchronized via a reference frequency (see Figure 8-14). The base station provides its frame trigger signal to the signal generators.

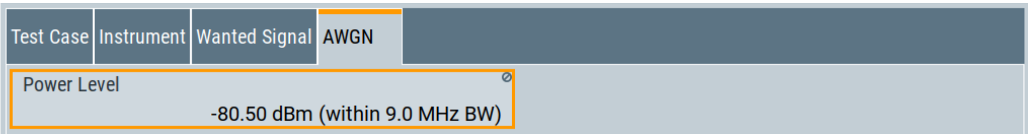
Short Description

The performance requirement of PUCCH format 5 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK must be 0.01 or less.









8.9.25 Test case 8.4.1: PRACH false alarm probability and missed detection

Test Purpose

The test verifies the receiver's ability to detect PRACH preamble under multipath fading propagation conditions for a given SNR (TS 36.141)

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538 (HARQ feedback line is not required).

The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

Short Description

The performance is measured by the total probability of false detection of the preamble (Pfa) and the probability of detection of preamble (Pd). For the SNRs defined in Table 8-39 and Table 8-40, the Pd shall be 99% or greater, Pfa shall be 0.1% or less.

The statistics are kept by the base station under test. Ten preambles have to be transmitted.

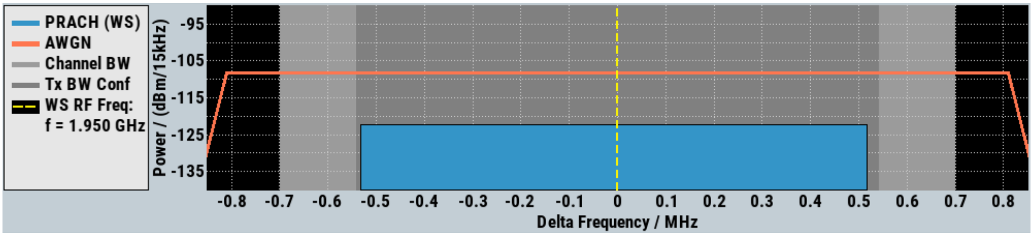
The normal mode test is applicable to all BS. The high-speed mode test is applicable to high-speed BS.

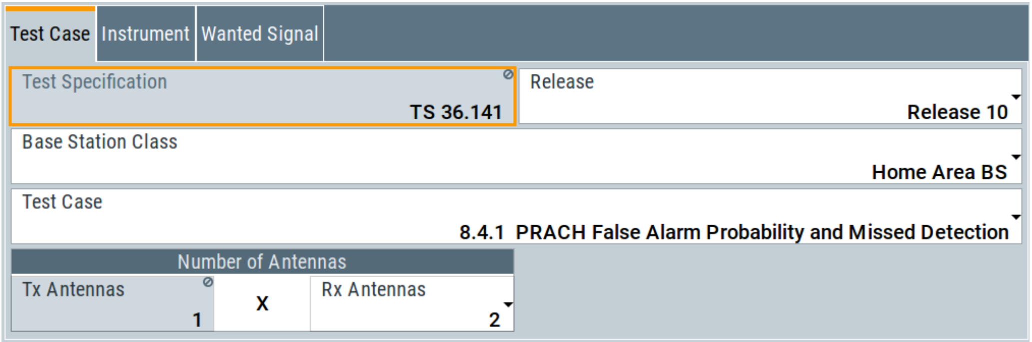
Table 8-39: PRACH missed detection test requirements for Normal Mode; the SNR [dB] is given per burst format

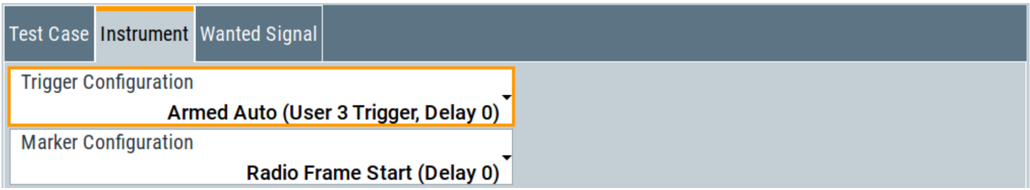
Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3	Burst format 4
2	AWGN	0	-13.9	-13.9	-16.1	-16.2	-6.9
	ETU 70	270	-7.4	-7.2	-9.4	-9.5	0.5
4	AWGN	0	-16.6	-16.4	-18.7	-18.5	-9.5
	ETU 70	270	-11.5	-11.1	-13.5	-13.3	-4.5

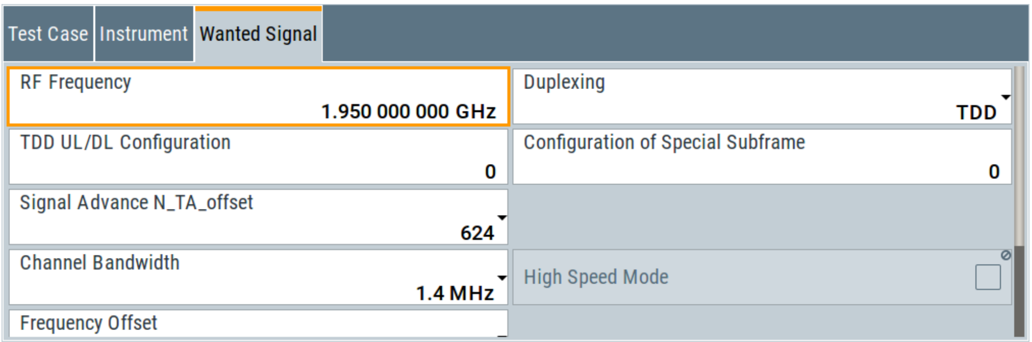
Table 8-40: PRACH missed detection test requirements for High-speed Mode; the SNR [dB] is given per burst format

Number of RX antennas	Propagation conditions	Frequency offset, Hz	Burst format 0	Burst format 1	Burst format 2	Burst format 3
2	AWGN	0	-13.8	-13.9	-16.0	-16.3
	ETU 70	270	-6.8	-6.7	-8.7	-8.9
	AWGN	625	-12.1	-12.0	-14.1	-14.1
	AWGN	1340	-13.1	-13.2	-15.2	-15.4
4	AWGN	0	-16.6	-16.3	-18.6	-18.5
	ETU 70	270	-11.2	-10.8	-13.1	-13.1
	AWGN	625	-14.6	-14.3	-16.5	-16.5
	AWGN	1340	-15.6	-15.2	-17.5	-17.5









The general and instrument related settings are described in Test case settings and Instrument settings

The common settings of the wanted signal are described in Chapter 8.6.4, "Wanted signal and cell-specific settings", on page 548.

For description of the propagation conditions settings and the AWGN configuration, refer to "Propagation Conditions" on page 592 and "AWGN Configuration" on page 592.

For detailed description of all available PRACH settings and the cross-reference between them, refer to Chapter 4.8.10, "PRACH configuration", on page 320.

Mode

Determines the measurements type, Pfa or Pd, the signal is generated for.

In "Detection Rate (Pd)" and "Alternating Pd and Pfa" mode, the generated sequence is repeated cyclically. The first preamble is offset with start offset determined by Timing Offset Base Value. From preamble to preamble, the timing offset ("Delta t") of the preambles increases by 0.1 us.

"False Detection Rate (Pfa)"	The generated signal is a noise like AWGN signal. This mode is intended for measurement of the total probability of false detection of the preamble (Pfa).
"Detection Rate (Pd)"	The generated signal is a sequence of 10 preamble and noise. The duration of one single sequence is 5 frames in FDD and 10 frames in TDD duplexing mode. This mode is intended for measurement of the probability of detection of preamble (Pd).
"Alternating Pd and Pfa"	The generated signal is a sequence of 10 enabled and 10 disabled preambles; during the latest only noise is transmitted. The duration of one single sequence is 10 FDD frames and 20 TDD frames. This mode is intended for measuring both the probability of detection of preamble (Pd) and the probability of false detection of the preamble (Pfa) in one run.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:GS:MODE` on page 1079

Configuration of Special Subframe
(enabled for TDD duplexing mode only)

Sets the Special Subframe Configuration number.

See also Chapter 2.2.1.1, "OFDMA parameterization", on page 21.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:SPSFrame` on page 1095

High Speed Mode
Enables a high-speed mode (restricted preamble set) or the normal mode (unrestricted preamble set).

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:HSMode` on page 1093

Frequency Offset
Sets the frequency offset, as defined in Table 8-39 and Table 8-40.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:FROFfset` on page 1093

Burst Format
Sets the burst format.

See also "Preamble Format (Burst Format)" on page 321.

Burst format 4 is enabled only for TDD duplexing mode, special subframe configurations 5 to 8 and disabled high-speed mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:BFORmat` on page 1091

Timing Offset Base Value

The timing offset base value is set to 50% of the Ncs. This value determines the start timing offset of the first preamble. From preamble to preamble, the timing offset ("Delta t") of the preambles increases by 0.1 us. This sequence of timing offsets is restarted after 10 preambles.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TCW:WS:TIOBase?` on page 1096

8.9.26 Test case 8.5.1: performance requirements for NPUSCH

Test Purpose

The test verifies the receiver's ability to achieve the throughput under multipath fading propagation conditions for a given SNR (TS 36.141 Performance requirements for NPUSCH format 1).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

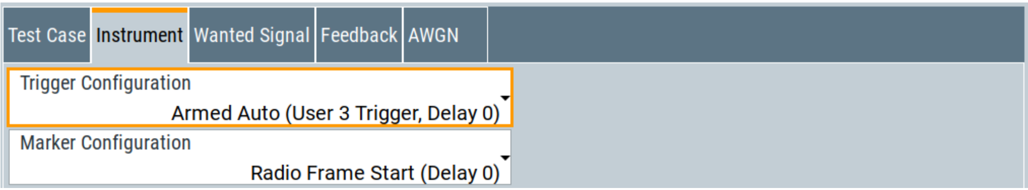
The test setup for NPUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

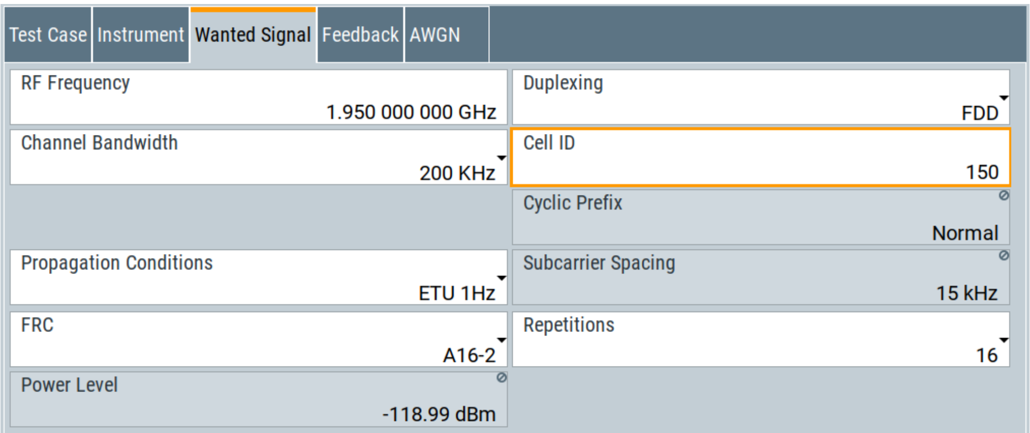
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539.

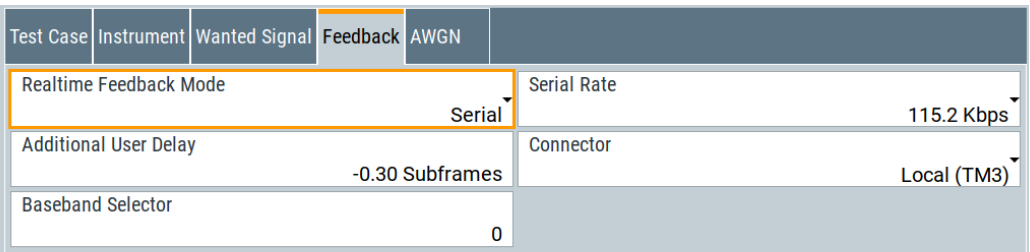
Short Description

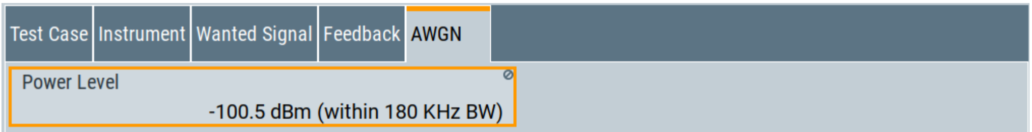
The performance requirement of NPUSCH format 1 is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in Annex A of TS 36.141. The performance requirements assume HARQ retransmissions.


EUTRA/LTE: Test Case Wizard
PUSCH (WS)
AWGN
Channel BW
Tx BW Conf
WS RF Freq:
f = 1.950 GHz
Power / (dBm/15kHz)
Delta Frequency / MHz
Test Case
Instrument
Wanted Signal
Feedback
AWGN
Test Specification
TS 36.141
Release
Release 13-15
Base Station Class
Wide Area BS
Test Case
8.5.1 Performance requirements for NPUSCH format 1
Number of Antennas
Tx Antennas
1
Rx Antennas
2
TS 36.141:
8.5.1 Performance requirements for NPUSCH format 1
Apply
OK


Test Case
Instrument
Wanted Signal
Feedback
AWGN
Trigger Configuration
Armed Auto (User 3 Trigger, Delay 0)
Marker Configuration
Radio Frame Start (Delay 0)


Test Case
Instrument
Wanted Signal
Feedback
AWGN
RF Frequency
1.950 000 000 GHz
Duplexing
FDD
Channel Bandwidth
200 KHz
Cell ID
150
Cyclic Prefix
Normal
Propagation Conditions
ETU 1Hz
Subcarrier Spacing
15 kHz
FRC
A16-2
Repetitions
16
Power Level
-118.99 dBm


Test Case
Instrument
Wanted Signal
Feedback
AWGN
Realtime Feedback Mode
Serial
Serial Rate
115.2 Kbps
Additional User Delay
-0.30 Subframes
Connector
Local (TM3)
Baseband Selector
0



FRC

Sets the FRC of NPUSCH wanted signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:NIOT:FRC on page 1097

Subcarrier Spacing

Sets the subcarier spacing of NB-IoT wanted signal.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TCW:WS:SCSPacing on page 1098

8.9.27 Test case 8.5.2: ACK missed detection for NPUSCH format 2

Test Purpose

The test verifies the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR (TS 36.141 ACK missed detection for NPUSCH format 2).

Required Options

See Chapter 8.9.1, "Required options", on page 587.

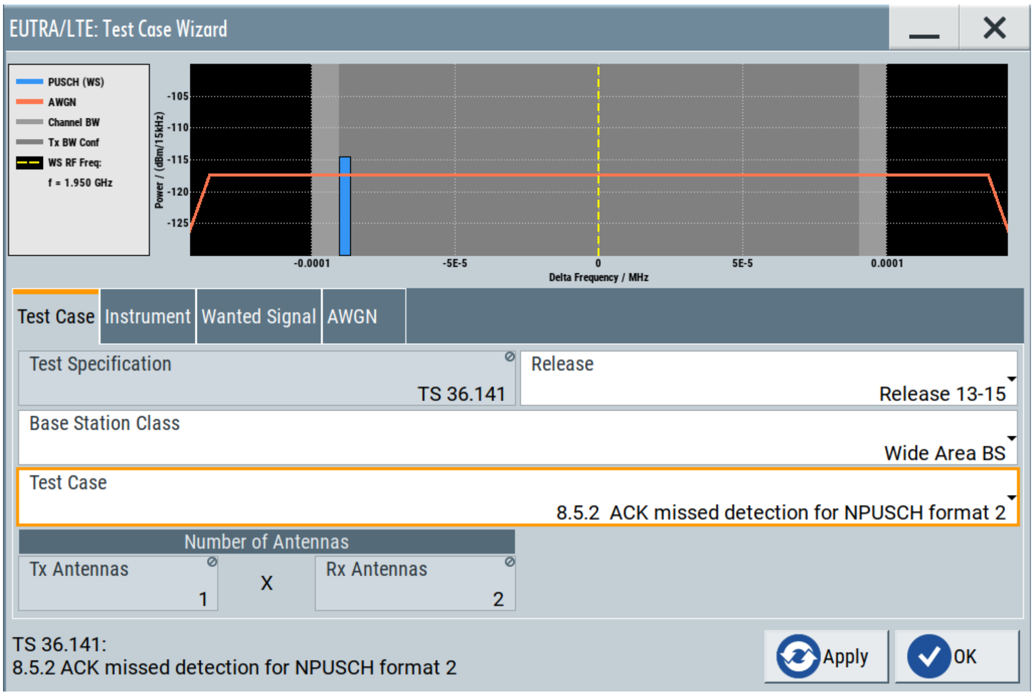
Test Setup

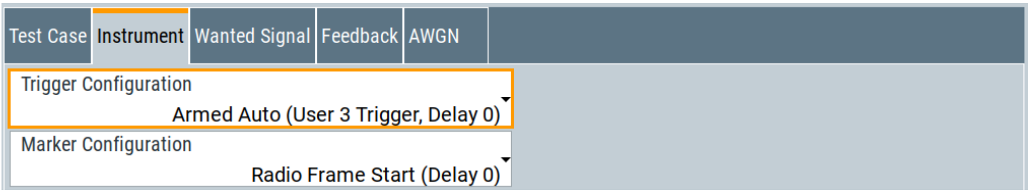
The test setup for NPUSCH tests with two Rx antennas is performed according to Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

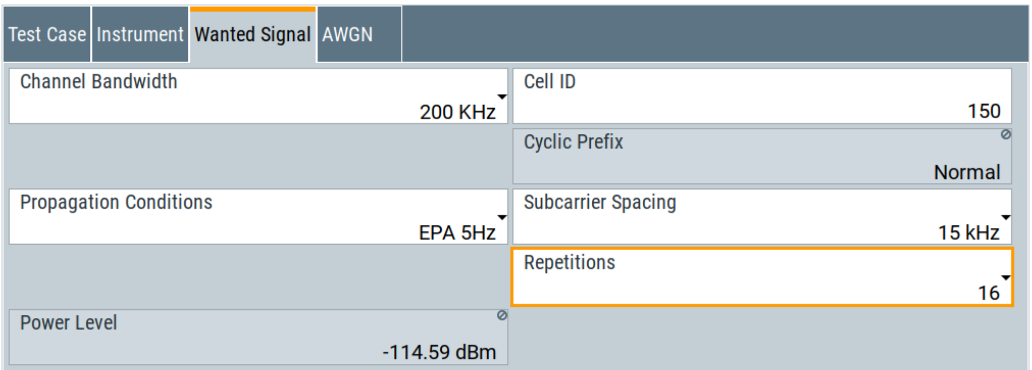
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539 (HARQ feedback line is not required).

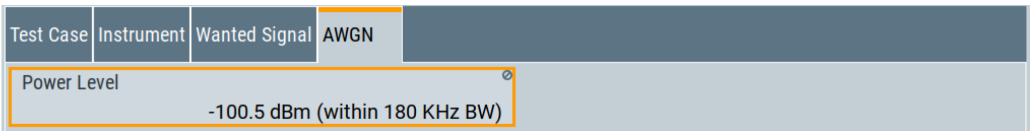
Short Description

The performance requirement of NPUSCH format 2 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK must be 0.01 or less.









Subcarrier Spacing

Sets the subcarier spacing of NB-IoT wanted signal.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:SCSPacing` on page 1098

8.9.28 Test case 8.5.3: performance requirements for NPRACH

Test Purpose

The test verifies the receiver's ability to detect NPRACH preamble under multipath fading propagation conditions for a given SNR (TS 36.141 Performance requirements for NPRACH)

Required Options

See Chapter 8.9.1, "Required options", on page 587.

Test Setup

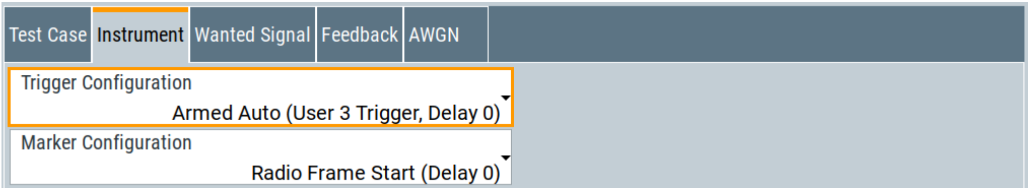
The test setup with two Rx antennas is performed according to the standard setup, see Chapter 8.4.3, "Test setup - diversity measurements", on page 538.

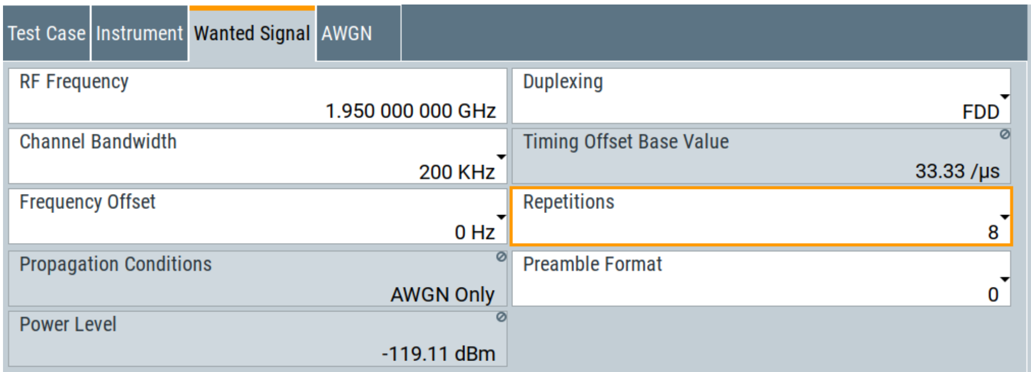
The test setup with four Rx antennas requires additional instruments, see Chapter 8.4.4, "Test setup - four RX antennas", on page 539.

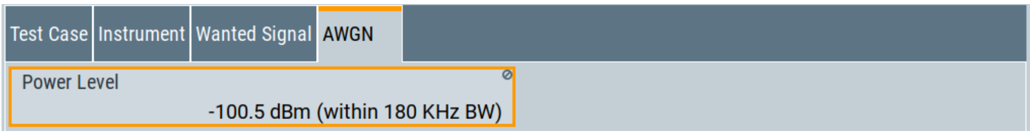
Short Description

The performance requirement of NPRACH for preamble detection is determined by two parameters: the total probability of false detection of the preamble (Pfa) and the probability of detection of the preamble (Pd). The performance is measured for the required SNR at following probabilities:

- Pd must be 99% or larger
- Pfa must be 0.1% or smaller







Preamble Format

Selects the preamble format of the wanted signal according to tables 8.5.3.5-1 (FDD) or 8.5.3.5-2 (TDD) of TS 36.141.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:TCW:WS:PFMT` on page 1097

9 Generating user plane data

If equipped with the option R&S SMW-K175, your R&S SMW can generate and export user plane (U-plane) data based on the O-RAN specifications.

The O-RAN alliance defines a standardized data format for 3GPP signals. Data is exported into a set of `.json` files which contains the raw frequency domain I/Q-samples.

The `.json` files can be parsed into a file format that you use for postprocessing.

For detailed information about the specifications, refer to the documents of the O-RAN alliance.

Access to U-plane data generation

You can activate U-plane data generation in the "General Settings" dialog. For details, see "U-Plane Generation" on page 70.

To select one of the predefined configurations via O-RAN test models, refer to "Test Models" on page 67

Note that U-plane data generation slows down the calculation speed of the instrument. Therefore, turn on U-plane data generation only if necessary.

9.1 Required options

The generation of U-plane data requires:

- Standard or wideband baseband generator (R&S SMW-B10/-B9)
- Baseband main module (R&S SMW-B13) or wideband baseband main module (R&S SMW-B13XT)
- Digital standard EUTRA/LTE releases 13/14/15 (R&S SMW--K119) or
- Digital standard NB-IoT release 15/16/17 (R&S SMW-K146)
- Option U-plane data generation (R&S SMW-K175)

9.2 File format and folder structure

When exporting the user plane, the R&S SMW stores the data in the `\user\U-Plane\` directory on its harddisk. A U-plane dataset itself consists of a set of subdirectories.

```
\Output_0
 \Carrier_0
 \Carrier_1
 \Carrier_N
\Output_1
```

```
 ...
\Output_N
```

Every folder contains a set of n `.json` files (`SF_<xx>.json)`, where n= 10 * No_of_rf_frames. The number of values in the file depends on the number of symbols. This number depends on the number of FFT samples:

number of I/Q values = number of symbols * FFT samples

- I/Q values within a symbol are separated by a comma
- The end of a symbol is indicated by a new line character (`\n`)
  Example:
  `0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,0+0j,`
  `0+0j,0+0j\n`

Note that the R&S SMW always generates a complete set of data, even for symbols that are not allocated. Those I/Q data have the value 0 ("0+0j"), while the I/Q data for symbols that are allocated have the actual real and imaginary values (e.g. "-0.707106781+0.707106781j").

10 Signal control and signal characteristics

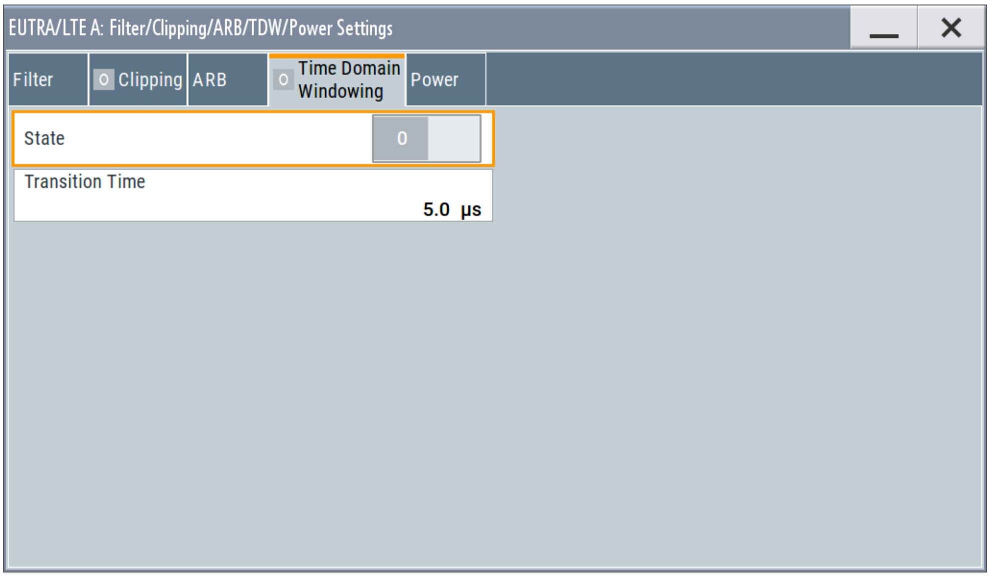
This section lists settings provided for improving the signal and spectrum characteristics of the generated signal, defining the signal power and the signal generation start.

It covers the following topics:

10.1 Time domain windowing settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Time Domain Windowing".



This dialog comprises the settings required for configuring the time domain windowing.

Settings:

State

Activates/deactivates the time domain windowing.

Time domain windowing is a method that influences the spectral characteristics of the signal. The method removes the spikes caused by the OFDM; it does not replace over-sampling and subsequent signal filtering.

Time domain windowing is not stipulated by the 3GPP standard.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDW:STATe` on page 694

Transition Time
Sets the transition time when time domain windowing is active.

The transition time defines the overlap range of two OFDM symbols. At a setting of 1 us and if sample rate = 15.36 MHz, 15 samples overlap.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TDW:TRTime` on page 695

10.2 Filter/clipping/ARB settings

Access:

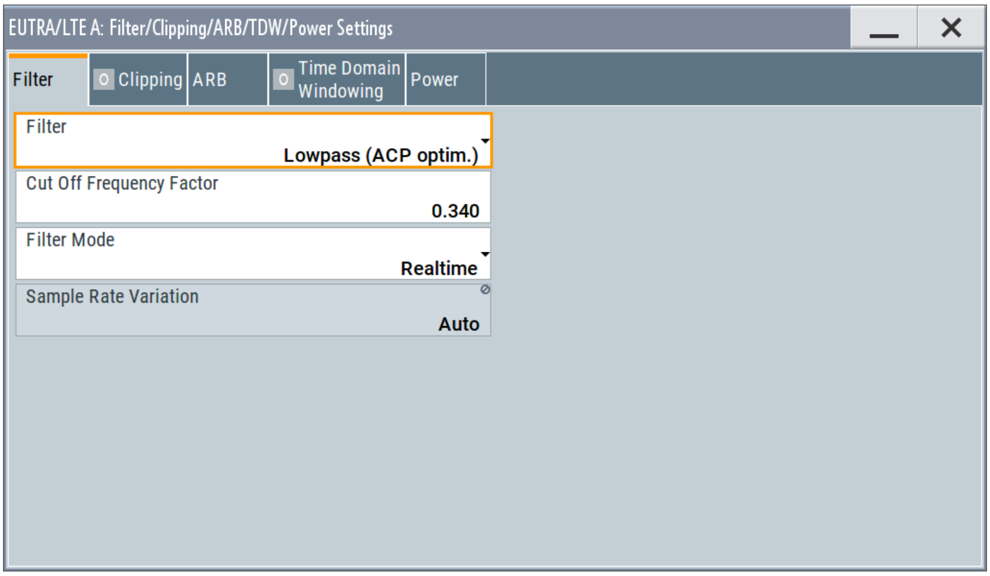
► Select "EUTRA/LTE > General > Filter/Clipping/ARB/TDW/Power Settings".

The dialog comprises the settings, for enabling time domain windowing and clipping, and adjusting the filter and power settings.

10.2.1 Filter settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Filter".



This dialog comprises the settings required for configuring the baseband filter.

Provided are the following settings for configuring the baseband filter:

Filter

Sets the baseband filter.

Remote command:

`[:SOURce<hw>]:BB:EUTRa:FILTer:TYPE` on page 688

Optimization

Selects one of the provided EUTRA/LTE filters.

Each filter is designed for different application field and optimized for a particular performance. Depending on the filter implementation, these filters require different calculation time. The applied upsampling factor also influences the size of the calculated output waveform file.

Waveforms can be calculated in the following ways:

- With the "Generate Waveform File" function
- With the signal generation software R&S WinIQSIM2

The following table outlines the difference between the provided EUTRA/LTE filters by comparing their major specifications.

Table 10-1: Overview of the EUTRA/LTE filters

Characteristic	"Best EVM"	"Best ACP" "Best ACP (Narrow)"	"Best EVM (no upsampling)"
Design goal	An excellent EVM performance while ignoring the effects on ACP	A combination of an excellent ACP performance and a good EVM performance "Best ACP (Narrow)" features also a smoother shape in frequency domain	A combination of an excellent ACP performance and a good EVM performance Small output waveform file size
Calculation time (in real-time processing)	By real-time processing, short calculation time	Long calculation time: the filtered signal is precalculated because of the filter complexity	Long calculation time: the filtered signal is precalculated because of the filter complexity
Upsampling	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate The signal processing requires twice as much internal memory. The available memory on the instrument is sufficient for the simulation of half as many frames compared to filter "Best EVM"	Upsampling is not applied The sample rate of the output waveform is not changed
Output waveform file size	Increased file size	Increased file size	File size is maintained The resulting file size is smaller than in the other cases
Recommended application field	Receiver and performance tests with internal real-time generation, where BLER is analyzed	Transmitter and components tests where excellent ACP is required	Receiver and performance tests with pre-generated waveform files, where BLER is analyzed

In specific configurations, an internal ("Auto") filter is applied automatically. This filter is designed for best possible optimization in configurations, like the carrier aggregation with carriers that span different bandwidths.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:OPTimization`
on page 690
`[:SOURce<hw>]:BB:EUTRa:FILTer:AUTO?` on page 691

Load User Filter
If Filter > "User" is selected, it opens the standard dialog "Select List File User Filter" for loading a user-defined filter file.

User filters are used as offline filters. The following types are supported:
- Files with predefined file format and extensions `VAF`
  For information, refer to the description "Introduction to "filtwiz" Filter Editor" on the Rohde & Schwarz web page.
- ASCII files with simple format and file extension `DAT`
  These files describe filters as a sequence of normalized filter coefficients. Each coefficient is defined as a pair of I and Q samples. The I and Q components alternate at each file line. The I and Q values vary between - 1 and + 1.
  A user filter can contain up to 2560 coefficients.
  The user filter must be real-valued. For both I and Q components of the coefficients, only real coefficients different than 0 are allowed.

You can create user filter files for example with MATLAB, see Example"Script that generates user filter file" on page 658.

Example: Script that generates user filter file

This MATLAB script creates a user filter file that fits the LTE default settings: "Channel Bandwidth = 10 MHz", "Number of Resource Blocks = 50", "FFT Size = 1024".

```
n_fft = 1048; %10MHz
n_scs = 50*12; %50RBs*12 subcarriers per RB

trans_region = 0.02 * n_fft/2; %in %, controls steepness of filter slopes,
relative to nyquist frequency

%cutoff frequencies
f = [n_scs/2 n_scs/2+trans_region];

%ripples in dB
rp = 0.01; %passband
rs = 80; %stopband
dev = [(10^(rp/20)-1)/(10^(rp/20)+1) 10^(-rs/20)];

%estimate filter order
[n,fo,ao,w] = firpmord(f,[1 0],dev,n_fft);

%generate filter coefficients
b = firpm(n,fo,ao,w);

fvtool(b); %displays filter response

%write filter out into .dat filter coefficient file
coeffs_out = zeros(2*length(b),1);
coeffs_out(1:2:end) = real(b);
coeffs_out(2:2:end) = imag(b);

dlmwrite(['smw_user_filter_' num2str(n) 'coeffs_' num2str(n_scs)
'scs_' num2str(n_fft) 'fft.dat'],coeffs_out);
```

Remote command:
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:USER on page 691

Rolloff factor or BxT

Sets the filter parameter.

The rolloff factor affects the steepness of the filter slopes. A "Rolloff Factor = 0" results in the steepest slopes; values near to 1 make the slopes more flat.

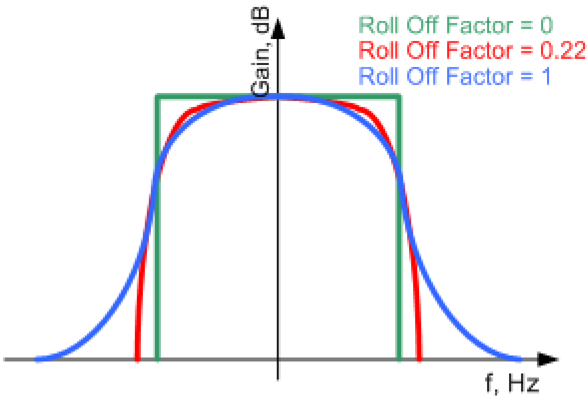


Figure 10-1: Example of the frequency response of a filter with different rolloff factors

For the default cosine filter, a rolloff factor of 0.10 is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine on page 689
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:RCOSine on page 689
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:PGAuss on page 689
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:GAUSs on page 689
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase on page 689
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:APCO25 on page 689
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:ROFactor on page 690

Cutoff frequency shift
(available for filter parameter cosine and EUTRA/LTE with EVM optimization only)

The cutoff frequency is a filter characteristic that defines the frequency at the 3 dB down point. The "Cut Off Frequency Shift" affects this frequency in the way that the filter flanks are "moved" and the transition band increases by "Cut Off Frequency Shift"*"Sample Rate".

- A "Cut Off Frequency Shift" = -1 results in a very narrow-band filter
- Increasing the value up to 1 makes the filter more broad-band
- By "Cut Off Frequency Shift" = 0, the -3 dB point is at the frequency determined by the half of the selected "Sample Rate".

Tip: Use this parameter to adjust the cutoff frequency and reach spectrum mask requirements.

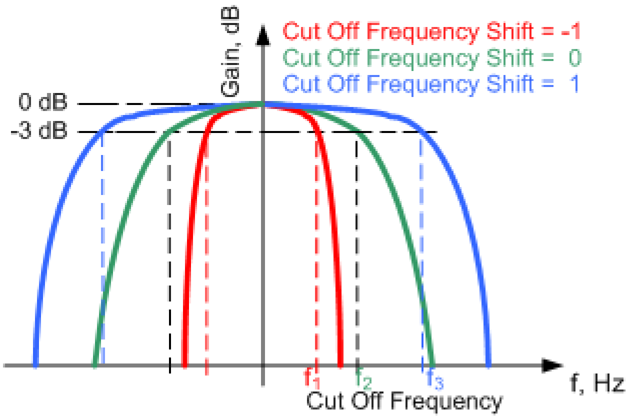


Figure 10-2: Example of the frequency response of a filter with different cutoff frequency shift

Example:

"Channel Bandwidth" = 10 MHz

"Sample Rate" = 15.36 MHz

"Cutoff frequency shift" = 0

Frequency at 3 dB down point = +/- 7.68 MHz

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine:COFS` on page 690
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS` on page 690

Cutoff Frequency Factor

(available for filter parameter lowpass and EUTRA/LTE with ACP optimization only)

Sets the value for the cutoff frequency factor.

The cutoff frequency of the filter can be adjusted to reach spectrum mask requirements.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASs` on page 689
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor` on page 690
`[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASSEVM` on page 689

Filter Mode

Selects an offline or real-time filter mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:FILTer:MODE` on page 689

Sample Rate Variation

Sets the sample rate of the signal. A variation of this parameter affects the ARB clock rate; all other signal parameters remain unchanged.

The value of this parameter is set according to the current physical settings, like the channel bandwidth.

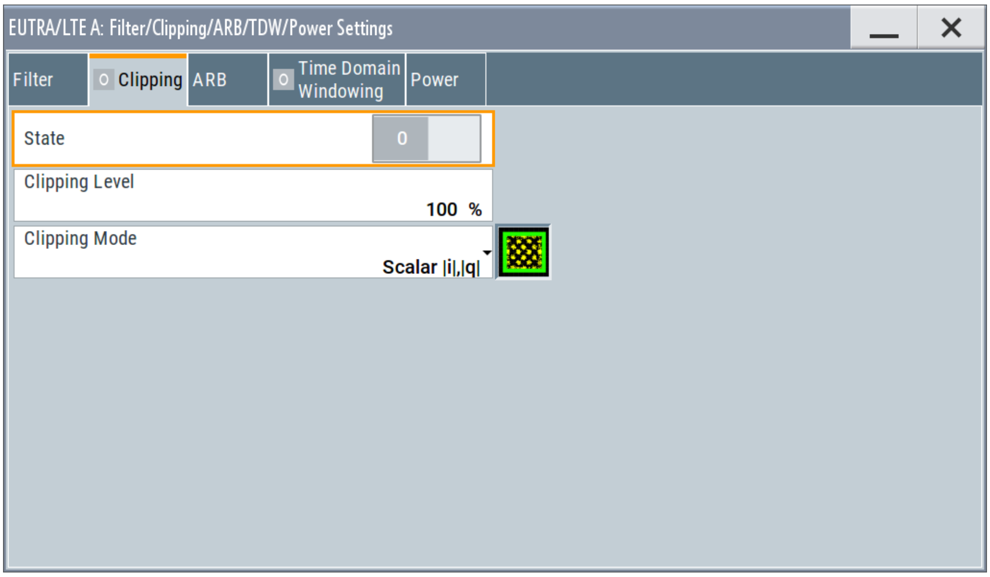
For certain configurations of carrier aggregation (like different channel BW in the carriers), the sample rate is set to a fixed value ("Auto") and cannot be changed.

Remote command:
[:SOURce<hw>]:BB:EUTRa:SRATe:VARiation on page 691

10.2.2 Clipping settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Clipping".



This dialog comprises the settings required for configuring the clipping.

Settings:

Clipping State
Switches baseband clipping on and off.

Baseband clipping is a simple and effective way of reducing the crest factor of the signal. Since clipping is done before to filtering, the procedure does not influence the spectrum. The EVM however increases.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:STATe on page 693

Clipping Level
Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:LEVel on page 692

Clipping Mode
Selects the clipping method. The dialog displays a graphical illustration on how this two methods work.

- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the angle changes.

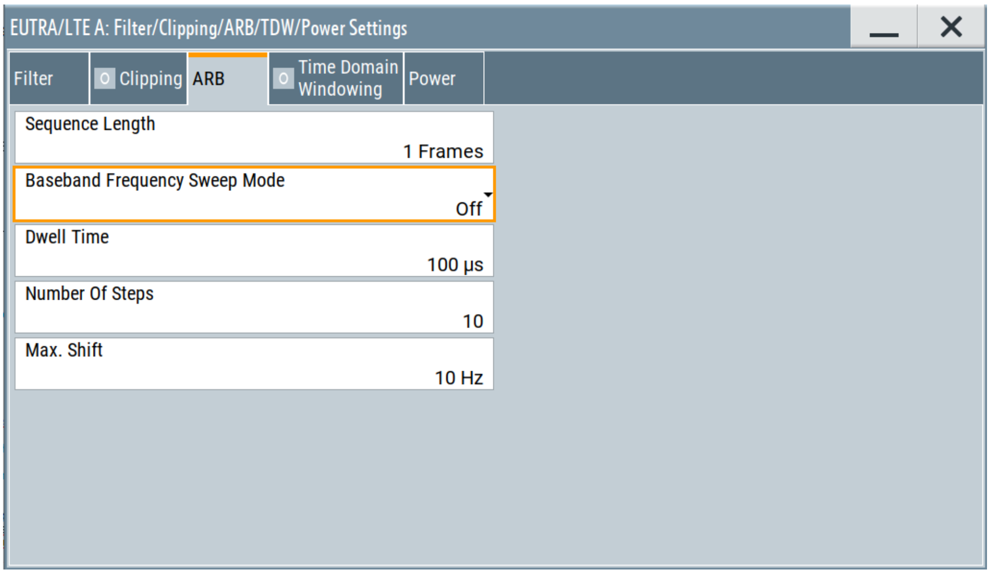
Selects the clipping method. A graphic illustrates how the two methods work.

Remote command:
[:SOURce<hw>]:BB:EUTRa:CLIPping:MODE on page 692

10.2.3 ARB settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > ARB".



This dialog comprises the settings required for configuring the arbitrary waveform. Frequency sweep can be configured also.

Settings:

(Current) Sequence Length
Sets the sequence length of the signal.

- The sequence length is set per default in number of frames. One frame corresponds to 10 ms. The signal is calculated in advance and output in the arbitrary waveform generator. The maximum number of frames is calculated as follows:
  Max. no. of frames = ARB waveform memory size/("Sampling Rate" x 10 ms).
- You can also select unit subframes.
  Note that for the sequence length in number of subframes is not supported in combination with the following features:
  – eMTC / NB-IoT
  – LAA (frame structure type 3)
  – "SFN Restart Period" = *3GPP (1024 Frames)*
  – Time domain windowing
  – "Power Reference" different from *Frame RMS Power*, *UL Part of Frame RMS Power*, and *DL Part of Frame RMS Power*
  – Uplink real-time feedback (for BTS conformance tests)

If the real-time feedback functionality is enabled, the signal of UE1 does not depend on the sequence length, because this signal is not calculated in advance. The configuration of the sequence length is then only required, if also the signal of UE2, UE3 or UE4 is used.

Remote command:
[:SOURce<hw>]:BB:EUTRa:SLENgth on page 686
[:SOURce<hw>]:BB:EUTRa:SUSLen on page 687

Baseband Frequency Sweep Mode
Disables or enables the frequency sweep.

For NB-IoT signals, the frequency sweep is configured as shown in the following figure.

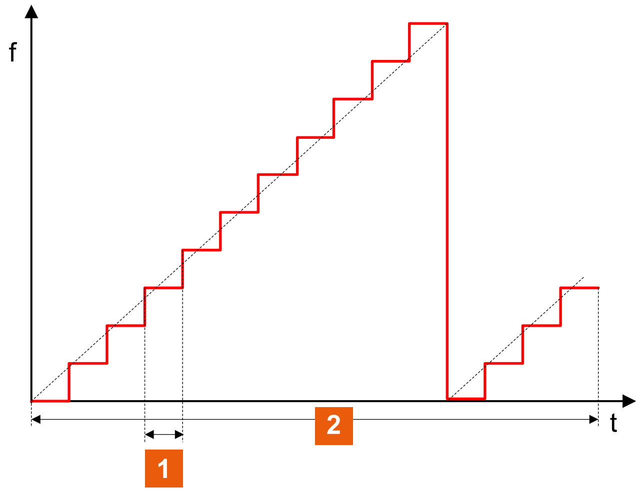


Figure 10-3: Sweep signal sawtooth shape

1 = Dwell time
2 = Sequence length

The frequency sweep can be enabled in one of the two modes:
- Before filter: The shift is calculated in the waveform.
- After filter: The shift is added after the signal filtering.

See also Chapter 10.2.1, "Filter settings", on page 655.

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:MODE on page 694

Dwell Time
Sets the dwell time for each frequency step of the sweep.

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:DTIMe on page 693

Number of Steps
Sets the number of iterations for increasing the frequency using the step of 0.1171875 Hz (90/768 ms).

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:STEPs on page 694

Max. Shift
Sets the maximal total frequency sweep (summary for all steps).

Remote command:
[:SOURce<hw>]:BB:EUTRa:BBFS:MAXShift on page 693

10.3 Adjusting the signal power

The R&S SMW equipped with option EUTRA/LTE (R&S SMW-K55) provides several possibilities to adjust the power level of the generated LTE signal. It also provides settings to adjust the relations between the power levels of the channels and signals in the LTE signal itself.

10.3.1 General power-related settings overview

The general power settings are as follows:

- Output level (P_{out}) of the instrument
  To adjust the value, select "Status bar > Level".

10.3.2 Downlink power-related settings overview

In downlink direction, the value displayed in the "Level" display defines the RMS level of the output signal calculated upon several frames.

- FDD duplexing mode
  The displayed RMS and the PEP values are valid for the whole frame.
- TDD duplexing mode
  The calculation is based only on the downlink parts of the frame, i.e. the DL subframes and the DwPTS.
  (See also parameter Power Reference).

Additionally to the general power settings, the following settings are influencing the power of the output signal in downlink direction:

- Downlink Reference Signal Structure
- Synchronization Signal Settings
- PBCH Power and PDSCH Power
- PCFICH settings, PHICH settings, (E)PDCCH settings
- Cell-specific settings
- NRS/N-SYNC (NPSS/NSSS)
- NPBCH, NPDCCH and NPDSCH settings

All DL power configurations are set relative to each other. The absolute power level of one resource element during one subframe depends on the configuration during the remaining subframes.

Example:

If:

- PDCCH power = 2 dB
- For a particular PDSCH, PDSCH power = -3 dB

The power level of the PDCCH subcarriers is with 5 dB higher than the power level of the PDSCH subcarriers.

The basis for the calculation of the absolute power level of the channels and the signals in DL direction is the **power of one reference signal resource element**. The value is displayed with the parameter "General DL Settings" > "Downlink Signals" > Reference Signal Power. Use this parameter to configure specific absolute power of one RS subcarrier, like for example to set a required SNR defined for a 15kHz subband.

Example:

- Select "EUTRA/LTE > Set to Default".
- "Level = - 30 dB"
- "RS Power per RE relative to Level Display = - 27.78 dB"
- Select "PDSCH power = - 3 dB"

The absolute power level of one single reference signal (RS) subcarrier is -57.78 dBm.

The absolute power level of a PDSCH subcarrier calculated based on the absolute power level of a single RS is -60.78 dBm.

10.3.3 Uplink power-related settings overview

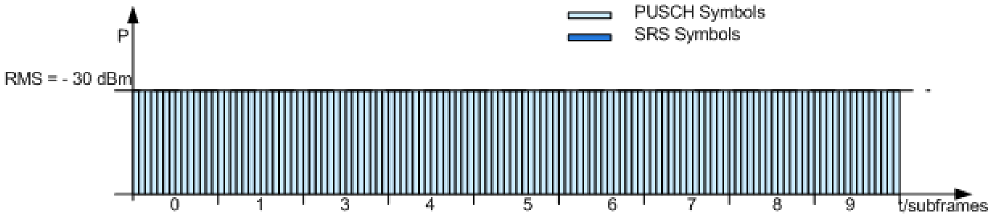
Additionally to the general power settings listed in General power-related settings overview, the following settings are influencing the power of the output signal in uplink direction:

- Power reference
- Power factors for PUSCH/PUCCH/PRACH/SRS

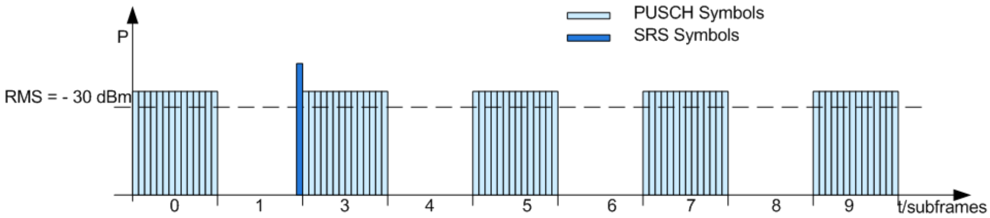
- DRMS Power Offset (available for PUSCH and PUCCH)
- UE Power

While generating an uplink signal, the power displayed in the "Level" display defines the current RMS level at the output. The RMS and PEP values however are calculated based upon different parts of the signal, depending on the value of the parameter Power Reference

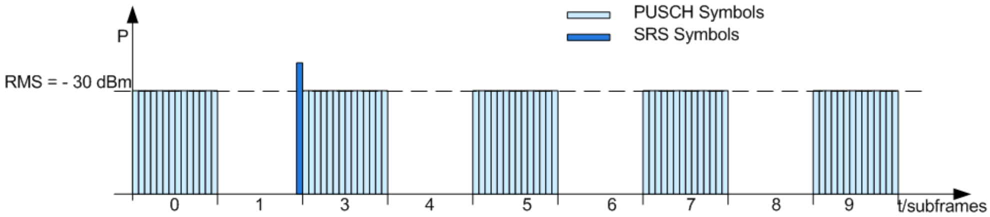
- "Power Reference" = "Frame RMS Power" (UL FDD) or "UL Part of Frame RMS Power" (UL TDD)
  In the FDD duplexing mode, the displayed RMS and the PEP values ("Level" and "PEP") are valid for the whole frame. In TDD duplexing mode, the calculation is based only on the uplink parts of the frame, i.e. the UL subframes and the UpPTS.



  Note: The absolute power of a single subframe depends also on the signal within of the remaining subframes.



- "Power Reference" = "UE Burst RMS Power" (UL FDD and UL TDD)
  The displayed "Level" and "PEP" values are measured only for a certain burst of a single UE. See the description of the parameter Power Reference for description of the decision algorithm and how the reference bursts are selected.

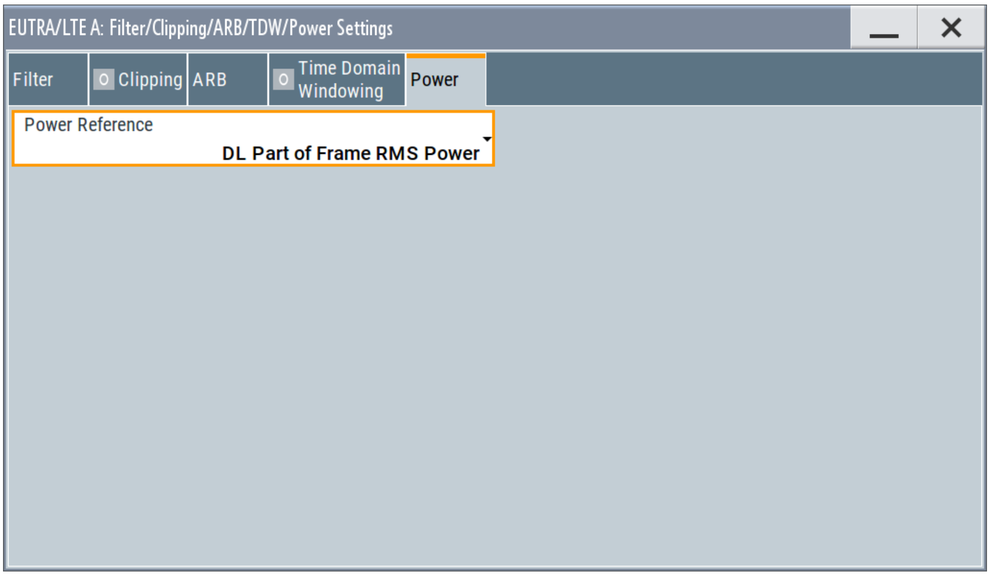


  Use this mode to simplify the configuration of the SNR required for the test cases defined in TS 36.141, in case the PUSCH is not transmitted in every subframe.

10.3.4 Power settings

Access:

► Select "Filter/Clipping/ARB/TDW/Power > Power".



This dialog comprises the settings required for configuring the global power level of the generated LTE signal.

For an overview of the provided power settings and detailed information on how to adjust them, refer to Chapter 10.3, "Adjusting the signal power", on page 664.

Settings:

Power Reference

Defines the reference the "Level" display in the status bar is referring to.

The available settings depend on whether carrier aggregation is used and if the carriers use the same duplexing or not.

"Frame RMS Power"
: The displayed RMS and PEP are measured during the whole frame.
All frames are considered, not only the first one.

"DL Part of Frame RMS Power"
: The displayed RMS and PEP are measured during the DL part of the frame (all DL subframes and the DwPTS).
All frames are considered, not only the first one.

"UL Part of Frame RMS Power"
: The displayed RMS and PEP are measured during the UL part of the frame (all UL subframes and the UpPTS).
All frames are considered, not only the first one.

"UE Burst RMS Power"
The displayed RMS and PEP are measured during an automatically selected **reference time span**, that is selected according to the following algorithm:
- For the first active UE, find the first active subframe.
In case of eMTC/NB-IoT, find the first transmission of the first active UE. Omit invalid subframes.
- Find the first PUSCH, PUCCH or both.
Exclude the DMRS.
- In PRACH mode, find the first PRACH preamble.
- If there is no active subframe, use the SRS.

The signal portion (subframe or slot number), the channel and the first active UE used as reference are displayed with the parameters Reference Subframe/Slot, Reference Channel, and Reference UE.
This power mode is required for the AWGN settings calculation (e.g. according to TS 36.141), in case the simulated UE does not use all subframes.
If at least one UL eMTC or NB-IoT UE is active, "UE Burst RMS Power" is the default level reference.

"NPBCH Symbols Power"
Option: R&S SMW-K115
Enabled in standalone NB-IoT operation (Downlink FDD mode, "Channel Bandwidth = 200 kHz" and "Activate NB-IoT = On")
The displayed RMS and PEP are measured during the NPBCH symbols 3, 9 and 11.

Remote command:
[:SOURce<hw>]:BB:EUTRa:POWC:LEVReference on page 695

Reference UE

If Power Reference = "UL Burst RMS Power", indicates the **first active UE** used as reference of the RMS and PEP measurement.

If several UEs are active during the measurement time, the displayed RMS and PEP values apply **to all UEs** that are active during the reference measurement time.

Example:

Standard SISO configuration, standard signal routing, no additional baseband gain:
- Two active UEs with "UE1 > UE Power = 0 dB" and "UE2 > UE Power = 0 dB".
UE1 and UE2 have active allocations in subframe = 0
- "Power Reference = UL Burst RMS Power"
- Reference time indicated as "Reference UE = UE1" and "Reference Subframe = 0"
- RMS value "Status bar > Level = -30 dBm"

Because during the reference subframe both UEs are active, the power of each UE during this subframe is -33 dBm. The indication "Reference UE = UE1" is merely information on the reference time span.

Remote command:
[:SOURce<hw>]:BB:EUTRa:POWC:RUE? on page 696

Reference Subframe/Slot
If Power Reference = "UL Burst RMS Power", displays the signal portion (subframe or slot) to that the measured RMS and PEP are referring.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:REFSubframe?` on page 696

Reference Channel
If Power Reference = "UL Burst RMS Power", displays the channel type the measured RMS and PEP are referring to.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:POWC:REFChannel` on page 696

10.4 Trigger settings

Access:

► Select "Baseband > EUTRA/LTE > Trigger In"

This dialog provides access to the settings necessary to select and configure the trigger, like trigger source, mode, trigger delay, trigger suppression, and to arm or trigger an internal trigger manually. The current signal generation status is displayed in the header of the tab together with information on the enabled trigger mode. As in the "Marker" and "Clock" tabs, this tab provides also access to the settings of the related connectors.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

The provided trigger signals are not dedicated to a particular connector. Trigger signals can be mapped to one or more USER x or T/M connectors.

Use the Local and global connectors settings to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.

To route and enable a trigger signal, proceed as follows:

- Define the signal source and the effect of a trigger event.
  Select "Trigger In" > "Mode" and "Trigger In" > "Source".
- Define the connector where the selected signal is provided.
  Use the "Global Connectors" settings.

Settings:

Trigger Settings Common to All Basebands

To enable simultaneous signal generation in all basebands, the R&S SMW couples the trigger settings in the available basebands in any instrument's configuration involving signal routing with signal addition. For example, in MIMO configuration, routing and summing of basebands or of streams.

The icon indicates that common trigger settings are applied.

You can access and configure the common trigger source and trigger mode settings in any of the basebands. An arm or a restart trigger event applies to all basebands, too. You can still apply different delay to each of the triggers individually.

Trigger Mode

Selects trigger mode, i.e. determines the effect of a trigger event on the signal generation.

For more information, refer to chapter "Basics" in the R&S SMW user manual.

- "Auto"
  The signal is generated continuously.
- "Retrigger"

The signal is generated continuously. A trigger event (internal or external) causes a restart.

- "Armed Auto"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously.
  An "Arm" stops the signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Armed Retrigger"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
  An "Arm" stops signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Single"
  The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".
  Every subsequent trigger event (internal or external) causes a restart.

Remote command:
`[:SOURce<hw>]:BB:EUTRa[:TRIGger]:SEQuence` on page 699

Signal Duration Unit
Defines the unit for describing the length of the signal sequence to be output in the "Single" trigger mode.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:SLUNit` on page 703

Trigger Signal Duration
Requires trigger "Mode" > "Single".

Enters the length of the trigger signal sequence.

Use this parameter, for example, for the following applications:

- To output the trigger signal partly.
- To output a predefined sequence of the trigger signal.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth` on page 703

Running/Stopped
With enabled modulation, displays the status of signal generation for all trigger modes.

- "Running"
  The signal is generated; a trigger was (internally or externally) initiated in triggered mode.
- "Stopped"
  The signal is not generated and the instrument waits for a trigger event.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:RMODe?` on page 702

Time Based Trigger
Requires trigger "Mode" > "Armed Auto"/"Single".

Activates time-based triggering with a fixed time reference.

The R&S SMW triggers signal generation when its operating system time ("Current Time") matches a specified time trigger ("Trigger Time"). As trigger source, you can use an internal trigger or an external global trigger.

How to: Chapter "Time-based triggering" in the R&S SMW user manual.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME[:STATe]` on page 704

Trigger Time

Requires trigger "Mode" > "Armed Auto"/"Single".

Sets date and time for a time-based trigger signal.

Set a trigger time that is later than the "Current Time". The current time is the operating system time of the R&S SMW. If you set an earlier trigger time than the current time, time-based triggering is not possible.

How to: Chapter "Time-based triggering" in the R&S SMW user manual.

"Date" Sets the date of the time-based trigger in format YYYY-MM-DD.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:DATE` on page 703

"Time" Sets the time of the time-based trigger in format hh:mm:ss.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:TIME` on page 704

Arm

Stops the signal generation until subsequent trigger event occurs.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute` on page 700

Execute Trigger

For internal trigger source, executes trigger manually.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute` on page 701

Trigger Source

The following sources of the trigger signal are available:

- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "Internal (Baseband A/B)"
  The trigger event is provided by the trigger signal from the other basebands.
  If common trigger settings are applied, this trigger source is disabled.
- "External Global Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the USER x connectors.
- "External Local Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1/2/3 connectors.

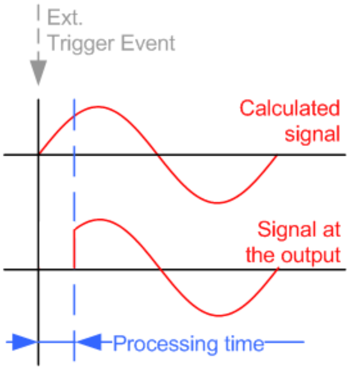
- "External Local Clock"
  The trigger event is the active edge of an external local clock signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1 connector.
- "Baseband Sync In"
  Option: R&S SMW-B9
  In primary-secondary instrument mode, secondary instruments are triggered by the active edge of the synchronization signal.

"External Local Clock/Trigger" require R&S SMW-B10.

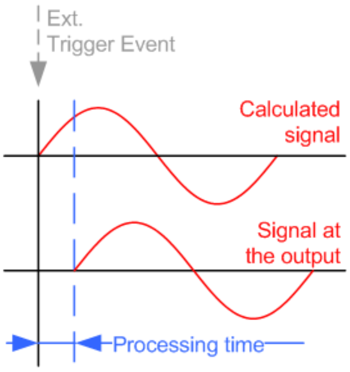
Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:SOURce on page 700

Sync. Output to External Trigger/Sync. Output to Trigger
Enables signal output synchronous to the trigger event.

- "On"
  Corresponds to the default state of this parameter.
  The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



- "Off"
  The signal output begins after elapsing of the processing time. Signal output starts with sample 0. The complete signal is output.
  This mode is recommended for triggering of short signal sequences. Short sequences are sequences with signal duration comparable with the processing time of the instrument.



In primary-secondary instrument mode, this setting ensures that once achieved, synchronization is not lost if the baseband signal sampling rate changes.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut
on page 701

External / Trigger Inhibit
Applies for external trigger signal or trigger signal from the other path.

Sets the duration with that any following trigger event is suppressed. In "Retrigger" mode, for example, a new trigger event does not cause a restart of the signal generation until the specified inhibit duration does not expire.

For more information, see chapter "Basics" in the R&S SMW user manual.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:INHibit on page 705
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:INHibit on page 702

(External) Delay Unit
Determine whatever the trigger delay is expressed in samples or directly defined as a time period (seconds).

To specify the delay, use the parameter (Specified) External Trigger Delay/(Specified) Trigger Delay.

The parameter Actual Trigger Delay/Actual External Delay displays the delay converted in time.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:DELay:UNIT on page 701

(Specified) External Trigger Delay/(Specified) Trigger Delay
The name of the parameter and the units the delay is expressed in, changes depending on the parameter (External) Delay Unit.

Delays the trigger event of the signal from:
- The external trigger source
- The other path
- The other basebands (internal trigger), if common trigger settings are used.

Use this setting to:
- Synchronize the instrument with the device under test (DUT) or other external devices
- Postpone the signal generation start in the basebands compared to each other
- Compensate delays and align the signal generation start in multi-instrument setup

For more information, see chapter "Basics on ..." in the R&S SMW user manual.

The parameter Actual Trigger Delay/Actual External Delay displays the delay converted in time.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:DELay on page 705
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:TDELay on page 706
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:DELay on page 701
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:TDELay on page 702

Actual Trigger Delay/Actual External Delay
Indicates the resulting external trigger delay in "Time" unit.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:RDELay? on page 705
[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:RDELay? on page 702

Timing Configuration
Comprises settings related to the timing configuration.

Signal Advance N_TA_offset ← Timing Configuration
Sets the parameter $N_{TA\ offset}$ as defined in the TS 36.211.

The parameter is available in "Uplink" direction and enabled "TDD" mode.

The TS 36.211 defines the signal advance parameter depending on the duplexing mode and specifies the following values:
- For FDD mode: $N_{TA\ offset}$ = 0
- For TDD mode: $N_{TA\ offset}$ = 624.

In this implementation, however, the signal advance for the TDD mode can also be set to 0.

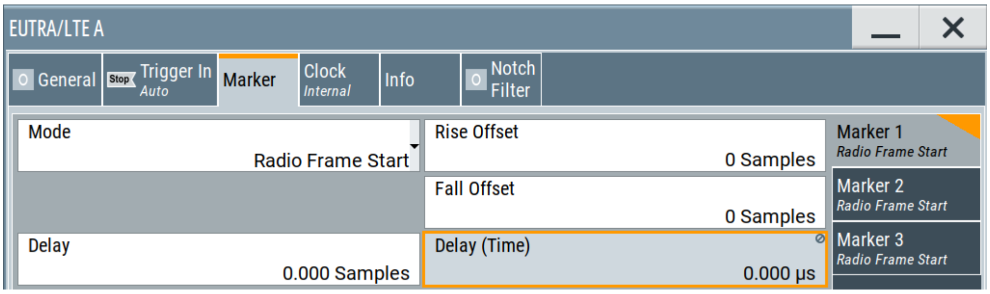
Note: The time shift due to the N_TA_offset is independent from the time shifts caused by the realtime feedback parameter Initial Timing Advance or by timing advance/adjustment commands. According to TS 36.211, the resulting time shift is the sum of the selected time shifts.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TIMC:NTAoffset on page 697

10.5 Marker settings

Access:

► Select "Baseband" > "EUTRA/LTE" > "Marker".



This tab provides settings to select and configure the marker output signal including marker mode and marker delay.

Routing and activating a marker signal

1. To define the signal shape of an individual marker signal "x", select "Marker" > "Marker x" > "Mode".
2. Optionally, define the connector for signal output. See Chapter 10.7, "Local and global connectors settings", on page 680.
   You can map marker signals to one or more USER x or T/M connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMW adds the marker signal to the baseband signal. Also, R&S SMW outputs this signal at the configured USER x connector.

About marker output signals

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

Settings:

Marker Mode

Marker configuration for up to 3 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

How to: "Routing and activating a marker signal" on page 676

"Restart (ARB)"
A marker signal is generated at the start of each ARB sequence.

"Radio Frame Start"
A marker signal is generated at the start of each radio frame.

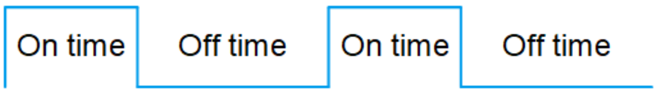
"Frame Active Part"
The marker signal is high whenever a burst is active and low during inactive signal parts.
For example, during the gaps between bursts in uplink mode or the uplink subframe in downlink TDD mode.
Feed this marker signal into a pulse modulator to decrease the carrier leakage during inactive signal parts.

"Subframe" A marker signal is generated at the start of each subframe.

"User Period" A marker signal is generated at the beginning of every user-defined period, as set with the parameter "Period."

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod
on page 708

"ON/OFF Period"
A regular marker signal that is defined by an ON/OFF ratio. A period lasts one ON and OFF cycle.



Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime
on page 708
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime
on page 708

"System Frame Number (SFN) Restart"
A marker signal is generated at the start of every SFN period.

"Internally Used"
Special automatically set marker signal for the realtime feedback mode or for the "SFN Restart Period = 3GPP (1024 Frames)".

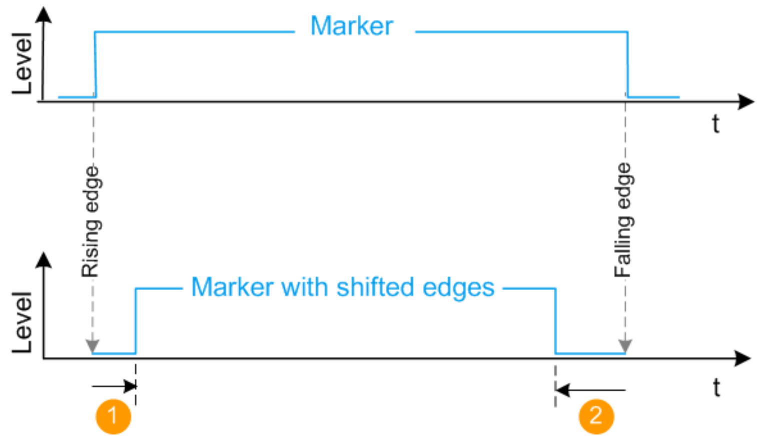
Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:MODE on page 707

Rise/Fall Offset

(For marker modes Subframe, Radio Frame Start, and Restart (ARB))

Sets the value for the rise/fall offset.

The ramps of the marker signal are shifted by the specified number of a samples. Positive values delay the rising ramp; negative values - shift it back.



1 = Positive rise offest
2 = Positive fall offest

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset on page 708
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset on page 708

Marker x Delay
Delays the marker signal at the marker output relative to the signal generation start.

Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay on page 709

Delay (Time)
Shows the marker delay time in microseconds, milliseconds or seconds depending on the set marker delay.

Remote command:
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DINSec? on page 709

10.6 Clock settings

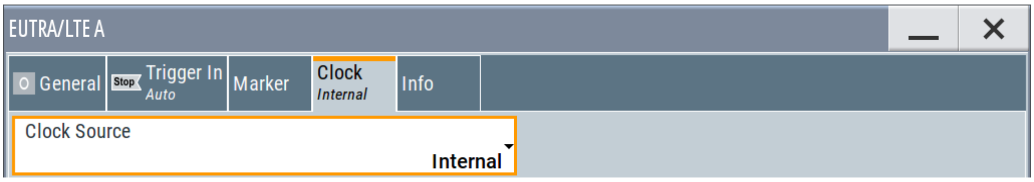
Access:

► Select "Baseband > EUTRA/LTE > Clock"

This tab provides access to the settings necessary to select and configure the clock signal, like the clock source and clock mode.

This section focuses on the available settings.

For information on how the settings affect the signal, refer to chapter "Basics" in the R&S SMW user manual.



Defining the clock

The provided clock signals are not dedicated to a particular connector. They can be mapped to one or more USER x and T/M/C connectors.

Use the Local and global connectors settings to configure the signal mapping, the polarity, the trigger threshold, and the input impedance of the input connectors.

To route and enable a trigger signal, perform the following *general steps*:

- Define the signal source, that is select the "Clock > Source".
- Define the connector where the selected signal is provided.
  Use the Local and global connectors settings.

Settings:

Clock Source

Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.
- "External Local Clock"
  Option: R&S SMW-B10
  The instrument expects an external clock reference at the local T/M/C connector.

"External Local Clock" requires R&S SMW-B10.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:CLOCk:SOURce` on page 697

Clock Mode

Option: R&S SMW-B10

Sets the type of externally supplied clock.

Remote command:
`[:SOURce<hw>]:BB:EUTRa:CLOCk:MODE` on page 697

Expected Clock Frequency

Option: R&S SMW-B10

If an external clock signal is used, this parameter indicates the expected clock frequency value.

Where "Expected Clock Frequency" = Sample Rate Variation

Measured External Clock
Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:
`CLOCk:INPut:FREQuency?`

10.7 Local and global connectors settings

Accesses a dialog to configure local connectors or global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs that are accessible via the "Baseband" block in the block diagram.

See also chapter "Local and global connectors settings" in the user manual.

11 Remote-control commands

The following commands are required to generate signals with the EUTRA/LTE options in a remote environment. We assume that the R&S SMW has already been set up for remote operation in a network as described in the R&S SMW documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

Conventions used in SCPI command descriptions

For a description of the conventions used in the remote command descriptions, see section "Remote Control Commands" in the R&S SMW user manual.

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
ENTity<ch>	1 to 4	Entity in a multiple entity configuration ENTity3|4 require option R&S SMW-K76
SOURce<hw>	[1] to 4	Available baseband signals
OUTPut<ch>	1 to 3	Available markers
SUBF<st0>	• DL 0 to 39 • UL 0 to 199	Subfame number The maximum value depends on the selected sequence length, see [:SOURce<hw>]:BB:EUTRa:SLENgth.
ALLoc<ch0>	• DL – For subframes with PBCH, i.e. SUBF0, SUBF10, SUBF20 and SUBF30: <ch0> = 0 to 111 – For all other subframes: <ch0> = 0 to 110 • UL 0 to 7 Where 0 refers to UE1 • for NB-IoT 0 to 100	• Allocation number • Allocation number (user equipment number) • NB-IoT DCI allocation
CELL<ch0> CELL<st0> CELL<dir> CELL<ccidx>	0 to 4	Component carrier Option R&S SMW-K85
CW<user> CW<cw> <cwid>	1 | 2	Codeword
ITEM<ch0>	0 to 19	Number of rows in the DCI table
UE<st>	[1] to 8	User equipment (UL)

Suffix	Value range	Description
USER<ch>	1|2|3|4	DL user
PMCH<ch0>	0 to 15	PM channel number
<srsidx>	1 to 6	SRS set
BURSt<st0>	0 to 39	LAA bursts
CARRier<ch>	0 to 4	NB-IoT DL carrier
CELV<ch0>	0 to 3	CE level
CFG<ch0>	0 to 2	NPRACH configuration
TRANs<ch>	0 to 10	eMTC/NB-IoT allocation
ATT<ch0>	0 to 40 0 to 30	eMTC PRACH preamble attempt NPRACH preamble attempt

Using SCPI command aliases for advanced mode with multiple entities

You can address multiple entities configurations by using the SCPI commands starting with the keyword `SOURce` or the alias commands starting with the keyword `ENTity`.

Note that the meaning of the keyword `SOURce<hw>` changes in the second case.

For details, see section "SCPI Command Aliases for Advanced Mode with Multiple Entities" in the R&S SMW user manual.

Programming examples

This description provides simple programming examples. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the instrument to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

The following commands specific to the EUTRA/LTE standard are described here:

11.1 Primary commands

[:SOURce<hw>]:BB:EUTRa:STATe <State>

Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:STATe ON`

Manual operation: See "State" on page 64

[:SOURce<hw>]:BB:EUTRa:DUPLexing <Duplexing>

Sets the duplexing mode.

Parameters:

<Duplexing> TDD | FDD

*RST: FDD

Example: `SOURce1:BB:EUTRa:DUPLexing FDD`

Manual operation: See "Duplexing" on page 66

[:SOURce<hw>]:BB:EUTRa:LINK <Link>

Sets the transmission direction.

Parameters:

<Link> UP | DOWN

*RST: DOWN

Example: `SOURce:BB:EUTRa:LINK DOWN`

Manual operation: See "Link Direction" on page 66

[:SOURce<hw>]:BB:EUTRa:STDMode <StandardMode>

Sets the supported 3GPP standard.

Parameters:

<StandardMode> LTE | IOT | LIOT

LTE
Standalone LTE mode.
IoT-specific commands containing the keywords `EMTC` or `NIOT` are discarded.

IOT
Standalone IoT mode.
The commands related to LTE-specific features like carrier aggregation or MBSFN are discarded.

LIOT
Mixed LTE and IoT configuration, for example for interoperability tests.

*RST: LTE

Example: See Example"NPRACH configuration" on page 953.

Options: LTE requires R&S SMW-K55
IOT|LIOT require R&S SMW-K115

Manual operation: See "Mode" on page 66

[:SOURce<hw>]:BB:EUTRa:PRESet

Sets the parameters of the digital standard to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command `SOURce<hw>:BB:EUTRa:STATe`.

Example: `SOURce1:BB:EUTRa:PRESet`

Manual operation: See "Set to Default" on page 64

[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog <Catalog>

Queries the files with settings in the default directory. Listed are files with the file extension `*.lte`.

Parameters:

<Catalog> <filename1>,<filename2>,...

Returns a string of filenames separated by commas.

Example:

```
MMEM:CDIR /var/user/lte
SOURce1:BB:EUTRa:SETTing:CATalog?
// lte, test
SOURce1:BB:EUTRa:SETTing:DEL "test"
SOURce1:BB:EUTRa:SETTing:LOAD "lte"
// SOURce1:BB:EUTRa:SETTing:STORe "lte_2"
```

Manual operation: See "Save/Recall" on page 65

[:SOURce<hw>]:BB:EUTRa:SETTing:DEL <Filename>

Deletes the selected file from the default or the specified directory. Deleted are files with extension `*.lte`.

Setting parameters:

<Filename> string

Filename or complete file path; file extension can be omitted

Example: See `[:SOURce<hw>]:BB:EUTRa:SETTing:CATalog` on page 685.

Usage: Setting only

Manual operation: See "Save/Recall" on page 65

[:SOURce<hw>]:BB:EUTRa:SETTing:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.lte`.

Parameters:

<Filename> string

Filename or complete file path; file extension can be omitted

Example: See [:SOURce<hw>]:BB:EUTRa:SETTing:CATalog on page 685.

Manual operation: See "Save/Recall" on page 65

[:SOURce<hw>]:BB:EUTRa:SETTing:STORe <Filename>

Stores the current settings into the selected file; the file extension (*.lte) is assigned automatically.

Parameters:

<Filename> string

Filename or complete file path

Example: See [:SOURce<hw>]:BB:EUTRa:SETTing:CATalog on page 685.

Manual operation: See "Save/Recall" on page 65

[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:TDD <Tdd>
[:SOURce<hw>]:BB:EUTRa:SETTing:TMOD:DL <Filename>

Selects a predefined test model as defined in TS 36.141.

Parameters:

<Filename> <test_model_name>

Example:

```
SOURce1:BB:EUTRa:SETTing:TMOD:TDD 'E-TM1_1__20MHz'
SOURce1:BB:EUTRa:SETTing:TMOD:DL 'ORAN-TC32371__FDD_1_4MHz'
SOURce1:BB:EUTRa:SETTing:TMOD:DL 'N-TM_Standalone'
```

Options: NB-IoT test models (N-TM) require R&S SMW-K115
O-RAN test models require R&S SMW-K175

Manual operation: See "Test Models" on page 67

[:SOURce<hw>]:BB:EUTRa:SLENgth <SLength>

Sets the sequence length of the signal in number of frames. The signal is calculated in advance and output in the arbitrary waveform generator. The maximum number of frames is calculated as follows:

Max. No. of Frames = Arbitrary waveform memory size/(sampling rate x 10 ms).

Parameters:

<SLength> integer

Range: 1 to dynamic
*RST: 1

Example: `BB:EUTR:SLEN 4`
Selects the generation of 4 frames.

Manual operation: See "(Current) Sequence Length" on page 662

[:SOURce<hw>]:BB:EUTRa:SUSLen <subLen>

Sets the sequence length of the signal in number of subframes. The signal is calculated in advance and output in the arbitrary waveform generator.

Parameters:

<SubLen> integer

Range: 1 to 1E5
*RST: 1

Example: `BB:EUTR:SUSL 10`
Selects the generation of 10 subframes.

Manual operation: See "(Current) Sequence Length" on page 662

[:SOURce<hw>]:BB:EUTRa:WAVeform:CREate <Filename>

Stores the current settings as an ARB signal in a waveform file (`*.wv`).

If real-time feedback is enabled, the waveform file is generated as if this functionality is disabled.

Note: The sequence length of the generated ARB file is set by the selected SFN restart period (`[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SRPeriod`).

Setting parameters:

<Filename> string

Filename or complete file path; file extension is assigned automatically

Example:

```
MMEM:CDIR /var/user/lte
SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:WAVeform:CREate "lte_test"
```

Usage: Setting only

Manual operation: See "Generate Waveform" on page 65

[:SOURce]:BB:EUTRa:VERSion?

Queries the version of the 3GPP standard underlying the definitions.

Return values:

<Version> string

Example: `BB:EUTR:VERS?`

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:UPLane:STATe <UPlaneState>

Turns user plane data generation according to the O-RAN standard on and off.

Parameters:

<UPlaneState> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:UPLane:STATe ON`

Options: R&S SMW-K175

Manual operation: See "U-Plane Generation" on page 70

11.2 Filter/clipping/power

11.2.1 Filter settings

[:SOURce<hw>]:BB:EUTRa:FILTer:TYPE <Type>

Selects the baseband filter type.

Parameters:

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | RECTangle | PGAuss | LPASs | DIRac | ENPShape | EWPShape | LTEFilter | LPASSEVM | SPHase | APCO25 | USER

*RST: LTEFilter

Example: `SOURce1:BB:EUTRa:FILTer:TYPE COS`
Sets the filter type.

Manual operation: See "Filter" on page 656

[:SOURce<hw>]:BB:EUTRa:FILTer:MODE <OptMode>

Selects an offline or real-time filter mode.

Parameters:

<OptMode> RTime | OFFLine

*RST: RTime

Example: See `[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase` on page 689

Manual operation: See "Filter Mode" on page 660

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:APCO25 <Apco25>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine <Cosine>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:GAUSs <Gauss>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASs <LPass>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LPASSEVM <CutoffFrequency>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:PGAuss <PGauss>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:RCOSine <RCosine>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:SPHase <SPhase>

Sets the filter parameter.

Filter type	Parameter	Parameter name	Min	Max	Incre-ment	Default
APCO25	Rolloff factor	<Apco25>	0.05	0.99	0.01	0.2
COSine	Rolloff factor	<Cosine>	0	1	0.01	0.1
GAUSs	BxT	<Gauss>	0.15	2.5	0.01	0.5
LPASs	Cutoff frequency	<LPass>	0.02	2	0.01	0.34
LPASSEVM	Cutoff frequency	<CutoffFrequency>	0.05	2	0.01	0.29
PGAuss	BxT	<PGauss>	0.15	2.5	0.01	0.5
RCOSine	Rolloff factor	<RCosine>	0	1	0.01	0.22
SPHase	BxT	<SPhase>	0.15	2.5	0.01	2

Example:

```
SOURce:BB:EUTRa:FILTer:TYPE COS
SOURce:BB:EUTRa:FILTer:PARameter:COSine 0.1
SOURce:BB:EUTRa:FILTer:PARameter:COSine:COFS -0.2
SOURce:BB:EUTRa:FILTer:MODE RTime
```

Manual operation: See "Rolloff factor or BxT" on page 658

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:COSine:COFS <Cofs>
[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS <CutOffFreqShift>

Sets the filter parameter.

Parameters:

<CutOffFreqShift> float

Range: -1 to 1
Increment: 0.01
*RST: -0.2

Example:

```
SOURce:BB:EUTRa:FILTer:TYPE LTEF
SOURce:BB:EUTRa:FILTer:PARameter:LTE:OPTimization ACP
SOURce:BB:EUTRa:FILTer:PARameter:LTE:COFS 0.34
```

Manual operation: See "Cutoff frequency shift" on page 659

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:OPTimization <Optimization>

Defines the applied LTE filter.

Parameters:

<Optimization> EVM | ACP | ACPN | BENU

Available are `EVM`, `ACP`, `ACPN` (ACP narrow) and `BENU` (Best EVM, no upsampling).

*RST: EVM

Example: See `[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFS` on page 690

Manual operation: See "Optimization" on page 656

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor <CutoffFactor>

Sets the cutoff frequency factor for the LTE filter type.

Parameters:

<CutoffFactor> float

Range: 0.02 to 2
Increment: 0.001
*RST: 0.34

Example:

```
SOURce:BB:EUTRa:FILTer:TYPE LTEF
SOURce:BB:EUTRa:FILTer:PARameter:LTE:OPTimization EVM
SOURce:BB:EUTRa:FILTer:PARameter:LTE:COFFactor 0.1
SOURce:BB:EUTRa:FILTer:PARameter:LTE:ROFactor -0.2
```

Manual operation: See "Cutoff Frequency Factor" on page 660

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:ROFactor <RollOffFactor>

Sets the rolloff factor for the LTE filter type.

Parameters:

<RollOffFactor> float

Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: See [:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:LTE:COFFactor on page 690

Manual operation: See "Rolloff factor or BxT" on page 658

[:SOURce<hw>]:BB:EUTRa:FILTer:AUTO?

Queries if the internal ("Auto") filter is applied.

This filter is selected automatically, if carrier aggregation with carriers that span different bandwidths is used.

Return values:

<Auto> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:FILTer:AUTO?`

Usage: Query only

Manual operation: See "Optimization" on page 656

[:SOURce<hw>]:BB:EUTRa:FILTer:PARameter:USER <Filename>

Loads the file from the default or the specified directory.

Loaded are files with extension `VAF` or `DAT`.

Parameters:

<Filename> string

Complete file path incl. filename and extension

Example:
```
SOURce:BB:EUTRa:FILTer:TYPE USER
SOURce:BB:EUTRa:FILTer:PARameter:USER "/var/user/my_filter.dat"
```

Manual operation: See "Load User Filter" on page 657

[:SOURce<hw>]:BB:EUTRa:SRATe:VARiation <Variation>

Sets the output sample rate.

A variation of this parameter affects the ARB clock rate; all other signal parameters remain unchanged.

The current value of this parameter depends on the current physical settings, like the channel bandwidth.

Parameters:
<Variation> float

Range: 400 to 4E7
Increment: 0.001
*RST: 15.360000E6
Default unit: Hz

Example:
```
SOURce:BB:EUTRa:LINK DOWN
SOURce:BB:EUTRa:DL:BW BW10_00
SOURce:BB:EUTRa:SRATe:VARiation?
// 15360000
```

Manual operation: See "Sample Rate Variation" on page 660

11.2.2 Clipping settings

[:SOURce<hw>]:BB:EUTRa:CLIPping:LEVel <Level>

Sets the limit for level clipping.

Parameters:
<Level> integer

Range: 1 to 100
*RST: 100

Example:
`BB:EUTR:CLIP:LEV 80PCT`
Sets the limit for level clipping to 80% of the maximum level.
`BB:EUTR:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping Level" on page 661

[:SOURce<hw>]:BB:EUTRa:CLIPping:MODE <Mode>

Sets the method for level clipping.

Parameters:
<Mode> VECTor | SCALar

VECTor
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

*RST: VECTor

Example: `BB:EUTR:CLIP:MODE SCAL`
Selects the absolute maximum of all the I and Q values as the reference level.
`BB:EUTR:CLIP:LEV 80PCT`
Sets the limit for level clipping to 80% of this maximum level.
`BB:EUTR:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping Mode" on page 662

[:SOURce<hw>]:BB:EUTRa:CLIPping:STATe <State>

Activates level clipping (Clipping). The value is defined with the command `[SOURce:]BB:EUTRa:CLIPping:LEVel`, the mode of calculation with the command `[SOURce:]BB:EUTRa:CLIPping:MODE`.

Parameters:
<State> ON | OFF
*RST: 0

Example: `BB:EUTR:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping State" on page 661

11.2.3 ARB settings

[:SOURce<hw>]:BB:EUTRa:BBFS:DTIMe <DwellTime>

Sets the dwell time for each frequency step of the sweep.

Parameters:
<DwellTime> float
Range: 0.0001 to 0.005
Increment: 0.000001
*RST: 0.0001
Default unit: s

Example: `SOURce1:BB:EUTRa:BBFS:DTIMe 1E-3`

Manual operation: See "Dwell Time" on page 664

[:SOURce<hw>]:BB:EUTRa:BBFS:MAXShift <MaxShift>

Sets the maximal total frequency sweep (summary for all steps).

Parameters:
<MaxShift> float

Range: 10 to 100
Increment: 1
*RST: 10
Default unit: Hz

Example: `SOURce1:BB:EUTRa:BBFS:MAXShift 50`

Manual operation: See "Max. Shift" on page 664

[:SOURce<hw>]:BB:EUTRa:BBFS:MODE <Mode>

Disables or enables the frequency sweep. The frequency sweep can be enbled before or after filtering.

Parameters:
<Mode> OFF | BEFore | AFTer

*RST: OFF

Example: `SOURce1:BB:EUTRa:BBFS:MODE AFT`

Manual operation: See "Baseband Frequency Sweep Mode" on page 663

[:SOURce<hw>]:BB:EUTRa:BBFS:STEPs <NumSteps>

Sets the number of iteration for increasing the frequency using the step of 0.1171875 Hz (90/768 ms).

Parameters:
<NumSteps> integer

Range: 10 to 1000
*RST: 10

Example: `SOURce1:BB:EUTRa:BBFS:STEPs 5`

Manual operation: See "Number of Steps" on page 664

11.2.4 Time domain windowing settings

[:SOURce<hw>]:BB:EUTRa:TDW:STATe <State>

Activates/deactivates the time domain windowing.

Parameters:
<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:TDW:STAT ON`
Activates time domain windowing.

Manual operation: See "State" on page 654

[:SOURce<hw>]:BB:EUTRa:TDW:TRTime <TransitionTime>

Sets the transition time when time domain windowing is active.

Parameters:

<TransitionTime> float

Range: 0 to 1E-5
Increment: 1E-7
*RST: 5E-6
Default unit: s

Example: `SOURce1:BB:EUTRa:TDW:TRTime 0.000002`
Sets the transition time to 2us.

Manual operation: See "Transition Time" on page 655

11.2.5 Power settings

[:SOURce<hw>]:BB:EUTRa:POWC:LEVReference <LevelReference>

Defines the reference for the "Level" display in the status bar.

Parameters:

<LevelReference> FRMS | DRMS | UEBurst | URMS | NPBCH

FRMS
The displayed RMS and PEP are measured during the whole frame.
All frames are considered, not only the first one.

DRMS
The displayed RMS and PEP are measured during the DL part of the frame (all DL subframes and the DwPTS).
All frames are considered, not only the first one.

URMS
The displayed RMS and PEP are measured during the UL part of the frame (all UL subframes and the UpPTS).
All frames are considered, not only the first one.

UEBurst
The displayed RMS and PEP are measured during a single subframe (or slot) of a certain UE.

NPBCH
In NB-IoT standalone operation, the displayed RMS and PEP are measured during the NPBCH symbols 3, 9 and 11.

*RST: FRMS

Example: `SOURce1:BB:EUTRa:POWC:LEVReference UEBurst`
Sets level reference to UE burst RMS power

Options: NPBCH requieres R&S SMW-K115

Manual operation: See "Power Reference" on page 667

[:SOURce<hw>]:BB:EUTRa:POWC:REFChannel <RefChannel>

If `[:SOURce<hw>]:BB:EUTRa:POWC:LEVReferenceUEBurst`, queries the channel type to that the measured RMS and PEP are referring.

Parameters:

<RefChannel> NF | PUSCH | PUCCH | PRACH | SRS | PUCPUS | SL
*RST: NF

Example:
```
BB:EUTR:POWC:LEVR UEB
BB:EUTR:POWC:RUE?
```

Options: SL requires R&S SMW-K119

Manual operation: See "Reference Channel" on page 669

[:SOURce<hw>]:BB:EUTRa:POWC:REFSubframe?

If `[:SOURce<hw>]:BB:EUTRa:POWC:LEVReferenceUEBurst`, queries the subframe or slot number used as reference for measuring the RMS and PEP values.

Return values:

<RefSubframe> integer
Range: 0 to 39
*RST: 0

Example:
```
SOURce1:BB:EUTRa:POWC:LEVReference UEB
SOURce1:BB:EUTRa:POWC:REFSubframe?
```

Usage: Query only

Manual operation: See "Reference Subframe/Slot" on page 669

[:SOURce<hw>]:BB:EUTRa:POWC:RUE?

If `[:SOURce<hw>]:BB:EUTRa:POWC:LEVReferenceUEBurst`, queries the UE to that the measured RMS and PEP are referring.

Return values:

<ReferenceUe> UE1 | UE2 | UE3 | UE4
*RST: UE1

Example:
```
BB:EUTR:POWC:LEVR UEB
BB:EUTR:POWC:RUE?
```
Queries the reference UE

Usage: Query only

Manual operation: See "Reference UE" on page 668

11.3 Clock

[:SOURce<hw>]:BB:EUTRa:CLOCk:SOURce <Source>

Selects the clock source:

- `INTernal`: Internal clock reference
- `ELCLock`: External local clock
- `EXTernal = ELCLock`: Setting only
  Provided for backward compatibility with other Rohde & Schwarz signal generators

Parameters:

<Source> INTernal|ELCLock|EXTernal

*RST: INTernal

Example: `SOURce1:BB:EUTRa:CLOCk:SOURce INTernal`
Selects an internal clock reference.

Options: ELCLock requires R&S SMW-B10

Manual operation: See "Clock Source" on page 679

[:SOURce<hw>]:BB:EUTRa:CLOCk:MODE <Mode>

Sets the type of externally supplied clock.

Parameters:

<Mode> SAMPle

*RST: SAMPle

Example: `SOURce1:BB:EUTRa:CLOCk:MODE SAMPle`

Options: R&S SMW-B10

Manual operation: See "Clock Mode" on page 679

11.4 Timing configuration

[:SOURce<hw>]:BB:EUTRa:TIMC:NTAoffset <NtaOffset>

Sets the parameter $N_{TA\ offset}$ as defined in the 3GPP TS 36.211.

Parameters:

<NtaOffset> NTA0 | NTA624

*RST: NTA0

Example:

`BB:EUTR:TIMC:NTA NTA0`

Sets parameter $N_{TA\ offset}$

Manual operation: See "Signal Advance N_TA_offset" on page 675

11.5 Trigger

Example: Configure and enable triggering

```
SOURce1:BB:EUTRa:TRIGger:SEQuence SINGle
SOURce1:BB:EUTRa:TRIGger:SLENgth 200
// the first 200 samples of the current waveform will be output after
// the next trigger event

// SOURce1:BB:EUTRa:TRIGger:SOURce INTB
// the internal trigger signal from the other path must be used
// SOURce1:BB:EUTRa:TRIGger:OBASeband:DELay 25
// SOURce1:BB:EUTRa:TRIGger:OBASeband:INHibit 10

SOURce1:BB:EUTRa:TRIGger:SOURce INT
SOURce1:BB:EUTRa:TRIGger:SEQuence ARETrigger
SOURce1:BB:EUTRa:STAT ON
SOURce1:BB:EUTRa:TRIGger:EXEcute
// executes a trigger, signal generation starts
SOURce1:BB:EUTRa:TRIGger:ARM:EXECute
// signal generation stops
SOURce1:BB:EUTRa:TRIGger:EXEcute
// executes a trigger, signal generation starts again
```

Example: Specifying delay and inhibit values in time units

```
SOURce1:BB:EUTRa:CLOCk 1000000
SOURce1:BB:EUTRa:TRIGger:SEQuence ARET
SOURce1:BB:EUTRa:TRIGger:SOURce EGT1
// external trigger signal must be provided at the USER connector
// SOURce1:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:EUTRa:TRIGger:DELay:UNIT SAMP
SOURce1:BB:EUTRa:TRIGger:EXTernal:DELay 100
SOURce1:BB:EUTRa:TRIGger:EXTernal:RDELay?
// Response: 100

SOURce1:BB:EUTRa:TRIGger:DELay:UNIT TIME
SOURce1:BB:EUTRa:TRIGger:EXTernal:TDELay 0.00001
SOURce1:BB:EUTRa:TRIGger:EXTernal:RDELay?
// Response: 0.00001

SOURce1:BB:EUTRa:TRIGger:DELay:UNIT SAMP
SOURce1:BB:EUTRa:TRIGger:EXTernal:DELay 10
```

[:SOURce<hw>]:BB:EUTRa[:TRIGger]:SEQuence <TriggerMode>

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

<TriggerMode> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Example: See Example"Configure and enable triggering" on page 698

Manual operation: See "Trigger Mode" on page 670

[:SOURce<hw>]:BB:EUTRa:TRIGger:SOURce <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the local or global connectors
  - `EGT1|EGT2`: External global trigger
  - `EGC1|EGC2`: External global clock
  - `ELTRigger`: External local trigger
  - `ELCLock`: External local clock
- Internal triggering by a signal from the other basebands (`INTA|INTB`)
- In primary-secondary instrument mode, the external baseband synchronization signal (`BBSY`)
- `OBASeband|BEXTernal|EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators.
  The R&S SMW accepts these values and maps them automatically as follows:
  `EXTernal = EGT1`, `BEXTernal = EGT2`, `OBASeband = INTA or INTB` (depending on the current baseband)

Parameters:

<Source> INTB|INTernal|OBASeband|EGT1|EGT2|EGC1|EGC2|ELTRigger|INTA|ELCLock|BEXTernal|EXTernal | BBSY

*RST: INTernal

Example: See Example"Configure and enable triggering" on page 698.

Options: ELTRigger|ELCLock require R&S SMW-B10
BBSY require R&S SMW-B9

Manual operation: See "Trigger Source" on page 672

[:SOURce<hw>]:BB:EUTRa:TRIGger:ARM:EXECute

Stops signal generation; a subsequent trigger event restarts signal generation.

Example: See Example"Configure and enable triggering" on page 698

Usage: Event

Manual operation: See "Arm" on page 672

[:SOURce<hw>]:BB:EUTRa:TRIGger:DELay:UNIT <DelUnit>

Sets the units in that the trigger delay is expressed.

Parameters:

<DelUnit> SAMPle | TIME
*RST: SAMPle

Example: See Example"Configure and enable triggering" on page 698

Manual operation: See "(External) Delay Unit" on page 674

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXECute

Executes a trigger.

Example: See Example"Configure and enable triggering" on page 698

Usage: Event

Manual operation: See "Execute Trigger" on page 672

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:SYNChronize:OUTPut <OutputState>

Enables signal output synchronous to the trigger event.

Parameters:

<OutputState> 1 | ON | 0 | OFF
*RST: 1

Example: See Example"Configure and enable triggering" on page 698

Manual operation: See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 673

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:DELay <Delay>

When triggering via the other basebands, delays the trigger event compared to the one in the other baseband.

Parameters:

<Delay> float
Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 674

See Example"Configure and enable triggering" on page 698

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:INHibit <Inhibit>

For triggering via the other path, specifies the number of samples by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: See Example"Configure and enable triggering" on page 698

Manual operation: See "External / Trigger Inhibit" on page 674

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:RDELay?

Queries the actual trigger delay (expressed in time units) of the trigger signal from the second path.

Return values:

<IntOthRDelay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"Specifying delay and inhibit values in time units" on page 699.

Usage: Query only

Manual operation: See "Actual Trigger Delay/Actual External Delay" on page 675

[:SOURce<hw>]:BB:EUTRa:TRIGger:OBASeband:TDELay <IntOthTDelay>

Specifies the trigger delay (expressed in time units) for triggering by the trigger signal from the other path.

Parameters:

<IntOthTDelay> float

Range: 0 to depends on other values
Increment: 250E-12
*RST: 0
Default unit: s

Example: See Example"Specifying delay and inhibit values in time units" on page 699.

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 674

[:SOURce<hw>]:BB:EUTRa:TRIGger:RMODe?

Queries the signal generation status.

Return values:

<RunMode> STOP | RUN

Example: `SOURce1:BB:EUTRa:TRIGger:RMODe?`

Usage: Query only

Manual operation: See "Running/Stopped" on page 671

[:SOURce<hw>]:BB:EUTRa:TRIGger:SLUNit <SeqLenUnit>

Defines the unit for the entry of the signal sequence length.

Parameters:

<SeqLenUnit> SEQuence | FRAMe | SUBFrame | SLOT | SAMPle

FRAMe
A single frame is generated after a trigger event.

SEQuence
A single sequence is generated after a trigger event.

SUBFrame
A single subframe is generated after a trigger event.

SLOT
A single slot is generated after a trigger event.

SAMPle
Number of samples are generated after a trigger event.

*RST: SEQuence

Example: See Example"Configure and enable triggering" on page 698.

Manual operation: See "Signal Duration Unit" on page 671

[:SOURce<hw>]:BB:EUTRa:TRIGger:SLENgth <SequenceLength>

Defines the length of the signal sequence that is output in the `SINGle` trigger mode.

Parameters:

<SequenceLength> integer

Range: 1 to 4294967295
*RST: 1

Example: See Example"Configure and enable triggering" on page 698.

Manual operation: See "Trigger Signal Duration" on page 671

[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:DATE <Year>, <Month>, <Day>

Sets the date for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this date via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Year> integer
Range: 1980 to 9999

<Month> integer
Range: 1 to 12

<Day> integer
Range: 1 to 31

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

Manual operation: See "Trigger Time" on page 672

[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>

Sets the time for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this time via the following command:

```
SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe
```

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Hour> integer
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 0 to 59

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

Manual operation: See "Trigger Time" on page 672

[:SOURce<hw>]:BB:EUTRa:TRIGger:TIME[:STATe] <State>

Activates time-based triggering with a fixed time reference. If activated, the R&S SMW triggers signal generation when its operating system time matches a specified time.

Specify the trigger date and trigger time with the following commands:

```
SOURce<hw>:BB:<DigStd>:TRIGger:TIME:DATE
SOURce<hw>:BB:<DigStd>:TRIGger:TIME:TIME
```

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

Manual operation: See "Time Based Trigger" on page 671

[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:DELay <Delay>

Sets the trigger delay.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0
Default unit: Samples

Example: See Example"Specifying delay and inhibit values in time units" on page 699.

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 674

[:SOURce<hw>]:BB:EUTRa:TRIGger[:EXTernal]:INHibit <Inhibit>

Specifies the number of symbols by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to dynamic
*RST: 0

Example: See Example"Specifying delay and inhibit values in time units" on page 699.

Manual operation: See "External / Trigger Inhibit" on page 674

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:RDELay?

Queries the time (in seconds) of an external trigger event is delayed for.

Return values:

<ExtResultDelay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"Specifying delay and inhibit values in time units" on page 699.

Usage: Query only

Manual operation: See "Actual Trigger Delay/Actual External Delay" on page 675

[:SOURce<hw>]:BB:EUTRa:TRIGger:EXTernal:TDELay <Delay>

Specifies the trigger delay for external triggering. The value affects all external trigger signals.

Parameters:

<Delay> float

Range: 0 to 688
Increment: 250E-12
*RST: 0
Default unit: s

Example: See Example"Specifying delay and inhibit values in time units" on page 699.

Manual operation: See "(Specified) External Trigger Delay/(Specified) Trigger Delay" on page 674

11.6 Marker

Example: Configure and enable standard marker signals

```
SOURce1:BB:EUTRa:TRIGger:OUTPut1:MODE FRAM
// selects a frame marker
SOURce1:BB:EUTRa:TRIGger:OUTPut1:ROFFset 20
// sets a rise offset of 20 samples
SOURce1:BB:EUTRa:TRIGger:OUTPut1:FOFFset 200
// sets a fall offset of 200 samples

SOURce1:BB:EUTRa:TRIGger:OUTPut2:MODE RAT
SOURce1:BB:EUTRa:TRIGger:OUTPut2:ONTime 20
SOURce1:BB:EUTRa:TRIGger:OUTPut2:OFFTime 200

SOURce1:BB:EUTRa:TRIGger:OUTPut3:MODE PERiod
SOURce1:BB:EUTRa:TRIGger:OUTPut3:PERiod 1600
// sets a period of 1600 samples
//  the marker signal is repeated every 1600th sample

SOURce1:BB:EUTRa:TRIGger:OUTPut3:DELay 1000
// Sets a delay of 1000 samples.
SOURce1:BB:EUTRa:TRIGger:OUTPut3:DINsec?
// Response in microseconds: 65.1041666666667
// Corresponds to a delay of about 65.104 microseconds.
```

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:MODE <Mode>

Defines the signal for the selected marker output.

Parameters:

<Mode> SUBFram | FRAM | RESTart | PERiod | RATio | FAP | SFNRestart

*RST: FRAM

Example: See Example"Configure and enable standard marker signals" on page 707.

Manual operation: See "Marker Mode" on page 676

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:FOFFset <FallOffset>
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ROFFset <RiseOffset>

Sets the rise offset for on/off ratio marker in number of samples.

Parameters:

<RiseOffset> integer

Range: -640000 to 640000
*RST: 0

Example: See Example"Configure and enable standard marker signals" on page 707.

Manual operation: See "Rise/Fall Offset" on page 677

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:ONTime <OnTime>
[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:OFFTime <OffTime>

Sets the number of samples during which the marker output is on or off.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

Parameters:

<OffTime> integer

Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 16777215
*RST: 1

Example: See Example"Configure and enable standard marker signals" on page 707.

Manual operation: See "Marker Mode" on page 676

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:PERiod <Period>

Sets the repetition rate for the signal at the marker outputs.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

Parameters:

<Period> unsigned integer

Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 4294967295
Increment: 1
*RST: 2
Default unit: Samples

Example: See Example"Configure and enable standard marker signals" on page 707.

Manual operation: See "Marker Mode" on page 676

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signals.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: See Example"Configure and enable standard marker signals" on page 707.

Manual operation: See "Marker x Delay" on page 678

[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DINSec?

Queries the marker delay in microseconds.

You can define a marker delay in samples via `[:SOURce<hw>]:BB:EUTRa:TRIGger:OUTPut<ch>:DELay`.

Return values:

<DelayInS> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: See Example"Configure and enable standard marker signals" on page 707.

Usage: Query only

Manual operation: See "Delay (Time)" on page 678

11.7 General TDD commands

[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf <SpecSubfrConf>

In TDD mode, sets the special subframe configuration number.

Parameters:

<SpecSubfrConf> integer

Range: 0 to 9
*RST: 0

Example: `SOURce1:BB:EUTRa:TDD:SPSConf 2`

Options: R&S SMW-K112: Special subframe configuration 9
R&S SMW-K119: Special subframe configuration 10 (if "Mode = LTE")
R&S SMW-K143: Special subframe configuration 10 (if "Mode = eMTC/NB-IoT")

Manual operation: See "TDD Special Subframe Config" on page 108

[:SOURce<hw>]:BB:EUTRa:TDD:UDConf <ULDLConf>

In TDD mode, sets the uplink/downlink configuration number.

Parameters:

<ULDLConf> integer

Range: 0 to 6
*RST: 0

Example: `:SOURce1:BB:EUTRa:TDD:UDConf 2`
Sets the UL/DL configuration

Manual operation: See "TDD UL/DL Configuration" on page 108

[:SOURce<hw>]:BB:EUTRa:TDD:UPTS <UpPtsSymbol>

If `[:SOURce<hw>]:BB:EUTRa:TDD:SPSConf` 10, sets the number of UpTPS symbols.

Parameters:

<UpPtsSymbol> 1 | 2

*RST: 1

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce:BB:EUTRa:TDD:SPSConf 10
SOURce:BB:EUTRa:TDD:UPTS 2
```

Options: R&S SMW-K119 (if "Mode = LTE")
R&S SMW-K143 (if "Mode = eMTC/NB-IoT")

Manual operation: See "Number of UpPTS Symbols" on page 108

11.8 General downlink commands

[:SOURce<hw>]:BB:EUTRa:DL:CONF:MODE <Scheduling>

Determines how the scheduling of the different PDSCH allocations inside of the DL allocation table is performed.

Parameters:

<Scheduling> MANual | AUTO | ASEQuence

MANual
No cross-reference between the settings made for the PDCCH DCIs and the PDSCHs settings.
Configure the PDSCH allocations manually.

AUTO
Precoding for spatial multiplexing according to TS 36.211 and the selected parameters.

ASEQuence
According to the required HARQ processes and redundancy versions

*RST: MANual

Example: `BB:EUTR:DL:CONF:MODE AUTO`
enables the generation of 3GPP compliant EUTRA/LTE signal and the PDSCH allocations are configured automatically according to the configuration of the PDCCH DCIs.

Options: ASEQuence requires R&S SMW-K112

Manual operation: See Chapter 4.2.1, "PDSCH scheduling settings", on page 71

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration <Configuration>

Sets the global MIMO configuration.

Parameters:

<Configuration> TX1 | TX2 | TX4 | SIBF

*RST: TX1

Example:

```
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1
SOURce1:BB:EUTRa:DL:MIMO:APM:MAPCoordinates CARTesian
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:AP0:ROW0:REAL 1
```

Manual operation: See "Global MIMO Configuration" on page 134

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:ANTenna <Antenna>

Sets the simulated antenna.

Parameters:

<Antenna> ANT1 | ANT2 | ANT3 | ANT4

*RST: ANT1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 712

Manual operation: See "Simulated Antenna" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:MAPCoordinates <Type>

Switches between the cartesian and cylindrical coordinates representation.

Parameters:

<Type>	CARTesian | CYLindrical *RST: CARTesian

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 712

Manual operation: See "Mapping Coordinates" on page 226

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB<st0> <AntPortCCIndex>

Maps a component carrier to a baseband.

Suffix:

<st0>	0 to 7 baseband identifier, where <st0>=0 indicates BB A

Parameters:

<AntPortCCIndex>	PC | SC1 | SC2 | SC3 | SC4 Component carrier *RST: PC

Manual operation: See "Mapping table" on page 226

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:REAL <AntPortMapDat>

Define the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0>	0 | 1 | 2 | 3 | 4 | 6 | 15 to 46 | 2000 to 2001 Antenna port `AP0|1|2|3` can only be mapped to the `BB0|1|2|3`
<st0>	0 to 7 Available basebands

Parameters:

<AntPortMapDat>	0 | 1 (for AP = 0 to 3); float (for AP = 4 | 6 | 15 to 46) The mapping of the first four APs `AP0|1|2|3` depends on the system configuration as follows: If `SCONfiguration:BASeband:SOURce SEParate`, then exactly one single AP can be mapped to a BB. If `SCONfiguration:BASeband:SOURce COUPled|CPENtity`, then none or exactly one single AP can be mapped to a BB. To map an AP, use the command `SOURce1:BB:EUTRa:DL:MIMO:APM:CS:AP0|1|2|3:ROW0|1|2|3:REAL 1`. The corresponding `...:CS:AP0|1|2|3:ROW0|1|2|3:IMAG` command has no effect.

The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows: |REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: dynamic

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 712.

Options: AP = 23 to 46 require R&S SMW-119
AP = 2000/2001 require R&S SMW-143

Manual operation: See "Mapping table" on page 226

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:APM:CS:AP<dir0>:ROW<st0>:IMAGinary <AntPortMapDat>

Define the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 4 | 6 | 15 to 46 | 2000 to 2001
Antenna port

<st0> 0 to 7
Available basebands

Parameters:

<AntPortMapDat> float

The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows: |REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: dynamic

Example: See [:SOURce<hw>]:BB:EUTRa:DL:MIMO:CONFiguration on page 712.

Options: AP = 23 to 46 require R&S SMW-119
AP = 2000/2001 require R&S SMW-143

Manual operation: See "Mapping table" on page 226

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer <Power>

Sets the reference signal power.

Parameters:

<Power>	float Range: -80 to 10 Increment: 0.01 *RST: 0

Example: `SOURce1:BB:EUTRa:DL:REFSig:POWer -10.00`

Manual operation: See "Reference Signal Power" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:EPRE?

Queries the RS Power per RE relative to Level Display.

Return values:

<RelToLevelDispl>	float Range: -1e3 to 1e3 Increment: 0.001 *RST: 0

Example: `BB:EUTR:DL:REFS:EPRE?`
Queries the RS Power per RE relative to Level Display.

Usage: Query only

Manual operation: See "RS Power per RE relative to Level Display" on page 110

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:TXANtenna <TxAntenna>

Defines on which antenna port the P-/S-SYNC is transmitted.

The available values depend on the number of configured antennas.

Parameters:

<TxAntenna>	NONE | ANT1 | ANT2 | ANT3 | ANT4 | ALL *RST: ALL

Example: `BB:EUTR:DL:SYNC:TXAN ALL`
Enables all antenna ports to transmit P-/S-SYNC

Manual operation: See "P-/S-SYNC Tx Antenna" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:PPOWer <PPower>

Sets the power of the primary synchronization signal (P-SYNC).

Parameters:

<PPower>	float Range: -80 to 10 Increment: 0.001 *RST: 0

Example: `BB:EUTR:DL:SYNC:PPOWer -10.00`
Sets the P-SYNC power to -10.00dB.

Manual operation: See "P-SYNC Power" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:SPOWer <SPower>

Sets the power of the secondary synchronization signal (S-SYNC).

Parameters:
<SPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:SYNC:SPOWer -10.00`
Sets the S-SYNC power to -10.00dB.

Manual operation: See "S-SYNC Power" on page 111

[:SOURce<hw>]:BB:EUTRa:DL:BW <Bw>

Sets the DL channel bandwidth.

Parameters:
<Bw> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00 | BW0_20 | USER

*RST: BW10_00

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Options: BW0_20 requires R&S SMW-K115
USER requires R&S SMW-K55

Manual operation: See "Channel Bandwidth" on page 101

[:SOURce<hw>]:BB:EUTRa:DL:NORB <Norb>

Selects the number of physical resource blocks per slot.

Parameters:
<Norb> integer

Range: 6 to 110
*RST: 50

Example:
```
SOURce1:BB:EUTRa:DL:BW USER
SOURce1:BB:EUTRa:DL:NORB 7
```

Example:
```
SOURce1:BB:EUTRa:DL:BW BW5_00
SOURce1:BB:EUTRa:DL:NORB?
// 25
```

Manual operation: See "Number of Resource Blocks Per Slot" on page 102

[:SOURce<hw>]:BB:EUTRa:DL:SRATe?

Queries the sampling rate.

Return values:

<SampleRate> float

Range: 192E4 to 3072E4
Increment: 1000
*RST: 1536E4

Example: `BB:EUTR:DL:SRAT?`
Queries the automatically set sampling rate.

Usage: Query only

Manual operation: See "Sampling Rate" on page 104

[:SOURce<hw>]:BB:EUTRa:DL:FFT <Fft>

Sets the FFT size.

Parameters:

<Fft> integer

Range: 64 to 2048
*RST: 1024

Example: `SOURce1:BB:EUTRa:DL:FFT?`

Manual operation: See "FFT Size" on page 102

[:SOURce<hw>]:BB:EUTRa:DL:OCCBandwidth?

Queries the occupied bandwidth.

Return values:

<OccupBandwidth> float

Example: `BB:EUTR:DL:OCCB?`
Queries the automatically set occupied bandwidth in downlink.

Usage: Query only

Manual operation: See "Occupied Bandwidth" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:OCCSubcarriers?

Queries the occupied subcarriers.

Return values:

<OccupSubcarr> integer

Range: 72 to 1321
*RST: 601

Example: `BB:EUTR:DL:OCCS?`
Queries the number of occupied subcarriers.

Usage: Query only

Manual operation: See "Number Of Occupied Subcarriers" on page 104

[:SOURce<hw>]:BB:EUTRa:DL:LGS?

Queries the number of left guard subcarriers.

Return values:

<Lgs> integer

Range: 28 to 364
*RST: 212

Example: `BB:EUTR:DL:LGS?`
Queries the number of left guard subcarriers.

Usage: Query only

Manual operation: See "Number Of Left/Right Guard Subcarriers" on page 104

[:SOURce<hw>]:BB:EUTRa:DL:RGS?

Queries the number of right guard subcarriers.

Return values:

<Rgs> integer

Range: 27 to 364
*RST: 211

Example: `BB:EUTR:DL:RGS?`
Queries the number of right guard subcarriers.

Usage: Query only

Manual operation: See "Number Of Left/Right Guard Subcarriers" on page 104

[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CID <CellId>

Sets the cell identity.

Parameters:

<CellId> integer

Range: 0 to 503
*RST: 0

Example: `BB:EUTR:DL:PLC:CID 100`
Sets the Cell ID.

Manual operation: See "Cell ID" on page 105

[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CIDGroup <CellIdGroup>

Sets the ID of the physical cell identity group.

Parameters:

<CellIdGroup> integer

Range: 0 to 167
*RST: 0

Example: `BB:EUTR:DL:PLC:CIDG 100`
Sets the ID of the physical cell identity group.

Manual operation: See "Physical Cell ID Group" on page 105

[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:PLID <PhysLayId>

Sets the identity of the physical layer within the selected physical cell identity group, set with the command `[:SOURce<hw>]:BB:EUTRa:DL[:PLCI]:CIDGroup`.

Parameters:

<PhysLayId> integer

Range: 0 to 2
*RST: 0

Example: `BB:EUTR:DL:PLC:PLID 2`
Sets the identity of the physical layer.

Manual operation: See "Physical Layer ID" on page 105

[:SOURce<hw>]:BB:EUTRa:DL:CSETtings:RARNti <RaRnti>

Sets the random-access response identity RA-RNTI.

The value selected here determines the value of the parameter "UE_ID/n_RNTI" in case a RA_RNTI "User" is selected.

Parameters:

<RaRnti> integer

Range: 1 to 60
*RST: 1

Example: `SOURce1:BB:EUTRa:DL:CSETtings:RARNti 5`

Manual operation: See "RA_RNTI" on page 108

[:SOURce<hw>]:BB:EUTRa:DL:CPC <CyclicPrefix>

Sets the cyclic prefix length for all LTE subframes.

Parameters:

<CyclicPrefix> NORMal | EXTended | USER

*RST: NORMal

Example: `SOURce1:BB:EUTRa:DL:CPC NORM`

Example:
```
SOURce1:BB:EUTRa:DL:CPC USER
SOURce1:BB:EUTRa:DL:SUBF6:CYCP NORM
SOURce1:BB:EUTRa:DL:SUBF1:CYCP EXT
```

Manual operation: See "Cyclic Prefix (General DL Settings)" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:ULCPc <GSCpcOppDir>

In TDD duplexing mode, sets the cyclic prefix for the opposite direction.

Parameters:

<GSCpcOppDir> NORMal | EXTended

*RST: NORMal

Example:
```
:SOURce1:BB:EUTRa:DUPLexing TDD
:SOURce1:BB:EUTRa:DL:ULCPc EXTended
```

Manual operation: See "UL/DL Cyclic Prefix" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:PB <Pb>

Sets the cell-specific ratio rho_B/rho_A according to TS 36.213.

Parameters:

<Pb> integer

Range: 0 to 3
*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa` on page 720.

Manual operation: See "PDSCH P_B" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:PDSCh:RATBa <RatioPbPa>
[:SOURce<hw>]:BB:EUTRa:DL:PDCCh:RATBa <RatioPbBa>
[:SOURce<hw>]:BB:EUTRa:DL:PBCH:RATBa <RatioPbPa>

Sets the transmit energy ratio among the resource elements allocated for teh channel in the OFDM symbols containing reference signal (P_B) and such not containing one (P_A).

Parameters:

<RatioPbPa> float

Range: -10 to 10
Increment: 0.001
*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:PDSCh:PB 1
SOURce1:BB:EUTRa:DL:PDSCh:RATBa?
// -0.969
SOURce1:BB:EUTRa:DL:PBCH:RATBa -5.0
SOURce1:BB:EUTRa:DL:PDCCh:RATBa -1.0
```

Manual operation: See "PDSCH/PDCCH/PBCH Ratio rho_B/rho_A" on page 106

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:BW <PrsBandwidth>

Defines the bandwidth in which the PRS is transmitted.

Parameters:

<PrsBandwidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

*RST: BW1_40

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Options: R&S SMW-K84

Manual operation: See "PRS Bandwidth" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:CI <ConfIdx>

Sets the PRS Configuration Index I_{PRS} as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Parameters:

<ConfIdx> integer

Range: 0 to 2399
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Options: R&S SMW-K84

Manual operation: See "PRS Configuration Index" on page 115

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:DPRS?

Queries the subframe offset of the PRS generation ($Delta_{PRS}$) as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Return values:

<DeltaPRS> integer

Range: 0 to 1279
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Usage: Query only

Options: R&S SMW-K84

Manual operation: See "PRS Subframe offset Delta_PRS" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:NPRS <NumberPRS>

Defines the number of consecutive DL subframes in that PRS are transmitted.

Parameters:

<NumberPRS> 1 | 2 | 4 | 6

*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Options: R&S SMW-K84

Manual operation: See "Number of PRS DL Subframes (N_PRS)" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:POW <PrsPower>

Sets the power of a PRS resource element relative to the power of a common reference signal resource element.

Parameters:

<PrsPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Options: R&S SMW-K84

Manual operation: See "PRS Power" on page 116

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe <PrsState>

Enables the generation of the PRS.

Parameters:

<PrsState> 1 | ON | 0 | OFF

*RST: OFF

Example:

```
:SOURce1:BB:EUTRa:DL:PRSS:CI 1
:SOURce1:BB:EUTRa:DL:PRSS:BW BW1_40
:SOURce1:BB:EUTRa:DL:PRSS:POW 0
:SOURce1:BB:EUTRa:DL:PRSS:MIPattern #H1,2
:SOURce1:BB:EUTRa:DL:PRSS:NPRS 2
:SOURce1:BB:EUTRa:DL:PRSS:STATe 1
```

Options: R&S SMW-K84

Manual operation: See "PRS State" on page 115

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:TPRS? <PeriodicityTPRS>

Queries the periodicity of the PRS generation (T_{PRS}) as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Parameters:

<PeriodicityTPRS> integer

Range: 160 to 1280
*RST: 160

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Usage: Query only

Options: R&S SMW-K84

Manual operation: See "PRS Periodicity T_PRS" on page 115

[:SOURce<hw>]:BB:EUTRa:DL:PRSS:MIPattern <PrsMutingInfo>, <BitCount>

Specifies a bit pattern that defines the muted and not muted PRS.

Parameters:

<PrsMutingInfo> numeric

Each bit defines the PRS state of one PRS occasion

0
PRS is muted

1
PRS is transmitted

*RST: #H3

<BitCount> integer

2, 4, 8 or 16 bits

Range: 2 to 16
*RST: 2

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PRSS:STATe on page 722

Options: R&S SMW-K84

Manual operation: See "PRS Muting Info" on page 116

11.9 General uplink commands

[:SOURce<hw>]:BB:EUTRa:UL:BW <BandWidth>

Sets the UL channel bandwidth.

Parameters:

<BandWidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00 | BW0_20 | USER

*RST: BW10_00

Example: `SOURce:BB:EUTRa:UL:BW BW20_00`

Options: BW0_20 requires R&S SMW-K115
USER requires R&S SMW-K55

Manual operation: See "Channel Bandwidth" on page 238

[:SOURce<hw>]:BB:EUTRa:UL:NORB <NumResBlocks>

Selects the number of physical resource blocks per slot.

Parameters:

<NumResBlocks> integer

Range: 6 to 110
*RST: 50

Example: `BB:EUTR:UL:BW USER`
Sets the bandwidth mode to USER in downlink.
`BB:EUTR:UL:NORB 7`
Sets the number of resource blocks to 7.

Manual operation: See "Number of Resource Blocks Per Slot" on page 239

[:SOURce<hw>]:BB:EUTRa:UL:SRATe?

Queries the sampling rate.

Return values:

<SampRate> float

Range: 192E4 to 3072E4
Increment: 1000
*RST: 1536E4

Example: `BB:EUTR:UL:SRAT?`
Queries the automatically set sampling rate.

Usage: Query only

Manual operation: See "Sampling Rate" on page 240

[:SOURce<hw>]:BB:EUTRa:UL:FFT <FftSize>

Sets the FFT (Fast Fourier Transformation) size. The available values depend on the selected number of resource blocks per slot.

Parameters:

<FftSize> integer

Range: 64 to 2048
*RST: 1024

Example: `BB:EUTR:UL:FFT?`
Queries the automatically set FFT size.

Manual operation: See "FFT Size" on page 239

[:SOURce<hw>]:BB:EUTRa:UL:OCCBandwidth?

Queries the occupied bandwidth. This value is set automatically according to the selected number of resource blocks per slot.

Return values:

<OccBandwidth> float

Default unit: MHz

Example: `BB:EUTR:UL:OCCB?`
Queries the automatically set occupied bandwidth in uplink.

Usage: Query only

Manual operation: See "Occupied Bandwidth" on page 240

[:SOURce<hw>]:BB:EUTRa:UL:OCCSubcarriers?

Queries the occupied subcarriers. The value is set automatically according to the selected number of resource blocks per slot.

Return values:

<OccSubcarriers> integer

Range: 72 to 1320
*RST: 600

Example: `BB:EUTR:UL:OCCS?`
Queries the number of occupied subcarriers.

Usage: Query only

Manual operation: See "Number Of Occupied Subcarriers" on page 241

[:SOURce<hw>]:BB:EUTRa:UL:LGS?

Queries the number of left guard subcarriers. The value is set automatically according to the selected number of resource blocks per slot.

Return values:

<LgSubCarr> integer

Range: 28 to 364
*RST: 212

Example: `BB:EUTR:UL:LGS?`
Queries the number of left guard subcarriers.

Usage: Query only

Manual operation: See "Number of Left/Right Guard Subcarriers" on page 241

[:SOURce<hw>]:BB:EUTRa:UL:RGS?

Queries the number of right guard subcarriers. The value is set automatically according to the selected number of resource blocks per slot.

Return values:

<RgSubCarr> integer

Range: 35 to 601
*RST: 211

Example: `BB:EUTR:UL:RGS?`
Queries the number of right guard subcarriers.

Usage: Query only

Manual operation: See "Number of Left/Right Guard Subcarriers" on page 241

[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CID <CellId>

Sets the cell identity.

Parameters:

<CellId> integer

Range: 0 to 503
*RST: 0

Example: `BB:EUTR:UL:PLC:CID 100`
Sets the cell ID.

Manual operation: See "Cell ID" on page 242

[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CIDGroup <PhysCellIdGroup>

Sets the ID of the physical cell identity group.

Parameters:

<PhysCellIdGroup> integer

Range: 0 to 167
*RST: 0

Example: `BB:EUTR:UL:PLC:CIDG 100`
Sets the UL physical cell ID group

Manual operation: See "Physical Cell ID Group" on page 242

[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:PLID <PhysicalLayerId>

Sets the identity of the physical layer within the selected physical cell identity group, set with the command `[:SOURce<hw>]:BB:EUTRa:UL[:PLCI]:CIDGroup`.

Parameters:

<PhysicalLayerId> integer

Range: 0 to 2
*RST: 0

Example: `BB:EUTR:UL:PLC:PLID 2`
Sets the UL physical layer ID

Manual operation: See "Physical Layer ID" on page 242

[:SOURce<hw>]:BB:EUTRa:UL:CPC <CyclicPrefix>

Sets the cyclic prefix length for all subframes.

Parameters:

<CyclicPrefix> NORMal | EXTended | USER

*RST: NORMal

Example: `SOURce1:BB:EUTRa:UL:CPC NORM`

Options: R&S SMW-K55: USER

Manual operation: See "Cyclic Prefix" on page 242

[:SOURce<hw>]:BB:EUTRa:UL:DLCPc <GSCpcOppDir>

In TDD mode, determines the cyclic prefix for the appropriate opposite direction.

Parameters:

<GSCpcOppDir> NORMal | EXTended

*RST: NORMal

Example:
```
:SOURce1:BB:EUTRa:DUPLexing TDD
:SOURce1:BB:EUTRa:UL:DLCPc EXTended
```

Manual operation: See "UL/DL Cyclic Prefix" on page 106

[:SOURce<hw>]:BB:EUTRa:UL:SOFFset <SfnOffset>

Set the start SFN value.

Parameters:

<SfnOffset> integer

Range: 0 to 4095
*RST: 0
Default unit: Frames

Example: `:SOURce1:BB:EUTRa:UL:SOFFset 10`
Sets the SFN start value

Manual operation: See "SFN Offset" on page 243

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:GRPHopping <GroupHopping>

Enables/disables group hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

Parameters:

<GroupHopping> 1 | ON | 0 | OFF
*RST: 0

Example: `BB:EUTR:UL:REFS:GRPH ON`
Enables group hopping

Manual operation: See "Group Hopping" on page 246

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SEQHopping <SequenceHopping>

Enables/disables sequence hopping for the uplink reference signals demodulation reference signal (DMRS) and sounding reference signal (SRS).

Parameters:

<SequenceHopping> 1 | ON | 0 | OFF
*RST: OFF

Example: `BB:EUTR:UL:REFS:SEQH ON`
Enables sequence hopping

Manual operation: See "Sequence Hopping" on page 246

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DSSHift <DeltaSeqShift>

Sets the delta sequence shift for PUSCH needed for the calculation of the group hopping pattern.

Parameters:

<DeltaSeqShift> integer
Range: 0 to 29
*RST: 0

Example: `BB:EUTR:UL:REFS:DSSH 3`
Sets the delta sequence shift for PUSCH

Manual operation: See "Delta Sequence Shift for PUSCH" on page 247

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DMRS <DrsDmrs>

Sets the part of the demodulation reference signal (DMRS) index which is broadcasted and therefore valid for the whole cell. This index applies when multiple shifts within a cell are used and is used by the calculation of the DMRS sequence.

Parameters:

<DrsDmrs> integer

Range: 0 to 11
*RST: 0

Example: `BB:EUTR:UL:REFS:DMRS 4`
Sets the demodulation reference signal index to 4

Manual operation: See "n(1)_DMRS" on page 247

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:ANSTx <AnSrsSimTxState>

Enables/disables simultaneous transmission of SRS (sounding reference signal) and ACK/NACK messages, i.e. transmission of SRS and PUCCH in the same subframe.

Parameters:

<AnSrsSimTxState> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:REFS:SRS:ANST ON`

Manual operation: See "A/N + SRS simultaneous Tx" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:MUPTs <MaxUpPts>

Enables/disables the cell-specific parameter srsMaxUpPts.

Parameters:

<MaxUpPts> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:REFS:SRS:MUPT ON`

Manual operation: See "SRS MaxUpPTS" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS <Csrs>

Sets the cell-specific parameter SRS bandwidth configuration (C_{SRS}).

Parameters:

<Csrs> integer

Range: 0 to 7
*RST: 0

Example: `BB:EUTR:UL:REFS:SRS:CSRS 4`
Sets the SRS bandwidth configuration

Manual operation: See "SRS Bandwidth Configuration C_SRS" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:DSFC?

Queries the value for the cell-specific parameter transmission offset Delta$_{SFC}$ in subframes, depending on the selected SRS subframe configuration ([:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS) and the dduplexing mode ([:SOURce<hw>]:BB:EUTRa:DUPLexing).

Return values:
<DeltSFC> string

Example: BB:EUTR:UL:REFS:SRS:SUC 4
Sets the SRS configuration
BB:EUTR:UL:REFS:SRS:DSFC?
Queries the Delta_SFC parameter

Usage: Query only

Manual operation: See "Transmission Offset Delta_SFC" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:SUConfiguration <SubFrameConfig>

Sets the cell-specific parameter SRS subframe configuration.

Parameters:
<SubFrameConfig> integer
Range: 0 to 15
*RST: 15

Example: BB:EUTR:UL:REFS:SRS:SUC 4
Sets the SRS configuration

Manual operation: See "SRS Subframe Configuration" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:TSFC?

Queries the value for the cell-specific parameter configuration period T$_{SFC}$ in subframes, depending on the selected SRS subframe configuration ([:SOURce<hw>]:BB:EUTRa:UL:REFSig:SRS:CSRS) and the duplexing mode ([:SOURce<hw>]:BB:EUTRa:DUPLexing).

Return values:
<Tsfc> string

Example: BB:EUTR:UL:REFS:SRS:SUC 4
Sets the SRS configuration
BB:EUTR:UL:REFS:SRS:TSFC?
Queries the T_SFC parameter

Usage: Query only

Manual operation: See "Configuration Period T_SFC" on page 248

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:CONFiguration <Configuration>

Sets the PRACH configuration number.

Parameters:

<Configuration> integer

Range: 0 to 63
*RST: 0

Example: `BB:EUTR:UL:PRAC:CONF 10`
Sets the PRACH configuration

Manual operation: See "PRACH Configuration" on page 249

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:FOFFset <FrequencyOffset>

Sets the prach-FrequencyOffset $n^{RA}_{PRBoffset}$

Parameters:

<FrequencyOffset> integer

Range: 0 to dynamic
*RST: 0

Example: `BB:EUTR:UL:PRAC:FOFF 2`
Sets the frequency offset

Manual operation: See "PRACH Frequency Offset" on page 249

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:RSET <RestrictedSet>

Enables/disables using of a restricted preamble set.

Parameters:

<RestrictedSet> URES | ARES | BRES | OFF | ON

URES|OFF
Unrestricted preamble set.

ARES|ON
Restricted set type A.

BRES
Restricted set type B.

*RST: URES

Example: `SOURce1:BB:EUTRa:UL:PRACh:RSET ARES`
Enables using of restricted set type A

Manual operation: See "PRACH Restricted Set" on page 251

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHMode <FreqHoppingMode>

Sets the frequency hopping mode for PUSCH.

Parameters:

<FreqHoppingMode> INTRa | INTer

*RST: INTRa

Example: `BB:EUTR:UL:PUSC:FHM INT`

Selects inter-subframe hopping mode

Manual operation: See "Frequency Hopping Mode" on page 251

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:FHOFfset <FHoppOffset>

Sets the PUSCH Hopping Offset N_{RB}^{HO}.

The PUSCH Hopping Offset determines the first physical resource block and the maximum number of physical resource blocks available for PUSCH transmission if PUSCH frequency hopping is used.

Parameters:

<FHoppOffset> integer

Range: dynamic to dynamic

*RST: 0

Example: `BB:EUTR:UL:PUSC:FHOF 2`

Set the PUSCH hopping offset

Manual operation: See "PUSCH Hopping Offset" on page 252

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NOSM <SubBandCount>

Sets the number of sub-bands (Nsb) into that the total range of physical resource blocks available for PUSCH transmission is divided. The frequency hopping is performed at sub-band level.

Parameters:

<SubBandCount> integer

Range: 1 to 110

*RST: 4

Example: `BB:EUTR:UL:PUSC:NOSM 3`

Sets the number of sub-bands

Manual operation: See "Number of Sub-bands" on page 252

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:NORB <RbCount>

Sets the PUCCH region in terms of reserved resource blocks, at the edges of the channel bandwidth.

Parameters:

<RbCount> integer

Range: 0 to 110

*RST: 4

Example: `BB:EUTR:UL:PUCC:NORB 3`
Reserves 3 RBs for PUCCH

Manual operation: See "Number of RBs used for PUCCH" on page 253

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:DESHift <DeltaShift>

Sets the delta shift parameter.

Parameters:
<DeltaShift> integer

Range: 1 to 3
*RST: 2

Example: `BB:EUTR:PUCC:DESH 3`
Sets the delta shift parameter

Manual operation: See "Delta Shift" on page 253

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1CS <N1Cs>

Sets the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Parameters:
<N1Cs> integer

Range: 0 to dynamic
*RST: 6

Example: `BB:EUTR:UL:PUCC:N1CS 5`
5 cyclic shifts are used for PUCCH format 1/1a/1b in an RB used for a combination of the PUCCH formats 1/1a/1b and 2/2a/2b

Manual operation: See "N(1)_cs" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2RB <N2Rb>

Sets bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

Parameters:
<N2Rb> integer

Range: 0 to dynamic
*RST: 1

Example: `BB:EUTR:UL:PUCC:N2RB 3`
Reserves 3 RB for PUCCH formats 2/2a/2b

Manual operation: See "N(2)_RB" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1NMax?

Queries the range of the possible PUCCH format 1/1a/1b transmissions from different users in one subframe and for normal CP.

Return values:

<N1NormCP> integer

Range: 0 to 110
*RST: 44

Example: `BB:EUTR:UL:PUCC:N1NM?`
Queries the range of the possible PUCCH formats 1/1a/1b transmissions.
`Response: 24`

Usage: Query only

Manual operation: See "Range n(1)_PUCCH (Normal/Extended CP)" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax?

Queries the range of the possible PUCCH format 1/1a/1b transmissions from different users in one subframe and for extended CP.

Return values:

<N1emax> integer

Range: 0 to 110
*RST: 29

Example: `BB:EUTR:UL:PUCC:N1EM?`
Queries the range of the possible PUCCH formats 1/1a/1b transmissions.
`Response: 10`

Usage: Query only

Manual operation: See "Range n(1)_PUCCH (Normal/Extended CP)" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N2Max?

Queries the range of possible number of PUCCH format 2/2a/2b transmissions from different users in one subframe.

Return values:

<N2Max> integer

Range: 0 to 110
*RST: 15

Example: `BB:EUTR:UL:PUCC:N2M?`
Queries the range of the possible PUCCH formats 2/2a/2b transmissions.
`Response: 16`

Usage: Query only

Manual operation: See "Range n(2)_PUCCH" on page 254

[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N5Max?
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N4Max?
[:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N3Max?

Queries the range of possible number of PUCCH format x transmissions from different users in one subframe.

Return values:

<N3Max> integer

Range: 0 to 549
*RST: 19

Usage: Query only

Options: N4Max|N5Max require R&S SMW-K119

Manual operation: See "Range n(3)_PUCCH" on page 254

11.10 DL frame configuration

[:SOURce<hw>]:BB:EUTRa:DL:BUR <Bur>

Selects either to fill unscheduled resource elements and subframes with dummy data or DTX.

In "Mode > eMTC/NB-IoT", unused resource elements are filled in with DTX.

Parameters:

<Bur> DUData | DTX

*RST: DUData

Example: `SOURce1:BB:EUTRa:DL:BUR DUData`
The unscheduled resource elements are filled with dummy data.

Manual operation: See "Behavior In Unscheduled REs (OCNG)" on page 137

[:SOURce<hw>]:BB:EUTRa:DL:CONSubframes <ConSubFrames>

Sets the number of configurable subframes.

Parameters:

<ConSubFrames> integer

Range: 1 to 40
*RST: 10

Example: `BB:EUTR:DL:CONS 10`
Ten subframes are configurable in downlink.

Manual operation: See "No Of Configurable (DL) Subframes" on page 137

[:SOURce<hw>]:BB:EUTRa:DL:RSTFrame

Resets all subframe settings of the selected link direction to the default values.

Example: `BB:EUTR:DL:RSTF`
Resets the downlink subframe parameters of path A to the default settings.

Manual operation: See "Reset All Subframes" on page 137

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:CYCPrefix <CycPrefix>

(enabled for `BB:EUTR:DL:CPC USER` only)

Sets the cyclic prefix for the according subframe.

Parameters:

<CycPrefix> NORMal | EXTended

*RST: NORMal

Example: `BB:EUTR:DL:CPC USER`
The cyclic prefix has to be adjusted on subframe basis.
`BB:EUTR:DL:SUBF6:CYCP NORM`
A normal prefix is used in subframe 6 in downlink.

Manual operation: See "Cyclic Prefix" on page 172

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALCount <AllocCount>

Sets the number of scheduled allocations in the selected subframe. The maximum number of allocations that can be scheduled depends on the number of the selected resource blocks.

Parameters:

<AllocCount> integer

Range: 0 to dynamic
*RST: 2 (SUBF0, SUBF10,SUBF20,SUBF30); 1(all other subframes)

Example:
```
BB:EUTR:DL:SUBF4:ALC 5
```
Five scheduled allocations are assigned to subframe four.

Manual operation: See "No. Of Used Allocations" on page 173

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CODWords <CodeWords>

Sets the number of codewords for an allocation.

Two codewords are available for global MIMO configuration with two or more antennas.

Parameters:

<CodeWords> 1 | 2

Range: 1 to 2
*RST: 1

Manual operation: See "Codeword" on page 174
See "Codeword" on page 214

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:MODulation <Modulation>

Sets the modulation scheme for the allocation.

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256 | QAM1024

*RST: QPSK

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW2:MOD QPSK
```
Selects QPSK as modulation scheme for the allocation.

Example:
```
SOUR:BB:EUTR:DL:SUBF1:ALL5:CW2:MOD QPSK
SOUR:BB:EUTR:DL:SUBF1:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF1:ALL7:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF1:ALL5:CW2:MOD?
Response: QPSK
```

Options: QAM256 requires option R&S SMW-K113
QAM1024 requires R&S SMW-K119

Manual operation: See "Modulation" on page 174

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:GAP <VrbGap>

Enables/disables the unitization of distributed Virtual Resource Blocks (VBR) and determines whether the first or the second VRB gap is applied.

Parameters:

<VrbGap> integer

0
A **localized distribution** is applied, i.e. the PDSCH mapping is performed on a direct VRB-to-PRB mapping.

1
Enables a **distributed** resource block allocation. The first VRB gap is used.

2
Enabled for "Channel Bandwidths" greater than 50 RBs.
The mapping is based on the second (smaller) VRB gap.

Range: 0 to 2
*RST: 0

Example:
```
SOUR:BB:EUTR:DL:BW BW10_00
SOUR:BB:EUTR:SUBF0:ALL2:GAP2
```

Manual operation: See "VRB Gap" on page 175

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBCount <ResBlockCount>

Sets the size of the selected allocation in resource blocks (per slot).

For allocations with two codewords, the number of resource blocks for the second codeword is automatically set to the number of resource blocks set for the first one.

Parameters:

<ResBlockCount> integer

AUTO
Indicates automatically calculated value depending on other settings

Range: 1 to 110
*RST: 1

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW:RBC 3
```

Manual operation: See "No. RB (Resource Blocks)" on page 176

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMCount <SymCount>

Sets the size of the selected allocation in OFDM symbols.

For content type PBCH, PDCCH and PDSCH, this value is set automatically.

For allocations with two codewords, the number of symbols for the second codeword is automatically set to number of symbols set for the first one.

Parameters:

<SymCount> integer

Range: 1 to 14
*RST: 6 (PBCH); 12 (PDSCH)

Example: For FDD mode and content type PDSCH, this value is set automatically in a way that the allocation always fills the complete subframe with consideration of the symbol offset.

```
SOUR:BB:EUTR:DL:SUBF1:CYCP NORM
SOUR:BB:EUTR:DL:SUBF2:ALL2:CW2:SYM 2
SOUR:BB:EUTR:DL:SUBF1:ALL2:CW2:SYMC 12
```

Manual operation: See "No. Sym." on page 176

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:RBOFfset <ResBlockOffset>

Queries the start resource block of the selected allocation.

Parameters:

<ResBlockOffset> integer

AUTO
Indicates automatically calculated value depending on other settings

Range: 0 to dynamic
*RST: dynamic

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:RBOF?`

Manual operation: See "Offset RB" on page 177

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SYMoffset <SymOffset>

Sets the start OFDM symbol of the selected allocation.

Parameters:

<SymOffset> integer

Range: 0 to 13
*RST: 2

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:SYM 5`
OFDM symbol five is the start OFDM symbol for allocation five in subframe four.

Manual operation: See "Offset Sym." on page 177

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:AOC <Aoc>

Sets whether automatic offset calculation is used or not.

Parameters:

<Aoc> 1 | ON | 0 | OFF

*RST: ON

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:AOC ON`
Activates the automatic offset calculation for the selected allocation.

Manual operation: See "Auto" on page 178

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PHYSbits?

Queries the number of physical bits for the selected allocation. The value is set automatically according to the current allocation settings.

Return values:

<PhysicalBits> integer

AUTO
Indicates automatically calculated value depending on other settings

Range: 0 to 105600
*RST: 0

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:PHYS?`
Queries the number of physical bits for allocation five in subframe four.

Usage: Query only

Manual operation: See "Phys. Bits" on page 178
See "Number of Physical Bits (DL)" on page 220

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DATA <Data>

Sets the data source for the selected allocation.

For allocations with two codewords, the data source for the second codeword is automatically set to the data source set for the first one.

Parameters:

<Data> USER1 | USER2 | USER3 | USER4 | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE | MIB | MCCH | MTCH

MIB
(Result parameter)
Indicates that the PBCH transmits real MIB data.
(See also [:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB on page 782)

MCCH|MTCH
(Result parameter)
Indicates allocations in the MBSFN subframes, if MBSFN is used.
(See also [:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MODE on page 752)

*RST: dynamic

Example:

```
BB:EUTR:DL:SUBF4:ALL5:CW:DATA PN9
```

PN9 is the data source for the selected allocation.

Manual operation: See "Data Source" on page 178

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:

```
BB:EUTR:DL:SUBF4:ALL5:CW:DATA PATT
BB:EUTR:DL:SUBF4:ALL5:CW:PATT #H3F,8
```

Manual operation: See "Data Source" on page 178

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:DSELect <DSelect>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DSelect> string

Filename incl. file extension or complete file path

Example:
```
BB:EUTR:DL:SUBF2:ALL5:CW:DATA DLISt
BB:EUTR:DL:SUBF2:ALL5:CW:DSELect
"/var/user/eutra_list1"
```

Manual operation: See "Data Source" on page 178

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:POWer <Power>

Sets the power P_{PDSCH} respectively P_{PBCH} for the selected allocation. The power of the PDCCH allocation P_{PDCCH} is read-only. The value is set with the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:POWer`.

For allocations with two codewords, the power for the second codeword is automatically set to the power set for first one.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: P_{PDSCH}, P_{PBCH}
```
SOUR:BB:EUTR:DL:SUBF1:ALL2:POW 10.00
```

Example: P_{PDCCH}
```
SOUR:BB:EUTR:DL:SUBF1:ENCC:PDCC:POW 2.00
SOUR:BB:EUTR:DL:SUBF1:ALL1:POW?
Response: 2
```

Manual operation: See "Rho A" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONType?

Queries the type for the selected allocation.

PBCH can be configured in subframe 0 only.

Return values:

<ConType> PDSCh | PBCH | PDCCh | PMCH | EPD1 | EPD2

*RST: PDSCh

Example:
```
BB:EUTR:DL:SUBF4:ALL5:CW:CONT?
Response: PDSC
```

Usage: Query only

Options: PMCH requires R&S SMW-K84
EPD1|EPD2 require R&S SMW-K112

Manual operation: See "Content Type" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:STATe <State>

Sets the allocation state to active or inactive.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:STAT OFF`

Deactivates the selected allocation.

Manual operation: See "State" on page 179

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CONFlict <Conflict>

Indicates a conflict between two allocations.

Parameters:

<Conflict> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:DL:SUBF4:ALL5:CW2:CONF?`

Queries for the selected allocation whether there is a conflict with another allocation.

Manual operation: See "Conflict" on page 180

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:USER<ch>:PHYSbits?

Queries the size of the selected allocation in bits and considering the subcarriers that are used for other signals or channels with higher priority.

If a User 1...4 is selected for the "Data Source" in the allocation table for the corresponding allocation, the value of the parameter "Number of Physical Bits" is the sum of the "Physical Bits" of all single allocations that belong to the same user in the selected subframe.

Return values:

<PhysicalBits> integer

Range: 0 to 100000
*RST: 0

Example: `BB:EUTR:DL:SUBF1:USER3:PHYS?`

Queries the number of physical bits

Usage: Query only

Manual operation: See "Number of Physical Bits (DL)" on page 220

11.11 DL MBFSN

Option: R&S SMW-K84.

Example: Enabling and configuring MBSFN transmission
The following is a simple example of how to configure an MBSFN signal.

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 512
SOURce1:BB:EUTRa:DL:BW BW1_40
SOURce1:BB:EUTRa:DL:MBSFn:MODE MIX
SOURce1:BB:EUTRa:DL:MBSFn:UEC C5
SOURce1:BB:EUTRa:DL:MBSFn:RHOA 0

SOURce1:BB:EUTRa:DL:MBSFn:SC:APER AP8
SOURce1:BB:EUTRa:DL:MBSFn:SC:AOFFset 2
SOURce1:BB:EUTRa:DL:MBSFn:SC:AMODe F4
SOURce1:BB:EUTRa:DL:MBSFn:SC:AVAL 11184810

SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:STATe 1
SOURce1:BB:EUTRa:DL:MBSFn:AI:ID 0
SOURce1:BB:EUTRa:DL:MBSFn:AI:NMRL 2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER RP128
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:MPER MP512
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC NRC2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NSI 4
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:OFFS 0
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS MCS2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:DATA PN9
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NPATtern #H0,1
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:NOFFset 0
SOURce1:BB:EUTRa:DL:MBSFn:AI:NIND?
// Response:  2
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:AVAL?
// Response:  11184810
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:MODulation?
Response:  QPSK
SOURce1:BB:EUTRa:DL:MBSFn:AI:MCCH:TBSize?
// Response: 2216

SOURce1:BB:EUTRa:DL:MBSFn:MTCH:CSAP AP64
SOURce1:BB:EUTRa:DL:MBSFn:MTCH:NPMChs 3
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:SASTart 0
SOURce1:BB:EUTRa:DL:MBSFn:PMCH1:SPERiod SPRF8
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MCSTwo 0
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MCS 5
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MOD?
// QPSK
```

```
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MCSTwo 1
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:MOD?
// QAM16
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:DATA PN9
SOURce1:BB:EUTRa:DL:MBSFn:PMCH0:STATe 1
SOURce1:BB:EUTRa:DL:MBSFn:PMCH1:SPERiod SPRF8
SOURce1:BB:EUTRa:DL:MBSFn:PMCH2:SPERiod SPRF8

SOURce1:BB:EUTRa:STATe 1
```

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:ID <AreaID>

Defines the MBSFN area ID, parameter N_{id}^{MBSFN}.

Parameters:

<AreaID> integer

Range: 0 to 255
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Area ID (N_ID_MBSFN)" on page 95

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:AVAL? <AllocationValue>

Indicates the subframes of the radio frames indicated by the "MCCH repetition period" and the "MCCH offset", that may carry MCCH.

Parameters:

<AllocationValue> integer

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Usage: Query only

Manual operation: See "Allocation Value (HEX)" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DATA <DataSource>

Sets the data source used for the MCCH.

Parameters:

<DataSource> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH Data Source" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:DLISt <DataList>

Sets the data list used as data source for MCCH.

Parameters:

<DataList> string

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH Data Source" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS <MCS>

Defines the Modulation and Coding Scheme (MCS) applicable for the subframes indicated by the "MCCH Allocation value" and for the first subframe of each MCH scheduling period (which may contain the MCH scheduling information provided by MAC).

Parameters:

<MCS> MCS19 | MCS13 | MCS7 | MCS2

*RST: MCS2

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH MCS" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MODulation? <Modulation>

Queries the values as set with the command `[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MCS`.

Parameters:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Usage: Query only

Manual operation: See "MCCH Modulation" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:MPER <ModifPeriod>

Sets the MCCH Modification Period.

Parameters:

<ModifPeriod> MP512 | MP1024

*RST: MP512

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH Modification Period" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NOFFset <NotifOffset>

Defines, together with the `[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC`, the radio frames in which the MCCH information change notification is scheduled.

Parameters:

<NotifOffset> integer

Range: 0 to 10
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Notification Offset" on page 98

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NPATtern <NotifPattern>, <BitCount>

Sets the pattern for the notification bits sent on PDCCH DCI format 1c.

Parameters:

<NotifPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745.

Manual operation: See "Notification Pattern" on page 98

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NRC <NotifRepetCoeff>

Selects the current change notification repetition period common for all MCCHs that are configured.

Parameters:

<NotifRepetCoeff> NRC2 | NRC4

*RST: NRC2

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Notification Repetition Coefficient" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:NSI <Index>

Defines the subframe used to transmit MCCH change notifications on PDCCH.

Parameters:

<Index> integer

In FDD: values 1 to 6 correspond with subframes #1, #2, #3, #6, #7 and #8
In TDD: values 1 to 5 correspond with subframe #3, #4, #7, #8 and #9

Range: 1 to dynamic
*RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Notification Subframe Index" on page 98

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:OFFS <McchOffset>

Indicates, together with the `[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER`, the radio frames in which MCCH is scheduled.

Parameters:

<McchOffset> integer

Range: 0 to 10
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH Offset" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:PATTern <Pattern>, <BitCount>

Sets the pattern used as data source for the MCCH.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745.

Manual operation: See "MCCH Data Source" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:RPER <RepetPeriod>

Defines the interval between transmissions of MCCH information in radio frames.

Parameters:

<RepetPeriod> RP64 | RP32 | RP128 | RP256

*RST: RP32

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH Repetition Period" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:STATe <MccState>

Enables/disables the MCCH.

Parameters:

<MccState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCCH State" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:MCCH:TBSize? <TB_Size>

Queries the values as determined by the "MCCH MCS".

Parameters:

<TB_Size> integer

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Usage: Query only

Manual operation: See "MCCH Transport Block Size" on page 97

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NIND <NotifIndicator>

Defines which PDCCH bit is used to notify the UE about change of the MCCH applicable for this MBSFN area.

Parameters:

<NotifIndicator> integer

Range: 0 to 7
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Notification Indicator" on page 96

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:AI:NMRL <RegionLength>

Defines how many symbols from the beginning of the subframe constitute the non-MBSFN region.

Parameters:

<RegionLength> integer

Range: 1 to 2
*RST: 2

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Non-MBSFN Region Length" on page 95

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MODE <MbsfnMode>

Enables the MBSFN transmission and selects a mixed MBSFN Mode.

Parameters:

<MbsfnMode> OFF | MIXed

*RST: OFF

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MBSFN Mode" on page 93

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:CSAP <AllocPeriod>

Defines the period during which resources corresponding with field *commonSF-Alloc* are divided between the (P)MCH that are configured for this MBSFN area.

Parameters:

<AllocPeriod> AP4 | AP8 | AP16 | AP32 | AP64 | AP128 | AP256

*RST: AP4

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Common Subframe Allocation Period" on page 98

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:MTCH:NPMChs <NumOfPMCHs>

Defines the number of PMCHs in this MBSFN area.

Parameters:

<NumOfPMCHs> int

Range: 1 to 15
Increment: 1
*RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Number of PMCHs" on page 99

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:STATe <PmchState>

Enables/disables the selected PMCH/MTCH.

Parameters:

<PmchState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "State" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DATA <DataSource>

Sets the data source for the selected PMCH/MTCH.

Parameters:

<DataSource>	PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE *RST: PN9

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Data Source" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:DLISt <DataList>

Sets the data list of the data source for the selected PMCH/MTCH.

Parameters:

<DataList>	string

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Data Source" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:PATTern <Pattern>, <BitCount>

Sets the pattern of the data source for the selected PMCH/MTCH.

Parameters:

<Pattern>	numeric *RST: #H0
<BitCount>	integer Range: 1 to 64 *RST: 1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Data Source" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MCSTwo <PmchMcsTwo>

Defines which of the two tables defined in TS 36.213 is used to specify the used modulation and coding scheme.

Parameters:

<PmchMcsTwo>	1 | ON | 0 | OFF **0** Table 7.1.7.1-1 is used

1
Table 7.1.7.1-1A is used
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Options: R&S SMW-K113

Manual operation: See "Use Table 2" on page 99

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MCS <MCS>

Sets the modulation and coding scheme (MCS) applicable for the subframes of the (P)MCH.

Parameters:
<MCS> integer
Range: 0 to 28
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCS" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:MOD?

Queries the used modulation.

Return values:
<PmchMod> QPSK | QAM16 | QAM64 | QAM256
*RST: QPSK

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Usage: Query only

Options: QAM256 requires R&S SMW-K113

Manual operation: See "Modulation" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SPERiod <SchedPeriod>

Defines the MCH scheduling period, i.e. the periodicity used for providing MCH scheduling information at lower layers (MAC) applicable for an MCH.

Parameters:
<SchedPeriod> SPM | SPRF8 | SPRF16 | SPRF32 | SPRF64 | SPRF128 | SPRF256 | SPRF512 | SPRF1024
*RST: SPM

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MCH Scheduling Period" on page 100

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SASTart <AllocStart>
[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:PMCH<ch0>:SAENd <AllocEnd>

Defines the first/last subframe allocated to this (P)MCH within a period identified by field *commonSF-Alloc*.

Parameters:

<AllocEnd> integer

Range: 0 to 1535
*RST: 23

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "SF Alloc Start/SF Alloc End" on page 99

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:RHOA <RhoA>

Defines the power of the MBSFN channels relative to the common Reference Signals.

Parameters:

<RhoA> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "MBSFN Rho A" on page 93

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AMODe <AllocationMode>

Defines whether MBSFN periodic scheduling is 1 or 4 frames.

Parameters:

<AllocationMode> F1 | F4

*RST: F1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Subframe Allocation Mode" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AOFFset <Offset>

Sets the Radio Frame Allocation Offset

Parameters:

<Offset> integer

Range: 0 to 31
*RST: 0

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Radio Frame Allocation Offset" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:APER <AllocPeriod>

Sets the Radio Frame Allocation Period.

Parameters:

<AllocPeriod> AP1 | AP2 | AP4 | AP8 | AP16 | AP32

*RST: AP1

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Radio Frame Allocation Period" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:SC:AVAL <AllocationValue>

Defines which MBSFN subframes are allocated.

Parameters:

<AllocationValue> integer

Range: 0 to #HFFFFFF
*RST: #H3F

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "Allocation value (HEX)" on page 94

[:SOURce<hw>]:BB:EUTRa:DL:MBSFn:UEC <UeCategory>

Defines the UE category as defined in TS 36.306.

Parameters:

<UeCategory> C1 | C2 | C3 | C4 | C5

*RST: C5

Example: See Example"Enabling and configuring MBSFN transmission" on page 745

Manual operation: See "UE Category" on page 93

11.12 DL carrier aggregation

Option: R&S SMW-K55 and R&S SMW-K85

Example: Enabling and configuring DL Carrier Aggregation

The following is an example of how to configure and enable DL carrier aggregation signal.

```
*RST
SCONfiguration:APPLy
SCONfiguration:MODE ADV
SCONfiguration:FADing MIMO2X2X2
SCONfiguration:BASeband:SOURce COUP
SCONfiguration:APPLy

SCONfiguration:OUTPut:MAPPing:RF1:MODE ADD
SCONfiguration:OUTPut:MAPPing:RF2:MODE ADD
SCONfiguration:OUTPut:MAPPing:RF1:STReam3:STATe 1
SCONfiguration:OUTPut:MAPPing:RF2:STReam4:STATe 1
SCONfiguration:OUTPut:MAPPing:IQOutput1:STReam3:STATe 0
SCONfiguration:OUTPut:MAPPing:IQOutput2:STReam4:STATe 0
SCONfiguration:OUTPut:MAPPing:STReam3:FOFFset 20000000
SCONfiguration:OUTPut:MAPPing:STReam4:FOFFset 20000000

SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:DL:CONF:MODE AUTO
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration?
// Response: TX2
SOURce1:BB:EUTRa:DL:CA:STATe?
// Response:  1
SOURce1:BB:EUTRa:DL:CA:CELL0:STATe?
// Response:  1
SOURce1:BB:EUTRa:DL:CA:CELL1:STATe?
// Response:  1
SOURce1:BB:EUTRa:DL:CA:CELL0:ID 0
SOURce1:BB:EUTRa:DL:CA:CELL0:DUPLexing?
// Response: FDD
SOURce1:BB:EUTRa:DL:CA:CELL0:BW BW10_00
SOURce1:BB:EUTRa:DL:CA:CELL0:SCINdex 0
SOURce1:BB:EUTRa:DL:CA:CELL0:CIF 1
SOURce1:BB:EUTRa:DL:CA:CELL0:PSTart 2
SOURce1:BB:EUTRa:DL:CA:CELL0:PHICh:DURation NORM
SOURce1:BB:EUTRa:DL:CA:CELL0:PHICh:NGParameter NG2
SOURce1:BB:EUTRa:DL:CA:CELL0:TDELay?
// Response: 0
SOURce1:BB:EUTRa:DL:CA:CELL1:INDEx?
// Response: 1
SOURce1:BB:EUTRa:DL:CA:CELL1:SCINdex 0
```

```
SOURce1:BB:EUTRa:DL:CA:CELL1:CIF 1

SOURce1:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB0?
// Response: PC
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB1?
// Response: PC
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB2?
// Response: SC1
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:CELL:BB3?
// Response: SC1

SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:APPend
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:SITem 0
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIFmt F2C
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:CIField 0
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:RAHR 131071
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:SITem 1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM1:DCIFmt F2C
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM1:DCIConf:CIField 1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM1:DCIConf:RAHR 10000
SOURce1:BB:EUTRa:STATe 1

SOURce1:FSIMulator:STANdard LMETU70M
SOURce1:FSIMulator:STATe 1
SOURce2:FSIMulator:STANdard LMETU70M
SOURce2:FSIMulator:STATe 1
OUTPut1:STATe 1
OUTPut2:STATe 1
```


[:SOURce<hw>]:BB:EUTRa:DL:CA:STATe <CaGlobalState>

Enables/disables the generation of several component carriers.

Parameters:
<CaGlobalState> 1 | ON | 0 | OFF
*RST: OFF

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "Activate Carrier Aggregation" on page 81

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BB <BasebandPath>

Determines the baseband block that generates the selected component carrier.

Parameters:
<BasebandPath> A | B
*RST: A

Options: R&S SMW-K85

Manual operation: See "Baseband" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:BW <Bandwidth>

Sets the bandwidth of the corresponding component carrier/SCell.

Parameters:
<Bandwidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00
*RST: BW10_00

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "Bandwidth" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:CIF <CifPresent>

Defines whether the CIF is included in the PDCCH DCI formats transmitted from the corresponding SCell.

Parameters:
<CifPresent> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "CIF Present" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DFReq <DeltaFreq>

Sets the frequency offset between the central frequency of the SCell and the frequency of the PCell.

Parameters:

<DeltaFreq> float

Value range depends on the installed options, the number of cells and the cell bandwidth.

Range: -40 to 40
Increment: 0.1
*RST: 0
Default unit: MHz

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "delta f / MHz" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:ID <PhysicalCellId>

Sets the physical Cell ID of the corresponding SCell.

Parameters:

<PhysicalCellId> integer

Range: 0 to 503
*RST: 0

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "Physical Cell ID" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DUPLexing <DlDuplexmode>

Selects the duplexing mode of the component carriers.

Parameters:

<DlDuplexmode> TDD | FDD | LAA

*RST: FDD

Example:

```
SOURce1:BB:EUTRa:DL:CA:CELL0:DUPLexing TDD
SOURce1:BB:EUTRa:DL:CA:CELL1:UDConf 3
SOURce1:BB:EUTRa:DL:CA:CELL1:SPSConf 2

// SOURce1:BB:EUTRa:DL:CONF:MODE AUTO
// SOURce1:BB:EUTRa:DL:CA:CELL1:DUPLexing FDD
// SOURce1:BB:EUTRa:DL:CA:CELL2:DUPLexing TDD
// SOURce1:BB:EUTRa:DL:CA:CELL2:UDConf 1
// SOURce1:BB:EUTRa:DL:CA:CELL2:SPSConf
```

Options: TDD and FDD combination requires R&S SMW-K113
LAA requires R&S SMW-K119

Manual operation: See "Duplexing" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:UDConf <DLCaTddULDLConf>

Sets the Uplink-Downlink Configuration number.

Parameters:

<DLCaTddULDLConf> integer

Range: 0 to 6
*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DUPLexing` on page 760

Options: R&S SMW-K112

Manual operation: See "TDD UL/DL Configuration" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:SPSConf <DLCaTddSSConf>

Sets the special subframe configuration number.

Parameters:

<DLCaTddSSConf> integer

Range: 0 to 10
*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:DUPLexing` on page 760

Options: R&S SMW-K112
R&S SMW-K119: special subframe configuration 10

Manual operation: See "TDD Special Subframe Config" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:INDex <CellIndex>

Sets the cell index of the corresponding SCell.

The cell index of the PCell is always 0.

Parameters:

<CellIndex> integer

Range: 1 to 7
*RST: 1

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "Cell Index" on page 82

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:POFFset <PowerOffset>

Sets the power offset of the SCells relative to the power level of the PCell.

Parameters:

<PowerOffset> float

Range: -80 to 80
Increment: 0.01
*RST: 0

Options: R&S SMW-K85

Manual operation: See "Power / dB" on page 86

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PSTart <PdschStart>

Sets the starting symbol of the PDSCH for the corresponding SCell.

Parameters:

<PdschStart> integer

Range: 1 to 4
*RST: 2

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "PDSCH Start" on page 84

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:SCINdex <SchedCellIndex>

Defines the component carrier/cell that signals the UL and DL grants for the selected SCell.

Parameters:

<SchedCellIndex> integer

Range: 0 to 7
*RST: 0

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "sched. Cell Index" on page 83

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:TDELay <TimeDelay>

Sets the time delay of the SCell relative to the PCell.

Parameters:

<TimeDelay> integer

Range: 0 to 700000
*RST: 0

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "Delay / ns" on page 86

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PHICh:DURation <Duration>

Sets the PHICH duration and defines the allocation of the PHICH resource element groups over the OFDM symbols.

Parameters:

<Duration> NORMal | EXTended

NORMal
The first OFDM symbol is allocated

EXTended
The first three OFDM symbols are allocated.

*RST: NORMal

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Options: CA:CELL<ch0> requires R&S SMW-K112

Manual operation: See "PHICH Duration" on page 85

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:PHICh:NGParameter <NgParameter>

Sets the parameter N_g according to TS 36.211.

Parameters:

<NgParameter> NG1_6 | NG1_2 | NG1 | NG2 | NGCustom

NG1_6 | NG1_2 | NG1 | NG2
Determines the number of PHICH groups.

NGCustom
(not if carrier aggregation is used)
The number of PHICH groups are set with the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:NOGRoups`.

*RST: NG1_6

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Options: CA:CELL<ch0> requires R&S SMW-K112

Manual operation: See "PHICH N_g" on page 84

[:SOURce<hw>]:BB:EUTRa:DL:CA:CELL<ch0>:STATe <CellState>

Activates/deactivates the component carrier/SCell.

Parameters:

<CellState> 1 | ON | 0 | OFF

*RST: OFF

Example: See Example"Enabling and configuring DL Carrier Aggregation" on page 757

Manual operation: See "State" on page 86

11.13 CSI-RS

Example: Enabling a CSI-RS transmission

The following is a simple example of how to configure a CSI-RS transmission.

```
SOURce1:BB:EUTRa:PRESet
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:DL:CSIS:ZP 4112
SOURce1:BB:EUTRa:DL:CSIS:ZPI 5
SOURce1:BB:EUTRa:DL:CSIS:ZPDelta?
// Response: 0
SOURce1:BB:EUTRa:DL:CSIS:ZPT?
// Response: 10
SOURce1:BB:EUTRa:DL:CSIS:STATe ON
SOURce1:BB:EUTRa:DL:CSIS:NAP AP1
SOURce1:BB:EUTRa:DL:CSIS:SFI 1
SOURce1:BB:EUTRa:DL:CSIS:CONFig0 0
SOURce1:BB:EUTRa:DL:CSIS:SFDelta?
// Response: 1
SOURce1:BB:EUTRa:DL:CSIS:SFT?
// Response: 5
SOURce1:BB:EUTRa:DL:CSIS:POW 0.5

SOURce1:BB:EUTRa:DL:SFSelection 1
SOURce1:BB:EUTRa:DL:SUBF1:ALCount 2
SOURce1:BB:EUTRa:DL:SUBF1:ALLoc1:CW1:PHYSbits?
// Response: 276
SOURce1:BB:EUTRa:DL:SUBF1:ALLoc1:CAW ON
// Response: 272
SOURce1:BB:EUTRa:DL:USER1:CAW:STATe ON
SOURce1:BB:EUTRa:STATe 1
```

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:CONFig[<st>] <CsiRsConfig>

Defines the CSI-RS configuration used for the current cell and for which the UE assumes non-zero transmission power.

Suffix:

<st> 0
CSI-RS configuration number

Parameters:

<CsiRsConfig> integer
Range: 0 to 31
*RST: 0

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: CELL<ch0> requires R&S SMW-K85
Suffix <st> requires R&S SMW-K119

Manual operation: See "Resource Configuration" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NAP <CsiRsNumAp>

Defines the number of antenna ports the CSI-RS are transmitted on.

Parameters:

<CsiRsNumAp> AP1 | AP2 | AP4 | AP8
*RST: AP1

Example: See Example"Enabling a CSI-RS transmission" on page 764

Manual operation: See "Number of AP per CSI-RS Configuration" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:POW <CsiRsPow>

Boosts the CSI-RS power compared to the cell-specific reference signals.

Parameters:

<CsiRsPow> float

Range: -8 to 15
Increment: 0.001
*RST: 0

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: CELL<ch0> requires R&S SMW-K85

Manual operation: See "CSI-RS Power" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SFDelta?

Sets the parameter subframe offset Δ_{CSI-RS} for cell-specific CSI-RS.

Return values:

<CsiRsOffs> integer

Range: 0 to 79
*RST: 0

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Usage: Query only

Options: CELL<ch0> requires R&S SMW-K85

Manual operation: See "Subframe Offset (Delta_CSI-RS)" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SFI <CsiRsSfConf>

Sets the parameter I_{CSI-RS} for cell-specific CSI-RS.

Parameters:

<CsiRsSfConf> integer

Range: 0 to 154
*RST: 0

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: CELL<ch0> requires R&S SMW-K85

Manual operation: See "Subframe Config (I_CSI-RS)" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SFT?

Queires the parameter subframe configuration period T_{CSI-RS} for cell-specific CSI-RS.

Return values:

<CsiRsPeriod> integer

Range: 5 to 80
*RST: 5

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Usage: Query only

Options: CELL<ch0> requires R&S SMW-K85

Manual operation: See "Periodicity (T_CSI-RS)" on page 121

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:STATe <CsiRsState>

Enables the transmission of a CSI-RS.

Parameters:

<CsiRsState> OFF | ON | 1 | 0

*RST: OFF

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: CELL<ch0> requires R&S SMW-K85

Manual operation: See "CSI-RS State" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZP <ZeroPow>

Sets the used CSI-RS configurations in the zero transmission power subframes.

Suffix:

<st0> 0|1

Distinguishes between the primary (ZP CSI-RS #0) and the additional (ZP CSI-RS #1) zero-power CSI reference signal of a cell.

Parameters:

<ZeroPow> decimal value

In the user interface, the 16 bits are set as a hexadecimal value. In the remote control, as a decimal value.

Range: 0 to 65535
Increment: 1
*RST: 0

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: CELL<ch0> requires R&S SMW-K85
ZPRS<st0> requires R&S SMW-K113

Manual operation: See "ZeroPowerCSI-RS (HEX)" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZPDelta?

Sets the parameter subframe offset Δ_{CSI-RS} for CSI-RS with zero transmission power.

Suffix:

<st0> 0|1

Distinguishes between the primary (ZP CSI-RS #0) and the additional (ZP CSI-RS #1) zero-power CSI reference signal of a cell.

Return values:

<ZeroPowOffs> integer

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Usage: Query only

Options: CELL<ch0> requires R&S SMW-K85
ZPRS<st0> requires R&S SMW-K113

Manual operation: See "Subframe Offset (Delta_CSI-RS)" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZPI <ZeroPowConf>

Sets the parameter I_{CSI-RS} for CSI-RS with zero transmission power.

Suffix:

<st0> 0|1
Distinguishes between the primary (ZP CSI-RS #0) and the additional (ZP CSI-RS #1) zero-power CSI reference signal of a cell.

Parameters:

<ZeroPowConf> integer

Range: 0 to 154
*RST: 0

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: CELL<ch0> requires R&S SMW-K85
ZPRS<st0> requires R&S SMW-K113

Manual operation: See "Subframe Config (I_CSI-RS)" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>][:ZPRS<st0>]:ZPT?

Sets the parameter subframe configuration period T_{CSI-RS} for CSI-RS with zero transmission power.

Suffix:

<st0> 0|1
Distinguishes between the primary (ZP CSI-RS #0) and the additional (ZP CSI-RS #1) zero-power CSI reference signal of a cell.

Return values:

<ZeroPowPer> integer

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Usage: Query only

Options: CELL<ch0> requires R&S SMW-K85
ZPRS<st0> requires R&S SMW-K113

Manual operation: See "Periodicity (T_CSI-RS)" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:DWPTs <DwPTS>

Enables transmission of the CSI-RS in the Downlink Pilot Time Slot (DwPTS) parts of the TDD frame.

Parameters:

<DwPTS> 1 | ON | 0 | OFF

*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NCFG on page 769.

Options: R&S SMW-K119

Manual operation: See "CSI-RS in DwPTS" on page 119

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NCFG <NumberOfConfigs>

Sets the number of CSI-RS configurations.

Parameters:

<NumberOfConfigs> 1 | 2 | 3 | 4 | 5 | 7

*RST: 1

Example:

```
SOURce1:BB:EUTRa:DL:CSIS:CELL0:STATe 1
SOURce1:BB:EUTRa:DL:CSIS:CELL0:DWPTs 1

SOURce1:BB:EUTRa:DL:CSIS:CELL0:NCFG 2
SOURce1:BB:EUTRa:DL:CSIS:CELL0:CDMType 4
SOURce1:BB:EUTRa:DL:CSIS:CELL0:NAP?
// AP8
SOURce1:BB:EUTRa:DL:CSIS:CELL0:CONFig0 1
SOURce1:BB:EUTRa:DL:CSIS:CELL0:FRDensity0 1
SOURce1:BB:EUTRa:DL:CSIS:CELL0:TRANscomb0 0
SOURce1:BB:EUTRa:DL:CSIS:CELL0:CONFig1 2
SOURce1:BB:EUTRa:DL:CSIS:CELL0:FRDensity1 D12
SOURce1:BB:EUTRa:DL:CSIS:CELL0:TRANscomb1 1
...
```

See also Example"Enabling a CSI-RS transmission" on page 764.

Options: R&S SMW-K119

Manual operation: See "Number of CSI-RS Configurations" on page 120

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:SCID <ScramblingId>

Sets the additional scrambling identity n_ID used to generate the NonZeroTxPower CSI-RS.

Parameters:

<ScramblingId> integer

Range: 0 to 503

Example: See Example"Enabling a CSI-RS transmission" on page 764.

Options: R&S SMW-K112

Manual operation: See "Scrambling Identity (n_ID)" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:CDMType <CDMType>

Sets the higher-level parameter `CDMType` that influence the antenna port mapping of the CSI-RS.

Parameters:

<CDMType> 2 | 4 | 8

*RST: 2

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NCFG` on page 769.

Options: R&S SMW-K119

Manual operation: See "CDMType" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:FRDensity[<st>] <CsiRFreqDensity>

Sets the parameter `NZP-FrequencyDensity`.

Parameters:

<CsiRFreqDensity> D1 | D12 | D13

*RST: 1

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NCFG` on page 769.

Options: R&S SMW-K119

Manual operation: See "Frequency Density" on page 122

[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:TRANscomb[<st>] <CsiRsTransComb>

Sets the parameter `NZP-TransmissionComb`.

Parameters:

<CsiRsTransComb> 0 | 1 | 2

*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:CSIS[:CELL<ch0>]:NCFG` on page 769.

Options: R&S SMW-K119

Manual operation: See "Transmission Comb" on page 123

11.14 LAA and DRS

Option: R&S SMW-K119

Example: Enabling a LAA SCell and configuring of one LAA burst

The following is a simple example of how to configure a LAA transmission.

```
SOURce1:BB:EUTRa:PRESet
SOURce1:BB:EUTRa:STDMode LTE
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN

// enable a LAA SCell
SOURce1:BB:EUTRa:DL:CONF:MODE AUTO
SOURce1:BB:EUTRa:DL:CA:CELL1:DUPLexing LAA
SOURce1:BB:EUTRa:DL:CA:CELL1:BW BW20_00
SOURce1:BB:EUTRa:DL:CA:CELL1:DFReq 70
SOURce1:BB:EUTRa:DL:CA:CELL1:CIF 1
SOURce1:BB:EUTRa:DL:CA:CELL1:STATe 1
SOURce1:BB:EUTRa:DL:CA:STATe 1
// configure the DRS
SOURce1:BB:EUTRa:DL:DRS:CELL1:PERiodicity P40
SOURce1:BB:EUTRa:DL:DRS:CELL1:OFFSet 1
SOURce1:BB:EUTRa:DL:DRS:CELL1:DURation DUR1
SOURce1:BB:EUTRa:DL:DRS:CELL1:PATTern 0
SOURce1:BB:EUTRa:DL:DRS:CELL1:STATe 1
// SOURce1:BB:EUTRa:DL:DRS:CELL2:PERiodicity P80
// SOURce1:BB:EUTRa:DL:DRS:CELL2:DURation DUR5
// SOURce1:BB:EUTRa:DL:DRS:CELL2:PATTern 1,0,-1,4,5
SOURce1:BB:EUTRa:DL:DRS:CELL1:CDSTate 1
SOURce1:BB:EUTRa:DL:DRS:CELL1:ZPNum 1
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:ZP 4
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:ZPI 1
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:ZPT?
// 5
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:ZPDelta?
// 1
SOURce1:BB:EUTRa:DL:DRS:CELL1:NZPNum 2
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:NZSCid 1
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:NZConfig C2
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:NZSFoffset?
SOURce1:BB:EUTRa:DL:DRS:CELL1:CSIRs1:NZQoffset M2

// set Tx mode and UL carrier
```

```
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M2
SOURce1:BB:EUTRa:DL:USER1:CELL1:TXM M2
SOURce1:BB:EUTRa:DL:USER1:ULCA0:STATe 1

// configure the LAA burst
SOURce1:BB:EUTRa:DL:LAA:CELL1:NUMBursts 1
SOURce1:BB:EUTRa:DL:LAA:CEINdex SC1
SOURce1:BB:EUTRa:DL:LAA:CELL1:BURSt0:STSFrame 5
SOURce1:BB:EUTRa:DL:LAA:CELL1:BURSt0:STSLot SEC
SOURce1:BB:EUTRa:DL:LAA:CELL1:BURSt0:DURation 3
SOURce1:BB:EUTRa:DL:LAA:CELL1:BURSt0:LSFSymbols SY11
SOURce1:BB:EUTRa:DL:LAA:CELL1:BURSt0:C1Mode N1N
SOURce1:BB:EUTRa:DL:LAA:CELL1:BURSt0:EPDCch F2
// configure the DCI format 1C
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:SITem 0
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:USER CCRNti
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:UEID?
// 65532

SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIFmt?
// F1C
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:SESPace?
// COMM
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:CELL 1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:PDCChtype?
// PDCC
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:PFMT 2
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:LAASubframe 1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:BITData?
// "000 1000 0000 0000"

// generate a waveform and save the configuration
SOURce1:FREQuency:CW 2143000000
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:WAVeform:CREate "/var/user/laa.wv"
SOURce1:BB:EUTRa:SETTing:STORe "/var/user/LAA"
```

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:STATe <DrsState>

Enables the selected DRS occasion configuration.

Parameters:

<DrsState> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "State" on page 125

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:PERiodicity <DrsPeriodicity>

Sets the DRS periodictity.

Parameters:

<DrsPeriodicity> P40 | P80 | P160
*RST: P40

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Periodicity" on page 125

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:OFFSet <DrsOffset>

Offsets the DRS start within the DRS occasion.

Parameters:

<DrsOffset> integer
Range: 0 to 159
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Offset" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:DURation <DrsDuration>

Sets the DRS duration.

Parameters:

<DrsDuration> DUR1 | DUR2 | DUR3 | DUR4 | DUR5

DUR1
For LAA SCells, the DRS is always 1 ms long

DUR2|DUR3|DUR4|DUR5
In FDD mode, sets duration of 2 ms to 5 ms

*RST: DUR1

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Duration" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:PATTern

Defines the subframes in that DRS is transmitted for up to 20 DRS occasions.

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Pattern" on page 126

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CDSTate <CsiRsState>

Enables defining the CSI-RS part of the DRS.

Parameters:

<CsiRsState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "CSI-RS Part of DRS" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:ZPNum <NumZeroPwrConf>

Enables up to 5 ZeroTxPower CSI-RS within the DRS period.

Parameters:

<NumZeroPwrConf> integer

Range: 0 to 5

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "ZeroTxPower/NonZeroTxPower CSI-RS Structure>Number of CSI-RS Configurations" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:NZPNum <NumNonZeroPwrCo>

Enables up to 96 NonZeroTxPower CSI-RS within the DRS period.

Parameters:

<NumNonZeroPwrCo> integer

Range: 0 to 96

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "ZeroTxPower/NonZeroTxPower CSI-RS Structure>Number of CSI-RS Configurations" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZP <ZeroPower>

Sets the used CSI-RS configurations in the zero transmission power subframes.

Suffix:

<st> 1 to 5
Selects the zero-power CSI reference signal (ZeroTxPower CSI-RS)
Value range depends on the value set with the command `[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:ZPNum`

Parameters:

<ZeroPower> integer

In the user interface, the 16 bits are set as a hexadecimal value. In the remote control, as a decimal value.

Range: 0 to 16 bit

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "ZeroPower CSI-RS" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZPI <SfConfig>

Sets the parameter I_{CSI-RS}.

Suffix:

<st> 1 to 5
Selects the zero-power CSI reference signal (ZeroTxPower CSI-RS)
Value range depends on the value set with the command `[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:ZPNum`

Parameters:

<SfConfig> integer

Range: 0 to 154

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Subframe Config (I_CSI-RS)" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZPT?

Queries the subframe configuration period T_{CSI-RS} value.

Suffix:

<st> 1 to 5

Selects the zero-power CSI reference signal (ZeroTxPower CSI-RS)

Value range depends on the value set with the command `[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:ZPNum`

Return values:

<Periodicity> integer

Range: 5 to 80

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Usage: Query only

Manual operation: See "Periodicity (T_CSI-RS)" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:ZPDelta?

Queries the subframe offset Δ_{CSI-RS} value.

Suffix:

<st> 1 to 5

Selects the zero-power CSI reference signal (ZeroTxPower CSI-RS)

Value range depends on the value set with the command `[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:ZPNum`

Return values:

<SFOffset> integer

Range: 0 to 80

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Usage: Query only

Manual operation: See "Subframe Offset (Delta_CSI-RS)" on page 127

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZSCid <ScramblingId>

Sets the individual scrambling identity of the NonZeroTxPower CSI-RS.

Suffix:

<st> 1 to 96
Selects the non-zero-power CSI reference signal (NonZeroTx-Power CSI-RS).
Value range depends on the value set with the command `[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:NZPNum`

Parameters:

<ScramblingId> integer
Range: 0 to 503
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Scrambling Identity (n_ID)" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZConfig <NonZeroPwrConf>

Sets the CSI-RS configuration.

Suffix:

<st> 1 to 96
Selects the non-zero-power CSI reference signal (NonZeroTx-Power CSI-RS)
Value range depends on the value set with the command `[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:NZPNum`

Parameters:

<NonZeroPwrConf> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31
Values outside the permitted discrete values are rounded down.
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "CSI-RS Configuration" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZSFoffset <NonZeroPSfOffs>

Queries the subframe offset between the SSS and the CSI-RS in a DRS.

Suffix:

<st> 1 to 96
Selects the non-zero-power CSI reference signal (NonZeroTx-Power CSI-RS).
Value range depends on the value set with the command [:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:NZPNum

Parameters:

<NonZeroPSfOffs> integer
Range: 0 to 4

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Subframe Offset with SSS" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:CSIRs<st>:NZQoffset <NonZeroPQOffs>

Sets the Q-offset.

Suffix:

<st> 1 to 96
Selects the non-zero-power CSI reference signal (NonZeroTx-Power CSI-RS)
Value range depends on the value set with the command [:SOURce<hw>]:BB:EUTRa:DL:DRS:CELL<ch0>:NZPNum

Parameters:

<NonZeroPQOffs> -24 | -22 | -20 | -18 | -16 | -14 | -12 | -10 | -8 | -6 | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24
Positive values outside the permitted discrete values are rounded down; negative values are rounded up.
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Q-Offset" on page 128

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CEINdex <CellIndex>

Selects the LAA SCell for that the LAA is configured.

Parameters:

<CellIndex> SC1 | SC2 | SC3 | SC4 | NONE
*RST: SC1

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "LAA Cell" on page 170

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:NUMBursts <NumberOfBursts>

Set the number of LAA bursts.

Parameters:

<NumberOfBursts> integer

Range: 0 to 10
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Number of LAA Bursts" on page 170

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:STSFrame <StartingSF>

Sets the first subframe of the LAA bust.

Parameters:

<StartingSF> integer

Range: 0 to 39
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Starting Subframe" on page 170

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:STSLot <StartingSlots>

Sets the starting slot.

Parameters:

<StartingSlots> FIRSt | SECond

FIRSt
s0: first slot of a subframe

SECond
s7: second slot of a subframe

*RST: FIRSt

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Starting Symbol" on page 170

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:DURation <Duration>

Sets the duration of the LAA burst.

Parameters:

<Duration> integer

Range: 1 to 10
*RST: 10

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Burst Duration (ms)" on page 170

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:ENSFrame?

Queries the number of the last subframe of the LAA burst.

Return values:

<EndingSubframe> integer

Range: 0 to 39
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Usage: Query only

Manual operation: See "Ending Subframe" on page 171

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:LSFSymbols <LastSFSymb>

Sets the number of OFDM symbols in the last subframe of the LAA burst.

Parameters:

<LastSFSymb> SY3 | SY6 | SY9 | SY10 | SY11 | SY12 | SY14

*RST: SY14

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "Number of Ending Symbols" on page 170

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:C1Mode <DCI1CMode>

Defines how the DCI format 1C is sent.

Parameters:

<DCI1CMode> MANual | N1 | N | N1N

*RST: N1N

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "LAA DCI 1C Mode" on page 171

[:SOURce<hw>]:BB:EUTRa:DL:LAA:CELL<ch0>:BURSt<st0>:EPDCch <EpdcchFormat>

Sets the (E)PDCCH format.

Parameters:

<EpdcchFormat> F2 | F3

*RST: F2

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "(E)PDCCH Format" on page 171

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:LAASubframe <DciLaaConf>

Sets the DCI format 1C field subframe configuration for LAA.

Parameters:

<DciLaaConf> integer

Range: 0 to 15
*RST: 0

Example: See Example"Enabling a LAA SCell and configuring of one LAA burst" on page 771.

Manual operation: See "DCI Format 1C for LAA" on page 206

11.15 Enhanced PBCH, PDSCH, PMCH

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB <State>

Enables transmission of real MIB data.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: ON

Example:

```
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc0:CW1:CONType?
// PBCH
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc0:CW1:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc0:CW1:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:PBCH:MIB 1
SOURce1:BB:EUTRa:DL:PBCH:SOFFset 0
SOURce1:BB:EUTRa:DL:PBCH:SRPeriod PERS
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc0:CW1:CCODing:TBSize 24
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc0:CW1:PHYSbits?
// 480
SOURce1:BB:EUTRa:DL:PBCH:MSPare #H001,10
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc0:CW1:STATe 1
```

Manual operation: See "MIB (including SFN)" on page 220

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SOFFset <SfnOffset>

Sets an offset for the start value of the SFN (System Frame Number).

Parameters:

<SfnOffset> integer

Range: 0 to 1020
Increment: 4
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB on page 782

Manual operation: See "SFN Offset" on page 220

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:SRPeriod <SfnRestPeriod>

Determines the time span after which the SFN (System Frame Number) restarts.

Parameters:

<SfnRestPeriod> PERSlength | PER3gpp

PER3gpp = "3GPP (1024 Frames)"
PERSlength = SFN restart period to the ARB sequence length

*RST: PERSlength

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB on page 782

Example: Option:R&S SMW-K115
See Example"PBCH and SIB1-BR configuration" on page 959.

Options: R&S SMW-K84

Manual operation: See "SFN Restart Period" on page 221

[:SOURce<hw>]:BB:EUTRa:DL:PBCH:MSPare <MibSpareBits>

Sets the 10 spare bits in the PBCH transmission.

Parameters:

<MibSpareBits> 64 bit

*RST: #H0,1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:PBCH:MIB on page 782

Manual operation: See "MIB Spare Bits" on page 221

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>:CAW <DlCsiAware>

Determines the way the PDSCH is processed.

Parameters:

<DlCsiAware> OFF | ON | 1 | 0

*RST: OFF

Example: See Example"Enabling a CSI-RS transmission" on page 764

Manual operation: See "CSI Awareness" on page 217

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing:ISBSize <SoftBufSize>

Sets the size of the IR soft buffer.

Parameters:

<SoftBufSize> integer

Range: 800 to 3667200
*RST: 3667200

Example:
```
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL5:PHYS?
Response: 2400
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW2:CCOD:TBS 1500
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW2:CCOD:ISBS 1600
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW2:CCOD:ISBS?
Response: 1600
```

Manual operation: See "IR Soft Buffer Size (PDSCH)" on page 221

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing: RVINdex <RedundVersIndex>

Sets the redundancy version index.

Parameters:

<RedundVersIndex> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:DL:SUBF4:ALL5:CW2:CCOD:RVIN 2`
Sets the redundancy version index to 2

Manual operation: See "Redundancy Version Index (PDSCH)" on page 221

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing: STATe <State>

Enables/disables channel coding for the selected allocation and codeword.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:DL:SUBF4:ALL5:CW2:CCOD:STAT OFF`

Manual operation: See "State Channel Coding (DL)" on page 219

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:CCODing: TBSize <TranspBlockSize>

Sets the size of the transport block.

Note: The parameter depends on the content type and the global MIMO configuration.

Parameters:

<TranspBlockSize> integer

Range: 1 to 1E7
*RST: 1500

Example:
```
BB:EUTR:DL:SUBF9:ALL5:PHYS?
```
Queries the number of physical bits of allocation 5
```
Response: 2400
BB:EUTR:DL:SUBF4:ALL5:CW2:CCOD:TBS 1500
```
Sets the transport block size to of allocation 5 to 1500 bits

Example:
```
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL5:PHYS?
Response: 2400
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW:CCOD:TBS 1000
SOUR:BB:EUTR:DL:SUBF9:ALL5:CW2:CCOD:TBS 1500
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW:CCOD:TBS?
Response: 1000
SOUR:BB:EUTR:DL:SUBF9:ALL4:CW2:CCOD:TBS?
Response: 1500
```

Manual operation: See "Transport Block Size/Payload (DL)" on page 221

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: PRECoding:AP <AntennaPorts>

Sets the antenna port(s) for the selected transmission mode.

Parameters:

<AntennaPorts> AP7 | AP5 | AP8 | AP78 | AP79 | AP710 | AP711 | AP712 | AP713 | AP714 | AP107 | AP108 | AP109 | AP110 | AP107108 | AP107109 | AP11 | AP13 | AP1113 | AP7 | AP5 | AP8 | AP78 | AP79 | AP710 | AP711 | AP712 | AP713 | AP714 | AP11 | AP13 | AP1113 | AP107 | AP108 | AP109 | AP110 | AP107108 | AP107109

Antenna port or antenna ports combination; the designation AP78 for example means AP7 and AP8

*RST: AP5

Options: R&S SMW-K84
AP11|AP13|AP1113|AP107|AP108|AP109|AP110|AP107108|
AP107109 require R&S SMW-K119

Manual operation: See "Antenna Ports" on page 215

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: PRECoding:APM <AntPortMap>

Sets the way that the logical antenna ports are mapped to the physical Tx-antennas.

See Chapter 4.5, "DL antenna port mapping settings", on page 222.

Parameters:

<AntPortMap> CB | RCB | FW

CB = codebook
RCB = random codebook
FW = fixed weights

*RST: CB

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBCI on page 863

Options: R&S SMW-K84

Manual operation: See "Antenna Port Mapping" on page 215

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CBINdex[<dir>] <CodeBookIndex>

Sets the codebook index for the selected allocation.

The combination of codebook index and the selected number of layers determines the codebook matrix used for precoding.

Parameters:

<CodeBookIndex> integer

Range: 0 to 15
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:CONType PDSCh
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:DATA PN16
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW:PRECoding:SCHeme BF
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW:PRECoding:TRSCheme TM9
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW:PRECoding:CBINdex2 0
```

Example: See also [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBCI on page 863

Manual operation: See "Codebook Index/Codebook Index 2" on page 216

[:SOURce<hw>]:BB:EUTRa:DL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:CBUA <CbUseAlt>

Applies the enhanced 4 Tx codebook.

Parameters:

<CbUseAlt> 1 | ON | 0 | OFF

OFF
Tthe normal codebook is used.

ON
Applied is the enhanced 4Tx codebook.

*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBUA on page 864.

Options: R&S SMW-K113

Manual operation: See "Use Alternative Codebooks" on page 215

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:CDD <CyclicDelayDiv>

Sets the CDD for the selected allocation.

The combination of cyclic delay diversity and the selected number of layers determines the precoding parameters for spatial multiplexing.

Parameters:

<CyclicDelayDiv> NOCDd | SMDelay | LADelay

NOCDd
Zero CDD

SMDelay
Small CDD

LADelay
Large CDD

*RST: NOCDd

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:PREC:CDD SMD`
Selects small CDD

Manual operation: See "Cyclic Delay Diversity" on page 216

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:DAFormat <DataFormat>

Switches between the Cartesian (Real/Imag.) and Cylindrical (Magn./Phase) coordinates representation.

Parameters:

<DataFormat> CARTesian | CYLindrical

*RST: CARTesian

Manual operation: See "Mapping Coordinates" on page 216

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:NOLayers <NoLayers>

Sets the number of layers for the selected allocation.

Parameters:

<NoLayers> integer

Range: 1 to 8
*RST: 1

Example: `BB:EUTR:DL:SUBF4:ALL5:CW:PREC:NOL 2`
Sets the number of layers to 2

Manual operation: See "Number of Layers" on page 214

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: PRECoding:SCHeme <Scheme>

(available for the first codeword only)

Selects the precoding scheme.

The available selections depend on the selected content type.

Parameters:

<Scheme> NONE | SPM | TXD | BF

NONE
Disables precoding.

SPM
Spatial multiplexing

TXD
Transmit diversity

BF
Sets the PDSCH to transmission mode selected with the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:TRSCheme`.

*RST: NONE

Example:

```
SOURce1:BB:EUTRa:DL:SUBF4:ALLoc5:CONType PDSCh
SOURce1:BB:EUTRa:DL:SUBF4:ALLac5:CW1:PRECoding:
SCHeme SPM
```

Sets the precoding scheme to spatial multiplexing

Manual operation: See "Precoding Scheme" on page 213

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]: PRECoding:SCID <ScrambIdentity>

Sets the scrambling identity according to 36.211, sec. 6.10.3.1.

This value is used for initialization of the sequence used for generation of the UE-specific reference signals.

Parameters:

<ScrambIdentity> integer

Range: 0 to 1
*RST: 0

Manual operation: See "Scrambling Identity n_SCID" on page 215

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:PRECoding:TRSCheme <TransmissScheme>

Determines the transmission mode (see also Table 2-6).

Parameters:
<TransmissScheme> TM10
*RST: TM7

Options: TM7|TM8 require R&S SMW-K84
TM9 requires R&S SMW-K85
TM10 requires R&S SMW-K112

Manual operation: See "Transmission Scheme" on page 213

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SCRambling:STATe <State>

Enables/disables the bit-level scrambling.

Parameters:
<State> 1 | ON | 0 | OFF
*RST: ON

Example:
```
SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:DATA PN9
SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:SCR:STAT ON
```
Enables scrambling

Example: If a "User 1..4" is selected for the Data Source for the corresponding allocation, this command is query only and the return value corresponds the state determined with the command `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe`.
```
SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:USER3:SCR:STAT ON
SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:SCR:STAT?
Response: On
```

Manual operation: See "State Scrambling (DL)" on page 218

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ALLoc<ch0>[:CW<user>]:SCRambling:UEID <Ueid>

Sets the user equipment identifier (n_RNTI) of the user to which the PDSCH transmission is intended. The UE ID is used to calculate the scrambling sequence.

Parameters:
<Ueid> integer
Range: 0 to 65535
*RST: 0

Example: `BB:EUTR:DL:SUBF0:ALL5:CW:UEID 120`

Sets the user equipment identifier.

Manual operation: See "UE ID/n_RNTI (PDSCH)" on page 218

11.16 Enhanced PCFICH, PHICH and PDCCH configuration

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:STATe <State>

Enables/disables the PDCCH, PCFICH and PHICH allocation.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: ON

Example: `BB:EUTR:DL:SUBF1:ENCC:STAT ON`

Enables PDCCH

Manual operation: See "State" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:SCRambling:STATe <State>

Enables/disables the scrambling of the enhanced channels.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: ON

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:SCRambling:STATe ON`

Manual operation: See "Scrambling State" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:SCHeme <Scheme>

Selects the precoding scheme for PDCCH.

Parameters:

<Scheme> NONE | TXD

NONE
Disables precoding.

TXD
Precoding for transmit diversity will be performed according to 3GPP TS 36.211 and the selected parameters

*RST: NONE

Example: `BB:EUTR:DL:SUBF1:ENCC:PREC:SCH TXD`
Selects the precoding scheme

Manual operation: See "Precoding Scheme" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PRECoding:NOLayers?

Queries the number of layers for PDCCH.

This value is fixed to 1 for PDCCH.

Return values:

<LayerCount> integer

Range: 1 to 2
*RST: 1

Example: `BB:EUTR:DL:SUBF1:ENCC:PREC:NOL?`
Queries the number of layers
`Response: 1`

Usage: Query only

Manual operation: See "Number of Layers (Enhanced Channels)" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:POWer <Power>

Sets the power of the PCFICH (P_{PCFICH}).

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PCF:POW -5
```

Sets the power of the PCFICH to -5 dBm

Manual operation: See "PCFICH Power" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PCFich:CREGion <ControlRegion>

Sets the number of OFDM Symbols to be used for PDCCH.

Parameters:

<ControlRegion> integer

Range: 1 to 4
*RST: 2

Example:

```
BB:EUTR:PHIC:DUR NORM
```

Selects PHICH normal duration

```
BB:EUTR:DL:SUBF1:ENCC:PCF:CREG 1
```

Sets the control region

Manual operation: See "Control Region for PDCCH (PCell)" on page 181

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:PMODe <PowerMode>

Determines whether the PHICHs in a PHICH group are sent with the same power or enables the adjustment of each P_{PHICH} individually.

Parameters:

<PowerMode> CONSt | IND

CONSt
The power of a PHICH in a PHICH group is set with the command `SOUR:BB:EUTR:DL:ENCC:PHIC:POW`.

IND
The power of the individual PHICHs is set separatelly

*RST: CONSt

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PHIC:PMOD CONS
BB:EUTR:DL:SUBF1:ENCC:PHIC:POW -5
// All PHICHs in the PHICH group are sent with this power
```

Manual operation: See "Power Mode" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:POWer <Power>

Sets the power of one PHICH (P_{PHICH}) in a PHICH group, i.e. the total power of one PHICH group is the sum of the power of the transmitted PHICHs within this group.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: -3.010

Example:

```
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:PMOD CONS
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:NOGR 1
SOUR:BB:EUTR:DL:SUBF2:CYCP NORM
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:ANP1 '1---1---'
SOUR:BB:EUTR:DL:SUBF2:ENCC:PHIC:POW - 3
// Sets the power of one PHICHs in a PHICH group to -3 dB
```

Manual operation: See "PHICH Power" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:NOGRoups <GroupCount>

Queries the number of available PHICH groups.

Parameters:

<GroupCount> integer

Range: 0 to dynamic
*RST: 2

Example: See [:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:GROup<gr0>:ITEM<user0>:POW on page 796.

Options: CELL<ccidx> requires R&S SMW-K112

Manual operation: See "Number of PHICH Groups" on page 183

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh:CELL<ch0>:ANPattern<gr0> <AnPattern>

Sets the ACK/NACK pattern for the corresponding PHICH group.

Parameters:

<AnPattern> string

String of 8 values

1
Indicates an ACK

0
Indicates a NACK

-

Indicates DTX

Example: See [:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:GROup<gr0>:ITEM<user0>:POW on page 796.

Options: CELL<ch0> requires R&S SMW-K112

Manual operation: See "ACK/NACK Pattern Group x" on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PHICh[:CELL<ccidx>]:GROup<gr0>:ITEM<user0>:POW <Power>

Sets the power of the individual PHICHs.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: -3.010

Example:

```
SOURce1:BB:EUTRa:DL:CA:STATe 1
SOURce1:BB:EUTRa:DL:CA:CELL0:PHICh:NGParameter NG1
SOURce1:BB:EUTRa:DL:CA:CELL0:PHICh:DURation NORM

SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:PMODe CONS
// sets the power mode
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:POWer -5
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:CELL0:NOGRoups?
// 7
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:CELL0:ANPattern0 0-1-11--
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:CELL0:GROup0:ITEM0:POW -5
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:CELL0:GROup0:ITEM2:POW -4
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:CELL0:GROup0:ITEM4:POW -6
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PHICh:CELL0:GROup0:ITEM5:POW 1
// sets the power of the PHICH#6 in the first PHICH group of the PCell
```

Options: CELL<ccidx> requires R&S SMW-K112

Manual operation: See "Power Settings Config." on page 184

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:POWer <Power>

Sets the power of the PDCCH (P_{PDCCH}).

The value set with this parameter is also displayed in the allocation table for the corresponding allocation.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:POW -5`
Sets the power of the PDCCH to -5dB

Manual operation: See "Power" on page 187

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:BITS <PhysBits>

Defines the number of bits allocated for PDCCH.

Parameters:

<PhysBits> integer

Range: 0 to 1E5
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:STAT ON`
Enables PDCCH.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:BITS?`
Queries the number of bits
`Response: 3144`

Manual operation: See "Number of PDCCH Bits / REGs / CCEs" on page 187

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVRegs <AvailRegionCoun>

Defines the number of the REGs that are available for the PDCCH allocation.

Parameters:

<AvailRegionCoun> integer

Range: 0 to 1E5
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:STAT ON`
Enables PDCCH.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:AVR?`
Queries the number of REGs
`Response: 393`

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:AVCCes <AvailCceCount>

Queries the number of the control channel elements (CCEs) that are available for the PDCCH allocation.

Parameters:
<AvailCceCount> integer

Range: 0 to 1E5
*RST: 0

Example: `BB:EUTR:DL:SUBF1:ENCC:STAT ON`
Enables PDCCH.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:AVCC?`
Queries the number of CCEs
`Response 43`

Manual operation: See "Number of PDCCH Bits / REGs / CCEs" on page 187

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:FORMat <Format>

Sets the PDCCH format.

Parameters:
<Format> VAR | -1 | 0 | 1 | 2 | 3

VAR
Enables full flexibility by the configuration of the downlink control information (DCI) format and content.

-1
Proprietary format for legacy support.

0 | 1 | 2 | 3
One PDCCH is transmitted on one, two, four or eight CCEs

*RST: VAR

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
Sets the PDCCH format.

Manual operation: See "PDCCH Format" on page 186

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:NOPDcchs <PdcchCount>

Sets the number of PDCCHs to be transmitted.

Parameters:
<PdcchCount> integer

Range: 0 to dynamic
*RST: 0

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF2:ENCC:PDCC:NOPD 20`
Sets the number of PDCCHs.

Manual operation: See "Number of PDCCHs" on page 188

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:ALRegs <AllocRegionCoun>

Defines the number of REGs that are actually allocated for PDCCH transmission (#REGs $\text{allocated}_{\text{PDCCH}}$).

Parameters:

<AllocRegionCoun> integer

Range: 0 to 1E5
*RST: 0

Example:

```
BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF2:ENCC:PDCC:NOPD 20
```
Sets the number of PDCCHs.
```
BB:EUTR:DL:SUBF2:ENCC:PDCC:ALR?
```
Queries the number of REGs
```
Response: 180
```

Manual operation: See "Number of REGs allocated to PDCCH" on page 188

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DREGs <DummyRegsCount>

Defines the number of REGs that are available for the PDCCH allocation but are not allocated.

Parameters:

<DummyRegsCount> integer

Range: 0 to 1E5
Increment: 1
*RST: 0

Example:

```
BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF2:ENCC:PDCC:NOPD 20
```
Sets the number of PDCCHs.
```
BB:EUTR:DL:SUBF2:ENCC:PDCC:ALR?
```
Queries the number of REGs
```
Response: 180
BB:EUTR:DL:SUBF2:ENCC:PDCC:DREG?
```
Queries the number of dummy REGs
```
Response: 213
```

Manual operation: See "Number of Dummy REGs" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DATA <Data>

Selects the data source for PDCCH.

Parameters:
<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE
*RST: PN9

Example: `BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DATA PN9`
PN9 is selected as data source

Manual operation: See "Data Source" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:PATTern <Pattern>, <BitCount>

Selects the bit pattern for the `PATT` selection.

Parameters:
<Pattern> numeric
*RST: #H0

<BitCount> integer
Range: 1 to 64
*RST: 1

Example:
```
BB:EUTR:DL:SUBF2:ENCC:PDCC:FORM 0
BB:EUTR:DL:SUBF1:ENCC:PDCC:DATA PATT
BB:EUTR:DL:SUBF1:ENCC:PDCC:PATT #H3F,8
```

Manual operation: See "Data Source" on page 189

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DSELect <Filename>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:
<Filename> string
Filename incl. file extension or complete file path

Example:
```
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat 0
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:DATA DLISt
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:DSELect "/var/user/temp/pdcch"
```

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:TRSource <TranSource>

Sets the behavior of the dummy REGs, i.e. determines whether dummy data or DTX is transmitted.

Parameters:
<TranSource> DATA | DTX
*RST: DATA

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:TRS DATA`

Manual operation: See "Dummy CCE REGs" on page 190

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DATA <Data>

Selects the data source for PDCCH.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:DATA PN9`
PN9 is selected as data source

Manual operation: See "Dummy CCE Data Source" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:DSELect <Filename>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<Filename> string

Filename incl. file extension or complete file path

Example:
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VAR`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:DCRegs:DATA DLISt`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:DCRegs:DSELect "/var/user/temp/pdcch`

Manual operation: See "Dummy CCE Data Source" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:DCRegs:PATTern <Pattern>, <BitCount>

Selects the bit pattern for the `PATT` selection.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:DATA PATT
BB:EUTR:DL:SUBF1:ENCC:PDCC:DCR:PATT #H3F,8
```

Manual operation: See "Dummy CCE Data Source" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SITem <SelectedItem>

Selects an PDCCH item, i.e. a row in the DCI table.

Parameters:

<SelectedItem> integer

Range: 0 to 39
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`
Selects the third row in the DCI table

Manual operation: See "Standard configuration functions" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:APPend

Adds a new row at the end of the DCI table.

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:APP`
Adds a new row

Manual operation: See "Standard configuration functions" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:INSert

Insert a new row before the currently selected item.

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`
Selects the third row in the DCI table
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:INS`
Inserts a new row before the third one

Manual operation: See "Standard configuration functions" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DELete

Deletes the selected row.

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`
Selects the third row in the DCI table
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:DEL`
Deletes the third row

Usage: Event

Manual operation: See "Standard configuration functions" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:DOWN
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UP

Moves the selected row down or up.

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:SIT 2`
Selects the third row in the DCI table
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:UP`
Moves the third row one row up

Manual operation: See "Standard configuration functions" on page 191

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:CONFlicts?

Queries the number of conflicts between the DCI formats.

To query whether there is a conflict in one particular PDCCH item, use the command `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CONFlict?` on page 809.

Return values:
<NoOfConf> integer

Range: 0 to 20
*RST: 0

Example:
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VARiable`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:CONFlicts?`
Response: `1`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:UITems?`
Response: `2`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM0:CONFlict?`
Response: `0`
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:CONFlict?`
Response: `1`
The DCI conflict is in the second PDCCH item
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:SOLVe`

Usage: Query only

Manual operation: See "Resolve Conflicts" on page 192
See "Conflict (DCI)" on page 198

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:SOLVe?

Triggers a built-in algorithm that re-assigns automatically the CCE values depending on the configured "Search Space"; previously configured CCE values will not be maintained.

If the conflict cannot be resolved automatically, the values are left unchanged.

Example: `:SOURce:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:SOLVe`

Usage: Query only

Manual operation: See "Resolve Conflicts" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:RESet

Resets the table.

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:RES`
Resets the table

Manual operation: See "Reset" on page 192

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:UITems <UsedItems>

Queries the number of used PDCCH items.

Parameters:

<UsedItems> integer

Range: 0 to 20
*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat
VARiable
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:
APPend
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:
UITems?
```
Response: `2`

Manual operation: See "Number of Used (E)PDCCH Items" on page 193

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIFmt <DciFormat>

Sets the DCI format for the selected PDCCH.

Parameters:

<DciFormat> F2D

*RST: F0

Example:
```
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat
VARiable
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:
ITEM1:DCIFmt F1
```

Options: F2D requires R&S SMW-K112

Manual operation: See "DCI Format" on page 195

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: UEID <Ueid>

Sets the n_RNTI for the selected PDCCH.

Parameters:

<Ueid> integer

Range: 0 to 100000
*RST: 0

Example:
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:UEID 100
```
Sets the n_RNTI

Manual operation: See "UE_ID/n_RNTI" on page 194

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CELL <CellIdx>

Determines the component carrier the corresponding DCI is transmitted on.

Parameters:

<CellIdx> integer

Range: 0 to 7
*RST: 0

Options: R&S SMW-K85

Manual operation: See "Cell Index" on page 194

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:PFMT <Format>

Sets the PDCCH format for the selected PDCCH.

Parameters:

<Format> integer

Range: 0 to 3
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets PDCCH format variable.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:PFMT 0`
Sets the PDCCH format.

Manual operation: See "(E)PDCCH Format (Variable)" on page 197

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:NCCes?

Queries the number of control channel elements used for the transmission of the PDCCH.

Return values:

<CceCount> integer

Range: 0 to 1E5
*RST: 1

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:NCC?`
Queries the number of CCEs

Usage: Query only

Manual operation: See "Number (E)CCEs" on page 198

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:CINDex <CceIndex>

Sets the CCE start index.

Parameters:

<CceIndex> integer

Range: 0 to 1E5
*RST: 0

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VAR`
Sets the PDCCH format.
`SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:CINDex 10`
Sets the CCE start index

Manual operation: See "(E)CCE Index" on page 198

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:PDCChtype <PdcchType>

Sets if the DCI is carried by a PDCCH or by an EPDCCH set.

Parameters:

<PdcchType> PDCCh | EPD1 | EPD2

EPD1|EPD2
EPDCCH sets cannot be allocated TDD special subframes, if the combinations listed in Table 4-7 apply.

*RST: PDCCh

Example: `SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM1:PDCChtype?`
See Example"Configuring EPDCCH transmission" on page 873
See also `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HACK` on page 814.

Options: R&S SMW-K112

Manual operation: See "(E)PDCCH" on page 195

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:NDCCes?

Queries the number of dummy CCEs that are appended to the PDCCH.

Return values:

<DummyCceCount> integer

Range: 0 to 1E5
*RST: 25

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:NDCC?`
Queries the number of dummy CCEs

Usage: Query only

Manual operation: See "No. Dummy (E)CCEs" on page 198

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: USER <User>

Selects the User the DCI is dedicated to.

The available DCI Formats depend on the value of this parameter.

Parameters:

<User> USER1 | USER2 | USER3 | USER4 | PRNTi | SIRNti | RARNti | NONE | U1E | U2E | U3E | UE4 | CCNRti

*RST: USER1

Return values:

<User> USER1 | USER2 | USER3 | USER4 | PRNTi | SIRNti | RARNti | NONE | U1SPs | U2SPs | U3SPs | U4SPs | U1E | U2E | U3E | UE4 | CCNRti

Range: USER1 to NONE
*RST: USER1

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:USER USER2`
The DCI is dedicated to User 2

Options: U1E|U2E|U3E|UE4 require R&S SMW-K113
CCNRti requires R&S SMW-K119

Manual operation: See "User" on page 193

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: SESPace <SearchSpace>

If enabled, this parameter configures the PDCCH DCI to be transmitted within the common or UE-specific search space.

Parameters:

<SearchSpace> OFF | AUTO | COMMon | UE | ON | 0 | 1

COMMon|UE
Common and UE-specific search spaces, as defined in the 3GPP specification

OFF|AUTO
For backwards compatibility only.

*RST: AUTO

Example: `BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:SESP UE`
The DCI is transmitted within the UE-specific search space.

Manual operation: See "Search Space" on page 196

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: CONFlict?

Indicates a conflict between two DCI formats.

Return values:

<Conflict> 1 | ON | 0 | OFF
*RST: OFF

Example: `SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:CONFlict?`
queries whether there is a conflict or not.

Usage: Query only

Manual operation: See "Conflict (DCI)" on page 198

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:APLayer <ApLayerId>

Sets the DCI Format 2C field antenna port(s), layer, scrambling Id.

Option:R&S SMW-K119:

Table 11-1: Value range <ApLayerId>

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:DMRS:STATe	[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:SEOL:STATe	1 codeword	2 codewords
0	0	0 to 6	0 to 7
1	0	0 to 11	0 to 14
1	1	0 to 1	0 to 1

Parameters:

<ApLayerId> integer
Range: 0 to 7
*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:USER1:TXM M9
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:FORMat VARiable
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:DCIFmt F2C
SOURce1:BB:EUTRa:DL:SUBF1:ENCC:PDCCh:EXTC:ITEM1:DCIConf:APLayer 2
```

Options: <ApLayerId> = 8 to 14 require R&S SMW-K119

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:BITData?

Queries the resulting bit data as selected with the DCI format parameters.

Return values:

<BitData>	string

Example:	`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
	Sets the PDCCH format.
	`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:BITD?`
	Queries the bit data

Usage:	Query only
Manual operation:	See "Bit Data" on page 199

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:CIField <CaIndField>

The CIF is present in **each** DCI Format and identifies the component carrier that carries the PDSCH or PUSCH for the particular PDCCH in the cross-carrier approach (see Figure 2-27).

Parameters:

<CaIndField>	integer Range: 0 to 7 *RST: 0

Example:	`BB:EUTR:DL:CA:STAT ON`
	`BB:EUTR:DL:USER2:CA:STAT ON`
	`BB:EUTR:DL:CA:CELL0:CIF ON`
	`BB:EUTR:DL:ENCC:PDCC:EXTC:ITEM1:DCIC:CIF 1`

Options:	R&S SMW-K85
Manual operation:	See "Carrier Indicator Field (CIF)" on page 194

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:F1AMode <Format1aMode>

Selects the mode of the DCI format.

Parameters:

<Format1aMode>	PDSCh | PRACh *RST: PDSCh

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1A`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:F1AM PRAC`
Sets the mode

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:PRINdex <PreambleIndex>

(PRACH mode only)

Sets the DCI Format 1A field Preamble index.

Parameters:

<PreambleIndex> integer

Range: 0 to 63
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1A`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:F1AM PRAC`
Sets the mode
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PRAC:PRIN 10`
Sets the preamble index

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PRACh:MINDex <MaskIndex>

(PRACH mode only)

Sets the DCI Format 1A field PRACH Mask Index.

Parameters:

<MaskIndex> integer

Range: 0 to 15
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1A`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:F1AM PRAC`
Sets the mode
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PRAC:MIND 10`
Sets the preamble index

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:CSIRequest <CsiRequest>

Sets the DCI Format 0 field CSI/CQI Request.

Parameters:

<CsiRequest> integer

Range: 0 to 1 (with carrier aggregation 0 to 3)
*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:CSIR
1
```

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:CSDMrs <CyclicShftDmRs>

Sets the DCI Format 0 field cyclic shift for DMRS.

Parameters:

<CyclicShftDmRs> integer

Range: 0 to 7
*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0
```
Sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:CSDM
1
```
Sets the cyclic shift

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:DLAindex <DlAssignIndex>

(Enabled for TDD mode only)

Sets the DCI Format 0/1A/1B/1D/2/2A field downlink assignment index.

Parameters:

<DlAssignIndex> integer

Range: 0 to 3
*RST: 0

Example:
`BB:EUTR:DUPL TDD`
Selects TDD mode.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:DLA 1`
Sets the downlink assignment index

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:DPOFfset <DpOffset>

Sets the DCI Format 1D field downlink power offset.

Parameters:
<DpOffset> 1 | ON | 0 | OFF
*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1D`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:DPOF ON`
Enables downlink power offset

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:GAP <Gap>

Sets the DCI Format 1A/1B/1C/1D field GAP value.

Parameters:
<Gap> ON | OFF
*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1C`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:GAP ON`
Enables gap value

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:HPN <HarqProcessNumb>

Sets the DCI Format 1/1A/1B/1D/2/2A field HARQ process number.

Parameters:

<HarqProcessNumb> integer

Range: 0 to 15
*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
```
Sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:HPN
5
```
Sets the HARQ process number

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:HACK <HarqAck>

Sets the DCI Format 2C/2D field HARQ-ACK resource offset.

Parameters:

<HarqAck> integer

Range: 0 to 3
*RST: 0

Example:

```
SCONfiguration:APPLy
SCONfiguration:MODE ADV
SCONfiguration:FADing MIMO4X4
SCONfiguration:BASeband:SOURce COUP
SCONfiguration:APPLy

SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M10

SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:SITem 0
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:PDCChtype EPD1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIFmt F2D
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:PDRE 0

SOURce1:BB:EUTRa:DL:USER1:EPDCch1:STAT 1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:HACK 1
```

Options: R&S SMW-K112

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:MCSR <Mcsr>

Sets the DCI formats 1/1B/1D/2/2A/2B/2C/2D field modulation and coding scheme.

Parameters:

<Mcsr> integer

Range: 0 to depends on the installed options
*RST: 0
Option:R&S SMW-K55
max = 31
Option:R&S SMW-K119
max = 63
Values 32 to 63 available if `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:MCS` `T4`.

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:MCSR
5
```

Options: Values 32 to 63 require R&S SMW-K119

**[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:
DCIConf:NDI** <NewDataIndicat>

Sets the DCI Format 0/1/1A/1B/1D field New Data Indicator.

Parameters:

<NewDataIndicat> ON | OFF

*RST: OFF

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:NDI ON`
Sets the New Data Indicator

**[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:
DCIConf:PDRE** <PdschRe>

Sets the DCI Format 2D field PDSCH RE mapping and QCL indicator.

Parameters:

<PdschRe> integer

Range: 0 to 3
*RST: 0

Example:

```
SCONfiguration:APPLy
SCONfiguration:MODE ADV
SCONfiguration:FADing MIMO4X4
SCONfiguration:BASeband:SOURce COUP
SCONfiguration:APPLy

SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M10
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:SITem 0
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIFmt F2D
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIConf:PDRE 0
```

Options: R&S SMW-K112

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:PFHopping <FreqHopState>

Sets the DCI Format 0 field PUSCH Frequency Hopping.

Parameters:

<FreqHopState> 1 | ON | 0 | OFF

*RST: OFF

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`

Sets the PDCCH format.

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`

Sets the DCI format

`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PFH ON`

Enables PUSCH Frequency Hopping

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:PMI <PmiState>

Sets the DCI Format 1B field PMI Confirmation for Precoding.

Parameters:

<PmiState> 1 | ON | 0 | OFF

*RST: OFF

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PMI
ON
```

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:PRECinfo <PrecodingInfo>

Sets the DCI Format 2/2A field Precoding Information.

Parameters:
<PrecodingInfo> integer

Range: 0 to 63
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:PREC 10`
Sets Precoding Information

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RAH <ResAllocHeader>

(Enabled for Channel Bandwidth > 10RBs)

Sets the DCI Format 1/2/2A field Resource Allocation Header.

Parameters:
<ResAllocHeader> 1 | ON | 0 | OFF

*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RAH ON`

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RAHR <Rahr>

Sets the DCI Format 0 field Resource Block Assignment and Hopping Resource Allocation.

Parameters:
<Rahr> integer

Range: 0 to dynamic
*RST: 0

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RAHR 100`
Sets Resource Block Assignment and Hopping Resource Allocation

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RAType <ResAllocType>

Sets the DCI Format 0 field Resource Allocation Type.

Parameters:

<ResAllocType> integer

Range: 0 to 1
*RST: 0

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RBA <ResBlockAssign>

Sets the DCI Format 0/1/1A/1B/1C/1D/2/2A field Resource Block Assignment.

Parameters:

<ResBlockAssign> integer

Range: 0 to 268435455
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F0`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RBA 100`
Sets Resource Block Assignment

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:RV <RedundVersion>

Sets the DCI Format 1/1A/1B/1D field Redundancy Version.

Parameters:

<RedundVersion> integer

Range: 0 to 3
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:RV 1`
Sets the Redundancy Version

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:SRSRequest <SrsRequest>

Sets the SRS Request filed.

Parameters:

<SrsRequest> integer

Range: 0 to 1
*RST: 0

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:SWAPflag <SwapFlag>

Sets the DCI Format 2/2A field Transport Block to Codeword Swap Flag.

Parameters:

<SwapFlag> ON | OFF

*RST: OFF

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:SWAP ON`
Enables Transport Block to Codeword Swap Flag

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:TB1:MCS <Mcs>
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:TB2:MCS <Mcs>

Sets the DCI Format 2/2A field Modulation and Coding Scheme.

Parameters:

<Mcs> integer

Range: 0 to 31
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TB1:MCS 5`
Sets the Modulation and Coding Scheme for TB1

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:TB1:NDI <NewDataIndicat>
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:TB2:NDI <NewDataIndicat>

Sets the DCI Format 2/2A field New Data Indicator.

Parameters:

<NewDataIndicat> ON | OFF

*RST: OFF

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TB2:NDI ON`
Sets the New Data Indicator for TB2

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB1:RV <RedundVersion>
[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:TB2:RV <RedundVersion>

Sets the DCI Format 2/2A field Redundancy Version.

Parameters:

<RedundVersion> integer

Range: 0 to 3
*RST: 0

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TB1:RV 1`
Sets the Redundancy Version for TB1

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:SID <ScramIdent>

Enables/disables the DCI Format 2B field Scrambling Identity.

Parameters:

<ScramIdent> 1 | ON | 0 | OFF

*RST: OFF

Example:

`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F2B`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:SID ON`
Enables the Scrambling Identity

Options: R&S SMW-K84

**[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:
DCIConf:TPCC** <TpcCommand>

Sets the DCI Format 0/1/1A/1B/1D/2/2A field TPC Command for PUSCH.

Parameters:

<TpcCommand> integer

Range: 0 to 3
*RST: 0

Example:
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
```
Sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TPCC
1
```
Sets the TPC Command for PUSCH

**[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:
DCIConf:TPCinstr** <TpcCommand>

Sets the DCI Format 3/3A field TPC Command.

Parameters:

<TpcCommand> bit pattern

The bit pattern length depends on the selected channel bandwidth and is automatically adjusted

Example:
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F3
```
Sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TPC
#B101,3
```
Sets the TPC Command

Manual operation: See "DCI Format 3/3A" on page 210

**[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:
DCIConf:TPMI** <Tpmi>

Sets the DCI Format 1B/1D field TPMI Information for Precoding.

Parameters:

<Tpmi> integer

Range: 0 to 15
*RST: 0

Example:

```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
```
Sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:TPMI
10
```
Sets the TPMI Information for Precoding

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:ULINdex <UlIndex>

(Enabled for TDD mode and UL/DL Configuration 0)

Sets the DCI Format 1B/1D field UL Index.

Parameters:

<UlIndex> integer

Range: 0 to 3
*RST: 0

Example:

```
BB:EUTR:DUPL TDD
```
Selects TDD mode.
```
BB:EUTR:TDD:UDC 0
```
Sets the UL/DL configuration
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR
```
Sets the PDCCH format.
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B
```
Sets the DCI format
```
BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:ULIN
1
```
Sets the UL Index

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:ULDLconf <DciUlDlConf>

Sets the UL/DL configuration numbers.

Each UL/DL configuration number consists of 3 bits and indicates one of the configurations listed in Figure 2-5.

Parameters:

<DciUlDlConf> 64 bits

Example:
```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:LINK DOWN

SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:USER U1E
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:SESPace AUTO
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIFmt?
//  F1C
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM1:DCIConf:ULDL #H3AF,12
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:PFMT 2
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:CINDex 0
```

Options: R&S SMW-K113

Manual operation: See "DCI Format 1C for eIMTA" on page 205

[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>: DCIConf:VRBA <VrbAssignState>

Sets the DCI Format 1A/1B/1D field Localized/Distributed VRB Assignment.

Parameters:

<VrbAssignState> ON | OFF

*RST: OFF

Example:
`BB:EUTR:DL:SUBF1:ENCC:PDCC:FORM VAR`
Sets the PDCCH format.
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIF F1B`
Sets the DCI format
`BB:EUTR:DL:SUBF1:ENCC:PDCC:EXTC:ITEM1:DCIC:VRBA ON`
Enables the Localized VRB Assignment

11.17 Auto sequence

Option: R&S SMW-K112

Example: How to enable and configure the auto sequence mode

```
SCONfiguration:MODE ADV
SCONfiguration:FADing MIMO2X2x2
SCONfiguration:BASeband:SOURce COUP
SCONfiguration:APPLy

SOURce1:BB:EUTRa:DL:CONF:MODE ASEQ
SOURce1:BB:EUTRa:DL:CA:CELL0:CIF 1
SOURce1:BB:EUTRa:DL:CA:CELL1:CIF 1
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M10
SOURce1:BB:EUTRa:DL:USER1:CELL1:TXM M9
SOURce1:BB:EUTRa:DL:USER2:CELL0:TXM M7
SOURce1:BB:EUTRa:DL:USER2:CELL1:TXM M7
```

```
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM1:DCIFmt F2D

SOURce1:BB:EUTRa:DL:USER1:STATe 1
SOURce1:BB:EUTRa:DL:USER2:STATe 1


SOURce1:BB:EUTRa:DL:USER1:AS:DL:AFSeq 1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:NHIDs 8
SOURce1:BB:EUTRa:DL:USER1:AS:DL:NHTRans 4
SOURce1:BB:EUTRa:DL:USER1:AS:DL:INDI 1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:SKPRocess 1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:USUBframe0 1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:USUBframe1 1
SOURce1:BB:EUTRa:DL:USER1:AS:UL:AFSeq 1
SOURce1:BB:EUTRa:DL:USER1:AS:UL:NHTRans 4
SOURce1:BB:EUTRa:DL:USER1:AS:UL:INDI 1
SOURce1:BB:EUTRa:DL:USER1:AS:APPLy
SOURce1:BB:EUTRa:DL:USER1:AS:ARBLen?
// 32
SOURce1:BB:EUTRa:DL:USER1:AS:ASLength

SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SLENgth?
// 320
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:MCSMode FIX
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:FMCS 30
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:RVCSequence "0,1,2,3"
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:SUBFrame?
// 0
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:HARQ?
// 0
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:TB1:NDI?
// 1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem1:TB1:NDI?
// 1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:TB1:RV?
// 0
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:URLCounter?
// 0

SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SEQelem0:PDRE?
// 0

SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SLENgth?
// 320
SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:VULTxpow 1
SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:SUBFrame?
// 2
SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:RBA?
// 0
SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:NDI?
// 1
SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:PTPC 2
```

```
SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL0:SEQelem2:CONFlict?
// 0
```

```
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:MCSMode TCR
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:TCR 0.333
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:TMOD QAM64
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL1:SELement 2
```

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ARBLen?

Queries the suggested ARB sequence length.

Return values:

<SugArbLen> integer

Range: 1 to 1E4
*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Usage: Query only

Manual operation: See "ARB Sequence Length > Suggested, Adjust Length" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:ASLength

Adjusts the ARB sequence length.

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Usage: Event

Manual operation: See "ARB Sequence Length > Suggested, Adjust Length" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:AFSeq <AutofillSeq>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:AFSeq <AutofillSeq>

Enables the automatic configuration of the DCIs.

Parameters:

<AutofillSeq> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Autofill DL/UL Sequence" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHIDs <NumHARQIds>

Sets the number of HARQ process IDs.

Parameters:

<NumHARQIds> integer

Range: 1 to 15
*RST: 8

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Number of HARQ Process IDs" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:NHTRans <NumHARQTrans>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:NHTRans <NumHARQTrans>

Sets the number of HARQ transmissions.

Parameters:

<NumHARQTrans> integer

Range: 1 to 32
*RST: 4

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Number of HARQ Transmissions" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:SKPRocess <SkipProc>

Skips HARQ process at unused subframes.

Parameters:

<SkipProc> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Skip Process at Unused Subframes" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:INDI <StartingNDI>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:INDI <StartingNDI>

Sets the new data indicator flag at the beginning of the sequence.

Parameters:

<StartingNDI> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Initial NDI" on page 152

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL[:CELL<ccidx>]:USUBframe<dir0> <UseSubfr>

Sets the downlink subframes to be used for the HARQ transmission.

Suffix:
<dir0> 0 to 9
DL subframe number

Parameters:
<UseSubfr> 1 | ON | 0 | OFF
*RST: 1

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Subframes to Use:" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:APPLy

Applies the selected auto sequence settings.

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Usage: Event

Manual operation: See "Apply" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:MCSMode <McsMode>

Sets how the Modulation and Coding Scheme is configured.

Parameters:
<McsMode> MANual | FIXed | TCR
*RST: TCR

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "MCS Mode" on page 153

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:FMCS <FixedMcs>

Sets the MCS value.

Parameters:
<FixedMcs> integer
Range: 0 to 31
*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "MCS" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TCR <TargetCR>

Sets the target code rate.

Parameters:

<TargetCR> float

Range: 0 to 1
Increment: 0.001
*RST: 0.333

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Target Code Rate, Target Modulation" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:TMOD <TargetMod>

Sets the target moduilation.

Parameters:

<TargetMod> QPSK | QAM16 | QAM64 | QAM256

*RST: QPSK

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Options: QAM256 requires R&S SMW-K113

Manual operation: See "Target Code Rate, Target Modulation" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RVCSequence <RVCodingSeq>

Sets the redundancy version sequence.

Parameters:

<RVCodingSeq> string

Up to 30 comma-separated values

Range: 0 to 3 (for each value in the sequence)
*RST: "0,1,2,3"

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "RV coding Sequence" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: HARQ <HARQProc>

Sets the HARQ process.

Parameters:

<HARQProc>	integer	
	Range:	0 to 15
	*RST:	0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "DL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: PDRE <ReMapQCL>

Sets the PDSCH RE mapping and QCL (quasi-co-location) indicator.

See also `[:SOURce<hw>]:BB:EUTRa:DL[:SUBF<st0>]:ENCC:PDCCh:EXTC:ITEM<ch0>:DCIConf:PDRE` on page 815

Parameters:

<ReMapQCL>	integer	
	Range:	0 to 3
	*RST:	0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Options: R&S SMW-K112

Manual operation: See "DL DCI Sequence Table" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SLENgth?
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SLENgth?

Queries the sequence length as number of subframes.

Return values:

<ULSeqLength>	integer	
	Range:	0 to max
	*RST:	0
	Default unit:	Subframes

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Usage: Query only

Manual operation: See "DL DCI Sequence Table" on page 154
See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: SUBFrame <DLSubfrNo>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>: SUBFrame <ASeqSubfrNo>

Sets the subframe number.

Parameters:

<ASeqSubfrNo> integer

Range: 0 to max
*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: TB1:MCS <DlMcs>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: TB2:MCS <DlMcs>

Sets the MCS.

Parameters:

<DlMcs> integer

Range: 0 to 31
*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: TB1:NDI <DlNdi>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>: TB2:NDI <DlNdi>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>: NDI <UlNDI>

Enables the new data indicator flag.

Parameters:

<UlNDI> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RLCCounter <RLCCounter>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB2:RLCCounter <RLCCounter>

Sets the RLC counter.

Parameters:

<RLCCounter> integer

Range: 0 to 31
*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB1:RV <DIRV>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:TB2:RV <DIRV>

Sets the redundancy version.

Parameters:

<DIRV> integer

Range: 0 to 3
*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SEQelem<dir0>:CONFlict?
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:CONFlict?

Queries if there is conflict.

Return values:

<UlSeqConflict> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Usage: Query only

Manual operation: See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:URLCounter <UseRLCCounter>

Enables/disables the use of RLC counter.

Parameters:

<UseRLCCounter> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Use RLC Counter" on page 154

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:RBA <UlRBA>

Sets the UL RBA.

Parameters:

<UlRBA> integer

Range: 0 to 2047

*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:PTPC <PuschTpc>

Sets the PUSCH TPC.

Parameters:

<PuschTpc> integer

Range: 0 to 3

*RST: 0

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SEQelem<dir0>:ULINdex <UlIndex>

In TDD mode and with "UL/DL Configuration = 0", sets the parameter UL Index.

Parameters:

<UlIndex> integer

Range: 0 to 3

*RST: 0

Example:

```
:SOURce1:BB:EUTRa:TDD:UDConf 0
:SOURce1:BB:EUTRa:DL:USER1:AS:UL:CELL1:SEQelem1:ULINdex 0
```

Manual operation: See "UL DCI Sequence Table" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:VULTxpow <VaryULTxPow>

Enables variation of the UL Tx power.

Parameters:

<VaryULTxPow> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"How to enable and configure the auto sequence mode" on page 823

Manual operation: See "Vary UL TX Power and RBA" on page 155

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:SELement <SelElem>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement <SelElem>

Selects a table element (i.e. table row).

Parameters:

<SelElem> integer

Range: 0 to 1499
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:APPend
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SELement
1
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:INSert
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:SELement
3
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:DELete
SOURce1:BB:EUTRa:DL:USER1:AS:DL:CELL0:RESet
```

Manual operation: See "Append, Insert, Delete, Reset" on page 156

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:APPend
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:APPend

Appends a table element at the end of the table.

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 834

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 156

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:INSert
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:INSert

Inserts a table element before the selected one.

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 834

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 156

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:DELete
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:DELete

Deletes the selected table element.

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 834

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 156

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:UL:CELL<st0>:RESet
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:RESet

Resets the DCI table, i.e. removes all table elements.

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:AS:DL:CELL<st0>:SELement on page 834

Usage: Event

Manual operation: See "Append, Insert, Delete, Reset" on page 156

11.18 UL frame configuration

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUCCh <ConfSubf>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CONSubframes:PUSCh <ConfSubframes>

Sets the number of configurable subframes.

Parameters:

<ConfSubframes> integer

Range: 1 to 40
*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:ID 100
SOURce1:BB:EUTRa:UL:UE2:ID 100
SOURce1:BB:EUTRa:UL:UE1:CONSubframes:PUCCh 10
SOURce1:BB:EUTRa:UL:UE1:CONSubframes:PUSCh 10
SOURce1:BB:EUTRa:UL:UE2:CONSubframes:PUCCh 8
SOURce1:BB:EUTRa:UL:UE2:CONSubframes:PUSCh 8
```

Manual operation: See "Number Of PUCCH/PUSCH Configurations/Number Of Configurable Subframes" on page 257

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:CYCPrefix <CyclicPrefix>

If `BB:EUTR:UL:CPC USER`, sets the cyclic prefix for the selected subframe.

Parameters:

<CyclicPrefix> NORMal | EXTended

*RST: NORMal

Example:

```
BB:EUTR:UL:CPC USER
BB:EUTR:UL:SUBF6:CYCP NORM
```

A normal prefix is used in subframe 6 in uplink.

Manual operation: See "Cyclic Prefix (UL)" on page 260

[:SOURce<hw>]:BB:EUTRa:UL:RSTFrame

Resets all subframe settings of the selected link direction to the default values.

Example: `BB:EUTR:UL:RSTF`
Resets the uplink subframe parameters of path A to the default settings.

Manual operation: See "Reset All Subframes" on page 260

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONType <ContentType>

Selects the content type for the selected allocation.

Parameters:

<ContentType> PUSCh | PUCCh | EMTC | NIOT
*RST: PUSCh

Example: `BB:EUTR:UL:SUBF4:ALL2:CONT PUSC`

Options: EMTC|NIOT require R&S SMW-K115

Manual operation: See "Content (UL)" on page 261
See "UE/Content Type" on page 325

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>][:PUSCh]:MODulation <Modulation>

Selects the modulation scheme for the allocation.

Suffix:

<cwid> 1..2
Codeword

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256
*RST: QPSK

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CONType PUSCh
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CODWords 1
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CW1:MODulation QPSK
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PHYSbits?
```

Options: QAM256 requires R&S SMW-K119

Manual operation: See "Modulation/Format" on page 261

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:PUCCh]:FORMat <Format>

Sets the PUCCH Format.

Parameters:

<Format> F1 | F1A | F1B | F2 | F2A | F2B | F3 | F4 | F5

*RST: F1

Example:

```
SOUR:BB:EUTR:UL:SUBF4:ALL2:CONT PUCC
SOUR:BB:EUTR:UL:SUBF4:ALL2:FORM F2A
```

Options: F4|F5 require R&S SMW-K119

Manual operation: See "Modulation/Format" on page 261
See "PUCCH Format" on page 334

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:RBCount <ResBlockCount>
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:RBCount?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:RBCount <NumberOfRBs>

Sets the size of the selected allocation in resource blocks (per slot).

Suffix:

<user> 1..2
Set

Parameters:

<NumberOfRBs> integer

Range: 0 to 110
*RST: 0

Example:

```
BB:EUTR:UL:UE1:REL R89
BB:EUTR:UL:SUBF0:ALL1:RBC 3
```

Example:

```
BB:EUTR:UL:UE2:REL R10
BB:EUTR:UL:SUBF0:ALL2:PUCC:RBC?
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:RBC 4
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:VRB 5
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET2:RBC 3
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET2:VRB 15
```

Manual operation: See "Set 1/Set 2 No. RB" on page 262

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:VRBoffset <VrbOffset>
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:SET<user>:VRBoffset <NumberOfVRBs>

Sets the virtual resource block offset of the selected subframe.

Suffix:

<user> 1..2

Parameters:

<NumberOfVRBs> integer

Range: 0 to 49
*RST: 0

Example:
```
BB:EUTR:UL:SUBF0:ALL1:VRB 6
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:VRB 5
BB:EUTR:UL:SUBF0:ALL2:PUSC:SET1:VRB 15
```

Manual operation: See "Set 1/Set 2 Offset VRB" on page 263

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:RBOFfset?
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUCCh:RBOFfset?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:SLOT<user0>:ALLoc<ch0>:PUSCh:SET<gr>:RBOFfset?

Queries the start resource block of the selected allocation in slot n of the subframe.

Suffix:

<user0> 0..1

<s2us> 1..2

Return values:

<RbOffs> integer

Range: 0 to 49
*RST: 2

Usage: Query only

Manual operation: See "Offset PRB Slot (n/n+1)" on page 263

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PHYSbits?
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:PHYSbits?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:PHYSbits?

Queries the number of physical bits for the selected allocation.

Suffix:

<cwid> 1..2
Codeword

Return values:

<PuscPhysBits> integer

Range: -1 to 105600
*RST: -1

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:
PHYSbits?
```

Usage: Query only

Manual operation: See "Phys. Bits / Total Number of Physical Bits" on page 264

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:POWer <Power>
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:POWer <PuccPower>
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:POWer <PuscPower>

Sets the power for the selected allocation.

Parameters:

<PuscPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example:
```
BB:EUTR:UL:SUBF4:ALL1:POW 3.00
BB:EUTR:UL:SUBF4:ALL2:PUSC:POW -1.00
BB:EUTR:UL:SUBF4:ALL2:PUCC:POW -1.00
```

Manual operation: See "Power (UL)" on page 264

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:STATe <State>
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:STATe <PuccState>
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:STATe <PuscState>

Sets the allocation state to active or inactive.

Note: Disabling an allocation deactivate the PUSCH/PUCCH and the corresponding demodulation reference signal, but does not affect other allocations of the UE or the sounding reference signal.

Parameters:

<PuscState> 1 | ON | 0 | OFF

*RST: dynamic

Options: AUTO requires R&S SMW-K115

Manual operation: See "State (UL)" on page 264

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:CONFlict?
[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CONFlict?
[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CONFlict?

Indicates a conflict between two allocations.

Return values:

<PuscConflict> 1 | ON | 0 | OFF

*RST: OFF

Usage: Query only

Manual operation: See "Conflict (UL)" on page 265

11.19 UL carrier aggregation

Option: R&S SMW-K55 and R&S SMW-K112.

Example: Activating UL carrier aggregation

```
SCONfiguration:APPLy
SCONfiguration:MODE ADV
SCONfiguration:FADing MIMO2X2X2
SCONfiguration:BASeband:SOURce COUP
SCONfiguration:APPLy

SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:CA:CELL0:DUPLexing FDD

SOURce1:BB:EUTRa:UL:CA:CELL1:INDex 5
SOURce1:BB:EUTRa:UL:CA:CELL1:ID 10
SOURce1:BB:EUTRa:UL:CA:CELL1:BW BW20_00
SOURce1:BB:EUTRa:UL:CA:CELL1:SUConfiguration 0
SOURce1:BB:EUTRa:UL:CA:CELL1:CSRS 7
SOURce1:BB:EUTRa:UL:CA:CELL1:DMRS 0
SOURce1:BB:EUTRa:UL:CA:CELL1:TDELay 0

SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:STATe 1
SOURce1:BB:EUTRa:STATe 1
OUTPut1:STATe 1
OUTPut2:STATe 1
```

[:SOURce<hw>]:BB:EUTRa:UL:CA:STATe <ULCaGlobState>

Enables UL carrier aggregation.

Parameters:

<ULCaGlobState> 1 | ON | 0 | OFF
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "Activate Carrier Aggregation" on page 235

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:INDex <ULCaCellIndex>

Sets the cell index of the corresponding SCell.

Parameters:

<ULCaCellIndex> integer
Range: 1 to 7
*RST: 1

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "Cell Index" on page 236

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:ID <ULCaPhyCellId>

Sets the physical Cell ID of the PCell and the SCells.

Parameters:

<ULCaPhyCellId> integer

Range: 0 to 503
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "Physical Cell ID" on page 236

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:BW <ULCaBw>

Sets the bandwidth of the corresponding component carrier.

Parameters:

<ULCaBw> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

*RST: BW10_00

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "Bandwidth" on page 236

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DFReq <ULCaDeltaF>

Sets the frequency offset between the central frequency of corresponding SCell and the frequency of the PCell.

Parameters:

<ULCaDeltaF> float

Value range depends on the installed options, the number of cells and the cell bandwidth.

Range: -60 to 60
Increment: 0.1
*RST: 0
Default unit: MHz

Example: See Chapter 11.19, "UL carrier aggregation", on page 841.

Manual operation: See "delta f / MHz" on page 236

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DUPLexing <ULCaDuplexMode>

Selects the duplexing mode of the component carriers.

Parameters:

<ULCaDuplexMode> TDD | FDD

*RST: FDD

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "Duplexing" on page 236

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:UDConf <ULCaTddULDLConf>

Sets the Uplink-Downlink Configuration number.

Parameters:
<ULCaTddULDLConf> integer
Range: 0 to 6
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "TDD UL/DL Configuration" on page 236

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SUConfiguration <ULCaSrsSubfConf>

Sets the SRS subframe configuration per component carrier.

Parameters:
<ULCaSrsSubfConf> integer
Range: 0 to 15
*RST: 15

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "SRS Subframe Configuration" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:DMRS <ULCaN1Dmrs>

Sets the parameter n(1)_DMRS per component carrier.

Parameters:
<ULCaN1Dmrs> integer
Range: 0 to 11
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "n(1)_DMRS" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:SPSConf <ULCaTddSSConf>

Sets the special subframeconfiguration number.

Parameters:
<ULCaTddSSConf> integer
Range: 0 to 10
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841.

Options: R&S SMW-K119: special subframe configuration 10

Manual operation: See "TDD Special Subframe Config" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:CSRS <ULCaSrsCSRS>

Sets the parameter SRS Bandwidth Configuration per component carrier.

Parameters:

<ULCaSrsCSRS> integer

Range: 0 to 7
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "SRS Bandwidth Configuration C_SRS" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:TDELay <TimeDelay>

Sets the time delay of the SCell relative to the PCell.

Parameters:

<TimeDelay> integer

Range: 0 to 7E5
*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "Delay / ns" on page 237

[:SOURce<hw>]:BB:EUTRa:UL:CA:CELL<ch0>:STATe <ULCaCellState>

Activates the corresponding component carrier.

Parameters:

<ULCaCellState> 1 | ON | 0 | OFF

*RST: 0

Example: See Chapter 11.19, "UL carrier aggregation", on page 841

Manual operation: See "State" on page 237

11.20 UL enhanced

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>: PUSCh:PRECoding:SCHeme <PrecodingScheme>

Sets the PUSCH precoding scheme.

Parameters:

<PrecodingScheme> NONE | SPM

*RST: NONE

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUSCh:TXMode M2
SOURce1:BB:EUTRa:UL:UE1:PUSCh:NAP AP2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:SCHeme SPM
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CODWords 2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:NOLayers 4
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:NAPused?
// Response: AP2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:CBINdex?
```

Options: R&S SMW-K85

Manual operation: See "Precoding Scheme" on page 325

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>: PUSCh:CODWords <NumOfCodeWords>

Sets the number of the used codeword.

Parameters:

<NumOfCodeWords> integer

Range: 1 to 2
*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:CELL0:SUBF0:ALLoc0:PUSCh:
CODWords?
```

Options: R&S SMW-K85/-K112

Manual operation: See "Codeword (UL)" on page 261
See "Number of Codewords" on page 325

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NOLayers <NumberOfLayers>

Sets the number of layers used by the PUSCh precoding.

Parameters:

<NumberOfLayers> integer

Range: 1 to 4
*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme on page 846

Options: R&S SMW-K85

Manual operation: See "Number of Layers" on page 325

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NAPused <NumUsedAntPorts>

Sets the number of antenna ports the PUSCH transmission uses.

Parameters:

<NumUsedAntPorts> AP1 | AP2 | AP4

*RST: AP1

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort on page 892

Options: R&S SMW-K85

Manual operation: See "Number of Used Antenna Port" on page 325

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:CBINdex <CodeBookIndex>

Sets the codebook index.

Parameters:

<CodeBookIndex> integer

Range: 0 to 23
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:SCHeme on page 846

Options: R&S SMW-K85

Manual operation: See "Codebook Index" on page 325

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>?

Queries the parameter n(2)_DMRS,λ (Layer λ).

Suffix:

<st0>	0..39
<ch0>	0..3
<layer>	0..3 Layer

Return values:

<Ndmrs> integer

Range: 0 to 11
*RST: 0

Example:
```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:PUSCh:DRS:
CYCShift 1
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:PUSCh:DRS:
NDMRs1?
Response: 6
```

Usage: Query only

Options: R&S SMW-K85

Manual operation: See "n(2)_DMRS,λ (Layer λ)" on page 327

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:MAPPing <BitsDmrsMapping>

Sets the *Cyclic Shift Field mapping table for DMRS bit* field

Parameters:

<BitsDmrsMapping> 1 | ON | 0 | OFF

*RST: 0

Example:
```
// enabling mapping the DMRS sequence on each second subcarrier
SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:DRS:ENHanced 1
SOURce1:BB:EUTRa:UL:CELL0:SUBF0:ALLoc1:PUSCh:MAPPing 1
```

Manual operation: See "Bit for DMRS Mapping Table" on page 327

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:STATe <State>

Enables/disables frequency hopping for PUSCH.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:FHOP:STAT ON`
Enables frequency hopping

Manual operation: See "Frequency Hopping" on page 326

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:TYPE?

Queries the frequency hopping type used, as defined in 3GPP TS36.213.

Return values:

<Type> TP1 | TP2 | NONE
*RST: NONE

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:FHOP:TYPE?`
Queries the frequency hopping type
`Response: TP2`

Usage: Query only

Manual operation: See "Hopping Type" on page 326

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:FHOP:IIHBits <InfoInHoppBits>

Sets the information in hopping bits according to the PDCCH DCI format 0 hopping bit definition.

Parameters:

<InfoInHoppBits> integer
Range: 0 to 3
*RST: 1

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:FHOP:IIHB 0`
Sets the information in hopping bits

Manual operation: See "Information in Hopping Bits" on page 326

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:CYCShift <Cyclicshift>

Sets the cyclic shift field in the uplink-related DCI formats.

Suffix:

<st0> 0..39
Subframe

<ch0> 0..3
Allocation

Parameters:

<Cyclicshift> int

Range: 0 to 7
Increment: 1
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:DRS:NDMRs<layer>? on page 848

Options: R&S SMW-K85

Manual operation: See "Cyclic Shift Field" on page 327

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>: PUSCh:HARQ:MODE <Mode>

Sets the ACK/NACK mode to Multiplexing or Bundling according to 3GPP TS 36.212, chapter 5.2.2.6.

ACK/NACK mode Bundling is defined for TDD duplexing mode only.

Parameters:

<Mode> MUX | BUNDling

*RST: MUX

Example: `BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:MODE MUX`
Selects multiplexing HARQ mode

Manual operation: See "ACK/NACK Mode" on page 329

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>: PUSCh:HARQ:NBUNdled <N_Bundled>

Sets the parameter N_bundled.

Parameters:

<N_Bundled> integer

Range: 1 to 6
*RST: 1

Example:
```
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:MODE BUND
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:NBUN 2
```

Manual operation: See "N_bundled" on page 329

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>: PUSCh:HARQ:BITS <Bits>

Sets the number of ACK/NACK bits.

Set this parameter to 0 to deactivate the ACK/NACK transmission for the corresponding subframe.

Parameters:

<Bits> integer

Range: 0 to dynamic
*RST: 1

Example:
```
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:BITS 2
```
Sets the number of A/N bits

Manual operation: See "Number of A/N Bits" on page 329

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:HARQ:CBITs?

Queries the number of coded ACK/NACK bits per codeword.

Suffix:

<cwid> 1..2
Codeword

Return values:

<Codedbits> integer

Range: 0 to max
Increment: 0
*RST: 2

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:HARQ:
BITS 2
```
Sets the number of A/N bits
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:
HARQ:CBITs?
Response: 8
```

Usage: Query only

Manual operation: See "Number of Coded A/N Bits (CW)" on page 330

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:HARQ:PATTern <Pattern>, <BitCount>

Sets the ACK/NACK pattern for the PUSCH.

Parameters:

<Pattern> 1024 bits

*RST: #H0

<BitCount> 1024 bits

Range: 1 to 64
*RST: 1

Example:
```
// Set 2-bit HARQ-ACK control information
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:ACKT BIT2
BB:EUTR:UL:SUBF4:ALL2:PUSC:HARQ:PATT #B10,2
```

Manual operation: See "ACK/NACK Pattern" on page 329

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<CodedBits> integer

Range: 0 to max

*RST: 22

Example: `SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:CQI:CBITs?`

Queries the number of coded CQI bits

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 331

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:BITS <Bits>

Sets the number of CQI bits before channel coding.

Parameters:

<Bits> integer

Range: dynamic to 1024

*RST: 10

Example: See `[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:PATTern` on page 852

Manual operation: See "Number of CQI Bits" on page 331

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:PATTern <Pattern>, <BitCount>

Sets the CQI pattern for the PUSCH.

The length of the pattern is determined by the number of CQI bits (`[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:BITS`).

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 1024

*RST: 1

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:CQI:BITS 6
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUSCh:CQI:PATTern #H100100,6
```

Manual operation: See "CQI Pattern" on page 331

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:CQI:CODWord?

Queries the codeword the CQI is mapped to.

Return values:

<CqiCodeWord> CW1 | CW2

*RST: CW1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
:SOURce1:BB:EUTRa:UL:UE1:PUSCh:TXMode M2
:SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:STATe 1
:SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:MODE COMB
:SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CODWords 2
:SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:CQI:CODWord?
// Response: CW1
```

Usage: Query only

Options: R&S SMW-K85

Manual operation: See "CQI mapped to" on page 331

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:RI:CBITs?

Queries the number of coded RI bits per codeword.

Suffix:

<cwid> 1..2
Codeword

Return values:

<CodedRiBits> integer

Range: 0 to max
*RST: 4

Example:
```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:RI:BITS 6
:SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CW1:PUSCh:RI:CBITs?
// Response: 14
```

Usage: Query only

Manual operation: See "Number of Coded RI Bits (CW)" on page 330

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:BITS <Bits>

Sets the number of rank indication (RI) bits.

Set this parameter to 0 to deactivate the RI for the corresponding subframe.

Parameters:

<Bits> integer

Range: 0 to 512
*RST: 1

Example:
```
BB:EUTR:UL:SUBF4:ALL2:PUSC:CQI:BITS 2
```
Sets the number of RI bits

Manual operation: See "Number of RI Bits" on page 330

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:RI:PATTern <Pattern>, <BitCount>

Sets the RI pattern for the PUSCH.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 1024
*RST: 1

Example:
```
// Set the number of RI bits
BB:EUTR:UL:SUBF4:ALL2:PUSC:RI:BITS 2
BB:EUTR:UL:SUBF4:ALL2:PUSC:RI:PATT #H10,2
```

Manual operation: See "RI Pattern" on page 330

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:ULSCh:BITS?

Queries the number of physical bits used for UL-SCH transmission.

Suffix:

<cwid> 1..2
Codeword

Return values:

<PhysBitCount> integer

Range: 0 to max
*RST: 1500

Example: `SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:CW1:PUSCh:ULSCh:BITS?`
Queries the number of physical bits for UL-SCH
`Response: 5688`

Usage: Query only

Manual operation: See "Number of Coded UL-SCH Bits" on page 332

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUSCh:ULSCh:BITS<cw>?

Queries the number of physical bits used for UL-SCH transmission.

Suffix:

<cw> 1..2
Codeword

Return values:

<PhysBitCount> integer

Range:	0 to max
Increment:	1
*RST:	1500

Example: `SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:ULSCh:BITS1?`
Queries the number of physical bits for UL-SCH
`Response: 5688`

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:TBSize <TranspBlockSize>

Sets the size of the transport block.

Suffix:

<cwid> 1 | 2
Codeword

Parameters:

<TranspBlockSize> integer

Range:	0 to 253440
*RST:	1500

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW0:PUSCh:CCODing:TBSize 100
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW2:PUSCh:CCODing:TBSize 1500
```

Manual operation: See "Transport Block Size/Payload (PUSCH)" on page 332

[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>[:CW<cwid>]:PUSCh:CCODing:RVINdex <RedundVersIndex>

Sets the redundancy version index.

Suffix:
<cwid> 1..2
Codeword

Parameters:
<RedundVersIndex> integer
Range: 0 to 3
*RST: 0

Example:
```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:CW1:PUSCh:
CCODing:RVINdex 2
```
Sets the redundancy version index

Manual operation: See "Redundancy Version Index (PUSCH)" on page 333

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NAPused?

Queries the number of antenna ports used for transmissions of the current PUCCH format.

Return values:
<NumAntennaPorts> integer
Range: 1 to 2
*RST: 1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUCCh:F1Naport AP2
SOURce1:BB:EUTRa:UL:UE1:PUCCh:F2Naport AP1
SOURce1:BB:EUTRa:UL:UE1:PUCCh:F3Naport AP1
SOURce1:BB:EUTRa:UL:SUBF0:Alloc0:PUCCh:NAPused?
// Response: 2
SOURce1:BB:EUTRa:UL:SUBF0:Alloc0:FORMat F2B
SOURce1:BB:EUTRa:UL:SUBF0:Alloc0:PUCCh:NAPused?
// Response: 1
```

Usage: Query only

Options: R&S SMW-K85

Manual operation: See "Number of Used Antenna Ports" on page 334

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NPAR<ap> <NPar>

Sets the resource index for the supported PUCCH formats.

Suffix:
<ap> 0..1
Antenna port index

Parameters:
<NPar> integer

n(x)_PUCCH_max depends on the PUCCH format; to query the value, use the corresponding command, for example [:SOURce<hw>]:BB:EUTRa:UL:PUCCh:N1EMax?.

Range: 0 to n(x)_PUCCH_max
*RST: 0

Example: `SOURce1:BB:EUTRa:UL:SUBF1:ALLoc2:PUCCh:NPAR0 10`

Manual operation: See "n_PUCCH" on page 334

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:BITS <Bits>

(PUCCH format ≥3)

Sets the number of ACK/NACK+SR+CSI bits before channel coding.

Parameters:
<Bits> Max number of bits depend on the PUCCH format

Range: 1 to dynamic
*RST: 1

Manual operation: See "Number of A/N+SR+CSI Bits" on page 338

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:CBITs?

(PUCCH format ≥3)

Queries the number of coded ACK/NACK+SR+CSI bits.

Return values:
<CBits> integer

Range: 0 to 48
*RST: 0

Usage: Query only

Manual operation: See "Number of Coded A/N+SR+CSI Bits" on page 338

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:HARQ:PATTern <Pattern>, <BitCount>

Sets the PUCCH ACK/NACK pattern or ACK/NACK + SR pattern per subframe.

Parameters:
<Pattern> 1024 bits

*RST: #H0

<BitCount>	1024 bits Range: 1 to 32 *RST: 1

Example:	`SOURce1:BB:EUTRa:SLENgth 4`
	`SOURce1:BB:EUTRa:UL:UE1:CONSubframes:PUCCh 8`
	`SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:FORMat F1A`
	`SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:HARQ:PATTern #B01001,5`
	`SOURce1:BB:EUTRa:UL:SUBF0:ALLoc1:FORMat F1B`

Manual operation:	See "A/N Pattern / A/N+SR+CSI Pattern" on page 336

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<CodedBits>	integer Range: 0 to max *RST: 20

Example:	`SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:CQI:CBITs?`
	Queries sets the number of coded CQI bits
	`Response: 20`

Usage:	Query only
Manual operation:	See "Number of Coded CQI Bits" on page 338

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:BITS <Bits>

Sets the number of CQI bits before channel coding.

Parameters:

<Bits>	integer Range: 1 to 13 *RST: 4
Example:	See `[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:PATTern` on page 858
Manual operation:	See "Number of CQI Bits" on page 337

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:PATTern <Pattern>, <BitCount>

Sets the CQI pattern for the PUCCH.

The length of the pattern is determined by the number of CQI bits (`[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CQI:BITS`).

Parameters:

<Pattern> numeric

*RST: #H1

<BitCount> integer

Range: 1 to 13
*RST: 4

Example:

```
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:CQI:BITS 6
SOURce1:BB:EUTRa:UL:SUBF4:ALLoc2:PUCCh:CQI:PATTern #B100100,6
```

Manual operation: See "CQI Pattern" on page 338

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:MRB <PucchMRB>

Sets the number of resource blocks used by PUCCH format 5.

Parameters:

<PucchMRB> 1 | 2 | 3 | 4 | 5 | 6 | 8

*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:FORMat F5
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:MRB 1
```

Options: R&S SMW-K119

Manual operation: See "M_RB" on page 338

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NOC <NOC>

Sets the PUCCH format 4 index n_{oc}.

Parameters:

<NOC> integer

Range: 0 to 1
*RST: 0

Example:

```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:FORMat F5
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:NOC 1
```

Options: R&S SMW-K119

Manual operation: See "n_oc" on page 338

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CYCShift <CyclicShiftDmrs>

Sets the cyclic shift.

Parameters:

<CyclicShiftDmrs> integer

Range: 0 to 7
*RST: 0

Example:
```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:FORMat F5
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:CYCShift 4
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:DMR1?
// 6
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:DMR1 2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:CYCShift?
// 1
```

Options: R&S SMW-K119

Manual operation: See "Cyclic Shift Field" on page 339

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:DMR1 <PuccDmrs1>

Sets the index $n^{(2)}_{DMRS}$.

Parameters:

<PuccDmrs1> 0 | 2 | 3 | 4 | 6 | 8 | 9 | 10

*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:CYCShift on page 859.

Options: R&S SMW-K119

Manual operation: See "n(1)_DMRS" on page 340

[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:DMR2?

Queries the index $n^{(2)}_{DMRS}$.

Return values:

<PuccDmrs2> integer

Range: 0 to 6
*RST: 0

Example:
```
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:FORMat F5
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUCCh:DMR2?
// 0
```

Usage: Query only

Options: R&S SMW-K119

Manual operation: See "n(2)_DMRS" on page 340

11.21 User configuration

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STATe <UserState>

Enables/disables a user.

Parameters:

<UserState> 1 | ON | 0 | OFF

*RST: 1

Example: `SOURce1:BB:EUTRa:DL:USER1:STATe OFF`

Manual operation: See "State" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CA:STATe <State>

Enables/disables carrier aggregation for the selected user.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Options: R&S SMW-K85

Manual operation: See "Activate CA" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TXM <TxMode>

Sets the transmission mode of the according user as defined in TS 36.213.

Parameters:

<TxMode> USER | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M10

*RST: USER

Option:R&S SMW-K115

<TxMode> = USER|M1|M2|M6|M9

Example: `SOURce1:BB:EUTRa:DL:USER1:TXM M6`

Options: M10 requires R&S SMW-K112

Manual operation: See "Tx Modes" on page 142

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TXM <TxMode>

Sets the transmission mode of the user.

Suffix:

<st0> 0 to 4

0 = PCell, 1 to 4 = SCell1 to SCell4

Parameters:

<TxMode> USER | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M10

*RST: USER

Example: `SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M9`

`SOURce1:BB:EUTRa:DL:USER1:CELL1:TXM M7`

Options: M10 requires R&S SMW-K112

Manual operation: See "Tx Modes" on page 142

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEC <UECategory>

Sets the UE Category.

Parameters:

<UECategory> USER | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 | C19 | C20 | M1 | NB1 | M2 | NB2

*RST: USER

Options: M1|NB1 require R&S SMW-K115
M2|NB2 require R&S SMW-K143

Manual operation: See "UE Category" on page 143

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ULCA<st0>:STATe <CuUlCaState>

Sets the state of the associated UL carriers, if carrier aggregation is enabled.

Suffix:

<st0> 0 to 4
0 = PCell, 1 to 4 = SCell1 to SCell4
LAA SCells cannot be associated with UL carriers; the corresponding UL carrier state is always off.

Parameters:

<CuUlCaState> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:CA:STATe 1
SOURce1:BB:EUTRa:DL:USER1:ULCA0:STATe 1
SOURce1:BB:EUTRa:DL:USER1:ULCA1:STATe 1
```

Options: R&S SMW-K85

Manual operation: See "UL Carriers Configuration" on page 142

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CELL <SelCompCar>

Sets the cell the antenna port mapping is related to, if a carrier aggregation is enabled.

Parameters:

<SelCompCar> PC0 | SC1 | SC2 | SC3 | SC4

*RST: PC0

Example:

```
:SOURce1:BB:EUTRa:DL:USER1:APM:CELL?
```

Manual operation: See "Cell" on page 228

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBCI <CbConstIdx>

Defines whether the codebook index is set globally or per subframe.

Parameters:

<CbConstIdx> 1 | ON | 0 | OFF

Manual operation: See "Constant Codebook Index" on page 227

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBUA <CbUseAlt>

Applies the enhanced 4 Tx codebook.

Parameters:

<CbUseAlt> 1 | ON | 0 | OFF

OFF
Tthe normal codebook is used.

ON
Applied is the enhanced 4Tx codebook.

*RST: 0

Example:

```
:SCONfiguration:APPLy
:SCONfiguration:FADing MIMO2X4X4
:SCONfiguration:BASeband:SOURce COUP
:SCONfiguration:APPLy

:ENTity1:SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX4
:ENTity1:SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M10
:ENTity1:SOURce1:BB:EUTRa:DL:USER1:APM:MODE CB
:ENTity1:SOURce1:BB:EUTRa:DL:USER1:APM:CBCI 0
:ENTity1:SOURce1:BB:EUTRa:DL:USER1:APM:CBUA 1

:ENTity1:SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:PRECoding:CBINdex2 1
:ENTity1:SOURce1:BB:EUTRa:DL:CELL0:SUBF0:ALLoc2:PUSCh:PRECoding:CBUA 1
```

Options: R&S SMW-K113

Manual operation: See "Use Alternative Codebooks" on page 227

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:CBINdex[<dir>] <CodeBookIndex>

Sets the codebook index for mapping mode Codebook.

Parameters:

<CodeBookIndex> integer

Range: 0 to 15
*RST: 0

Manual operation: See "Codebook Index/Codebook Index 2" on page 227

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MAPCoordinates <MapCoord>

Switches between the Cartesian (Real/Imag.) and Cylindrical (Magn./Phase) coordinates representation.

Parameters:

<MapCoord> CARTesian | CYLindrical

*RST: CARTesian

Options: R&S SMW-K84

Manual operation: See "Mapping Coordinates" on page 228

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM:MODE <AntPortMap>

Defines the antenna port mapping method.

Parameters:

<AntPortMap> CB | RCB | FW

CB
Codebook

RCB
Random codebook

FW
Fixed weight

*RST: FW

Manual operation: See "Antenna Port Mapping" on page 226

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:REAL <AntPortMapData>

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<user> 0 to 7
layer

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Parameters:

<AntPortMapData> float

The `REAL` (Magnitude) and `IMAGinary` (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|`REAL`+j*`IMAGinary`| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: dynamic

Manual operation: See "Mapping table" on page 228

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:APM[:LAYer<user>]:AP<dir0>:BB<st0>:IMAGinary <AntPortMapData>

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<user> 0 to 7
layer

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Parameters:

<AntPortMapData> float

The `REAL` (Magnitude) and `IMAGinary` (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|`REAL`+j*`IMAGinary`| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: 0

Manual operation: See "Mapping table" on page 228

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CCODing:STATe <State>

Sets the channel coding for all allocations belonging to the selected user.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:DL:USER2:CCOD:STAT ON`
Enables channel coding for the allocations belonging to user 2.

Manual operation: See "Channel Coding State" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:UEID <Ueid>

Sets the user equipment ID.

Parameters:

<Ueid> integer

Range: 0 to 65535
*RST: 0

Example: `BB:EUTR:DL:USER2:UEID 3308`
Sets the UE ID.

Manual operation: See "UE ID" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA <Data>

Selects the data source for the selected user configuration.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example:

```
SOURce1:BB:EUTRa:USER0:DATA PN23
// file lte_datalist.dm_iqd must exsist in the default directory
SOURce1:BB:EUTRa:USER2:DATA DLISt
SOURce1:BB:EUTRa:USER2:LIST "/var/user/lte_datalist.dm_iqd"
SOURce1:BB:EUTRa:USER4:DATA PATTern
SOURce1:BB:EUTRa:USER4:PATTern #H1C4A9,17
```

Manual operation: See "Data Source, DList/Pattern" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DSELect <DSelect>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DSelect> string

File name incl. file extension or complete file path

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 867.

Manual operation: See "Data Source, DList/Pattern" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:DATA on page 867.

Manual operation: See "Data Source, DList/Pattern" on page 144

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:INITpattern <PatternInit>

Selects the starting seed for data sources for the PDSCH allocation.

Parameters:
<PatternInit> integer

Range: 0 to #H7fffff
*RST: 1

Example:
```
SOURce1:BB:EUTRa:USER0:DATA PATTern
SOURce1:BB:EUTRa:USER0:PATTern #H1C4A9,17
SOURce1:BB:EUTRa:USER0:INITpattern #H1111
```

Manual operation: See "Data Source Init" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EIMTarnti <EIMTARnti>

Sets the dedicated eIMTA-RNTI.

Parameters:
<EIMTARnti> integer

Range: 1 to 65523
*RST: 1

Example:
```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:DL:USER1:EIMTarnti 10
```

Options: R&S SMW-K113

Manual operation: See "eIMTA-RNTI" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:PA <Power>

Sets PDSCH power factor according to TS 36.213, chapter 5.2.

Parameters:
<Power> -6.02 | -4.77 | -3.01 | -1.77 | 0.97 | 2.04 | 3.01 | 0

*RST: 0

Example:
```
BB:EUTR:DL:USER2:PA 2.04
```
Selects the P_A

Manual operation: See "P_A" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:ASRS:STATe <CuApSrsState>

Enables/disables an aperiodic transmission of SRS for the selected user.

Parameters:
<CuApSrsState> 1 | ON | 0 | OFF

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DL:USER2:ASRS:STATe ON
```

Manual operation: See "Aperiodic SRS State" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CAW:STATe <CuCsiAware>

Enables/disables the CSI awareness for the selected user.

Parameters:

<CuCsiAware> OFF | ON | 1 | 0

*RST: OFF

Example: See Example"Enabling a CSI-RS transmission" on page 764

Manual operation: See "CSI Awareness State" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:MCS <McsTable>

Defines which of the tables defined in TS 36.213 is used to specify the used modulation and coding scheme.

Parameters:

<McsTable> 0 | OFF | T1 | 1 | ON | T2 | T3 | T4

0|OFF|T1
Table 7.1.7.1-1

1|ON|T2
Table 7.1.7.1-1A

T3
Table 7.1.7.1-1B

T4
Table 7.1.7.1-1C

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:USER1:CELL0:MCS T1`

Options: T1|T2 require R&S SMW-K113
T3|T4 requireR&S SMW-K119

Manual operation: See "MSC Table" on page 145

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TBAL <TBSAltIndex>

Sets the which of the transport block size (TBS) tables defined in TS 36.213 is used.

Parameters:

<TBSAltIndex> 0 | OFF | T1 | 1 | ON | T2 | T3 | T4

0|OFF|T1 ="TBS Alt. Index = 0"
1|ON|T2 = "TBS Alt. Index = 1"
T3 = "TBS Alt. Index = 2"
T3 = "TBS Alt. Index = 3"

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:USER1:CELL0:TBAL T1`

Options: T1|T2 require R&S SMW-K113
T3|T4 requireR&S SMW-K119

Manual operation: See "TBS Alt. Index" on page 146

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:MCSTwo:STATe <McsTable2Old>

This command is supported for backwards compatibility. Use `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:MCS` on page 869 instead.

Parameters:

<McsTable2Old> 1 | ON | 0 | OFF

*RST: 0

Options: R&S SMW-K113

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:TALTindex:STATe <TBSAltIndexOld>

This command is supported for backwards compatibility. Use `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:TBAL` on page 869 instead.

Parameters:

<TBSAltIndexOld> 1 | ON | 0 | OFF

*RST: 0

Options: R&S SMW-K113

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:DMRS:STATe <DmrsAltTable>

Sets the value of the higher-layer parameter `dmrs-tableAlt`.

Parameters:

<DmrsAltTable> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM TM10
SOURce1:BB:EUTRa:DL:USER1:CELL0:DMRS:STATe 1
```

Options: R&S SMW-K119

Manual operation: See "DMRS Alt Table" on page 146

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:CELL<st0>:SEOL:STATe <SemiOpenLoop>

Sets the value of the higher-layer parameter `semiOpenLoop`.

Parameters:

<SemiOpenLoop> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM TM10
SOURce1:BB:EUTRa:DL:USER1:CELL0:SEOL:STATe 1
```

Options: R&S SMW-K119

Manual operation: See "Semi Open Loop" on page 146

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STHP:STATe <State>

Sets if NB-IoT UEs are capable of understanding the HARQ process bit.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:RELease NOIT
SOURce1:BB:EUTRa:DL:USER1:STHP:STATe 1
...
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:HPNMber 1
```

Example: See Example"DCI format N0 configuration" on page 943.

Options: R&S SMW-K115
1|ON requires R&S SMW-K143

Manual operation: See "Support two HARQ Processes" on page 147

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:STATe <State>

Enables/disables scrambling for all allocations belonging to the selected user.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: ON

Example:

```
SOUR:BB:EUTR:DL:USER3:SCR:STAT OFF
// Disables scrambling for allocations belonging to user 3

SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:DATA USER3
SOUR:BB:EUTR:DL:SUBF0:ALL4:CW:SCR:STAT?
// 0
SOUR:BB:EUTR:DL:SUBF0:ALL5:CW:SCR:STAT?
// 0
```

Manual operation: See "Scrambling State" on page 162

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:USE <Use>

Defines how the DMRS scrambling sequence is initialized.

Parameters:

<Use> 1 | ON | 0 | OFF

OFF
DRMS sequence is generated with the variable $n_{ID} = N_{ID}^{cell}$.

ON
Used are two variable $n_{ID} = n_{ID}^{DMRS,i}$ set with the commands [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:ID1|ID2

Example:

```
SOURce1:BB:EUTRa:DL:MIMO:CONFIguration TX4
SOURce1:BB:EUTRa:DL:USER1:TXM M10
SOURce1:BB:EUTRa:DL:USER1:SCRambling:CELL0:DMRS:USE 1
SOURce1:BB:EUTRa:DL:USER1:SCRambling:CELL0:DMRS:ID1 100
SOURce1:BB:EUTRa:DL:USER1:SCRambling:CELL0:DMRS:ID1 220
SOURce1:BB:EUTRa:DL:USER1:SCRambling:CELL0:CSI:USE 1
SOURce1:BB:EUTRa:DL:USER1:SCRambling:CELL0:CSI:IDENt 100
```

Options: R&S SMW-K112

Manual operation: See "Use DMRS Scrambling Identities" on page 162

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:ID1 <Ident>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:ID2 <Ident>

Sets the DMRS scrambling identity.

Parameters:

<Ident> integer

Range: 0 to 503
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SCRambling:CELL<st>:DMRS:USE on page 871.

Options: R&S SMW-K112

Manual operation: See "DMRS Scrambling Identity 1/2" on page 162

11.22 EPDCCH

Option: R&S SMW-K112

Example: Configuring EPDCCH transmission

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:DL:CONF:MODE AUTO
// EPDCCH cannot be activated in manual mode

SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:TTYP LOC
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:PRBS PRB2
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:RBA 1200
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:NID 100
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:PWR 0
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:STAT 1

SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:USER USER1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:PDCChtype EPD1
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:DCIFmt F1A
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:SESPace?
// UE
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:PFMT 2
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:NCCes?
// 2
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:CINDex 20
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:NDCCes?
// 4
SOURce1:BB:EUTRa:DL:SUBF0:ENCC:PDCCh:EXTC:ITEM0:CONFlict?
// 0

SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:DATA?
// USER1
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:RBCount?
// AUTO
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:RBOFfset?
// AUTO
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:CONType?
// EPD1
SOURce1:BB:EUTRa:DL:SUBF0:ALLoc2:CW1:STATe?
// 1
```

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:STATe <State>

Enables the EPDCCH transmission for the select user and component carrier.

Suffix:

<dir>	1|2 EPDCCH set

Parameters:

<State>	1 | ON | 0 | OFF *RST: 0

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "Activate EPDCCH" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STATe <State>

Enables the EPDCCH set.

Suffix:

<dir>	1|2 EPDCCH set

Parameters:

<State>	1 | ON | 0 | OFF *RST: 0

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "Set 1/2 State" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:TTYP <TransType>

Select the EPDCCH transmission type.

Suffix:

<dir>	1|2 EPDCCH set

Parameters:

<TransType>	LOCalized | DISTributed *RST: LOCalized

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "Transmission Type" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:PRBS <NumPRBs>

Sets the number of used physical resource block (PRB) pairs.

Suffix:
<dir> 1|2
EPDCCH set

Parameters:
<NumPRBs> PRB2 | PRB4 | PRB8
*RST: PRB2

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "Number of PRB Pairs" on page 159

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:RBA <RBA>

Defines the resource blocks used for the EPDCCH transmission.

Suffix:
<dir> 1|2
EPDCCH set

Parameters:
<RBA> integer
Range: 0 to 1000
*RST: 0

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "Resource Block Assignment" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:NID <EpdcchId>

Sets the identifier $n^{EPDCCH}_{ID,m}$ used to calculate the UE-specific scrambling sequence.

Suffix:
<dir> 1|2
EPDCCH set

Parameters:

<EpdcchId> integer

Range: 0 to 503
*RST: 0

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "N^EPDCCH_ID" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:POWer <RelPower>

Sets the power of the EPDCCH allocations relative to the power of the reference signals.

See `[:SOURce<hw>]:BB:EUTRa:DL:REFSig:POWer` on page 714.

Suffix:

<dir> 1|2
EPDCCH set

Parameters:

<RelPower> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"Configuring EPDCCH transmission" on page 873.

Example: Option:R&S SMW-K115
See Example"Configuring the MPDCCH sets" on page 956.

Manual operation: See "Relative EPDCCH Power" on page 160

11.23 Dummy data configuration

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:MODulation <Modulation>

Selects modulation for dummy data.

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256 | QAM1024

*RST: QPSK

Example: `BB:EUTR:DL:DUMD:MOD QAM16`
16QAM is selected as modulation for dummy data.

Options: QAM256 requires R&S SMW-K113
QAM1024 requires R&S SMW-K119

Manual operation: See "Modulation" on page 138

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:POWer <Power>

Sets the power for dummy data.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:DL:DUMD:POWer 10.00`
Sets the power for dummy data to 10 dB.

Manual operation: See "Power (Dummy Data)" on page 139

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DATA <Data>

Selects the data source for dummy data.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: `BB:EUTR:DL:DUMD:DATA PN9`
PN9 is selected as data source for dummy data.

Manual operation: See "Data Source" on page 138

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:DSELect <Filename>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<Filename> string

Filename incl. file extension or complete file path

Example:
```
SOURce1:BB:EUTRa:DL:DUMD:DATA DLIS
SOURce1:BB:EUTRa:DL:DUMD:DSELect "/var/user/temp/lte_dl.dm_iqd"
```

Manual operation: See "Data Source" on page 138

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:PATTern <Pattern>, <BitCount>

Sets the bit pattern.

Parameters:

<Pattern> <bit pattern>

*RST: #H0

<BitCount> integer

Range: 1 to 64

*RST: 1

Example: `SOURce1:BB:EUTRa:DL:DUMD:PATTern #H1E,8`

Manual operation: See "Data Source" on page 138

[:SOURce<hw>]:BB:EUTRa:DL:DUMD:OPSubframes <OmitPrsSf>

If the OCNG is used, you can disable (omit) the OCNG transmission in the non-muted PRS subframes.

Parameters:

<OmitPrsSf> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:BUR DUData
SOURce1:BB:EUTRa:DL:PRSS:MIPattern #H2,2
SOURce1:BB:EUTRa:DL:DUMD:OPSubframes ON
```

Manual operation: See "Omit PRS Subframes" on page 139

11.24 SPS configuration

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe <UsrSpsState>

Enables SPS (semi-persistence scheduling).

Parameters:

<UsrSpsState> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER2:SPS:STATe ON
SOURce1:BB:EUTRa:DL:USER2:SPS:CRNTi 250
SOURce1:BB:EUTRa:DL:USER2:SPS:SINTerval S20
SOURce1:BB:EUTRa:DL:USER2:SPS:SACTivation 1
SOURce1:BB:EUTRa:DL:USER2:SPS:SRELease 3
```

Manual operation: See "Activate SPS" on page 167

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:CRNTi <UserSpsCRnti>

Sets the SPS C-RNTI parameter.

Parameters:

<UserSpsCRnti> integer

Range: 1 to 65523
*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 878

Manual operation: See "SPS C-RNTI" on page 167

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SINTerval <UserSpsInt>

Defines the SPS interval.

Parameters:

<UserSpsInt> S10 | S20 | S32 | S40 | S64 | S80 | S128 | S160 | S320 | S640

*RST: S10

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 878

Manual operation: See "SPS Interval" on page 167

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SACTivation <UsrSpsActSubfr>
[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:SRELease <UsrSpsRelSubfr>

Defines the start and end subframes of the semi-persistent scheduling.

Parameters:

<UsrSpsRelSubfr> integer

Range: 0 to 65535
*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:SPS:STATe on page 878

Manual operation: See "Activation/Release Subframe No" on page 167

11.25 User equipment

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:RELease <Release>

Sets which LTE release version the UE supports.

Parameters:

<Release> R89 | LADV | EMTC | NIOT

*RST: R89 (R&S SMW-K55) | EMTC (R&S SMW-K115)

Example: `SOURce1:BB:EUTRa:UL:UE1:RELease LADV`

Options: R89 requires R&S SMW-K55
LADV requires R&S SMW-K85
EMTC|NIOT require R&S SMW-K115

Manual operation: See "3GPP Release" on page 256

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:DACRestart <RestartState>

If activated, the indicated values are restarted at the specified intervals.

Parameters:

<RestartState> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:UL:UE1:DACRestart 1`

Manual operation: See "Restart Data, A/N, CQI and RI Every Subframe and Code-word/Restart Data and A/N Every Subframe" on page 267

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:ID <Id>

Sets the radio network temporary identifier (RNTI) of the UE.

Parameters:

<Id> integer

Range: 0 to 65535
*RST: 0

Example: `BB:EUTR:UL:UE3:ID 303`
Sets the UE ID

Manual operation: See "UE ID/n_RNTI" on page 267

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:STATe <State>

Selects the user equipment state.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 1 (UE1); 0 (UE2 to UE7)

Example: `BB:EUTR:UL:UE2:STAT ON`
Activates UE2.

Manual operation: See "State" on page 266

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:MODE <Mode>

Selects whether the user equipment is in standard or in PRACH mode.

Parameters:

<Mode> STD | PRACh

*RST: STD

Example: `BB:EUTR:UL:UE:MODE STD`
Selects the standard mode for UE1.

Manual operation: See "Mode" on page 268

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:POWer <Power>

Sets the power level of the selected UE.

Parameters:
<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE2:POW -5.0`
Sets the power of UE2

Manual operation: See "UE Power" on page 268

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:OCID:STATe <OverrideCellID>

if enabled, you can set an user-defined cell ID for the selected user.

Parameters:
<OverrideCellID> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:CA:STATe 0
SOURce1:BB:EUTRa:UL:PLCI:CID 20

SOURce1:BB:EUTRa:UL:UE1:OCID:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CID 10
```

Manual operation: See "Override Cell ID" on page 267

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CID <ULUECELLID>

Sets the UE-specific cell ID.

Parameters:
<ULUECELLID> integer

Range: 0 to 503
*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:OCID:STATe` on page 883.

Manual operation: See "Cell ID" on page 267

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:ALRB <AllocResBlocks>

Queries the number of the allocated resource blocks for the selected FRC.

Parameters:
<AllocResBlocks> integer

Range: 0 to 110
*RST: 0

Example:
```
BB:EUTR:UL:UE2:FRC:TYPE A34
```
Sets the FRC
```
BB:EUTR:UL:UE2:FRC:ALRB?
Response: 25
```

Manual operation: See "Allocated Resource Blocks" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:MODulation?

Queries the modulation for the selected FRC (`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE` on page 886).

Return values:

<Modulation> QPSK | QAM16 | QAM64 | QAM256

*RST: QPSK

Example:
```
BB:EUTR:UL:UE2:FRC:TYPE A34
BB:EUTR:UL:UE2:FRC:MOD?
// QPSK
```

Usage: Query only

Manual operation: See "Modulation (FRC)" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:N2DMrs <N2Dmrs>

Sets the UE specific part of the demodulation reference signal (DMRS) index for all PUSCH allocation of the selected UE in all subframes.

Parameters:

<N2Dmrs> integer

Range: 0 to 10
*RST: 0

Example:
```
SOUR:BB:EUTR:UL:SUBF4:ALL0:PUSC:NDMR 3
```
Sets the n(2)_DMRS
```
SOUR:BB:EUTR:UL:UE1:FRC:STAT ON
```
Enables FRC
```
SOUR:BB:EUTR:UL:UE1:FRC:N2DM 5
```
Sets the DMRS index for all PUSCH allocation of the selected UE in all subframes
```
SOUR:BB:EUTR:UL:SUBF4:ALL0:PUSH:N2DM?
Response: 5
```

Manual operation: See "n(2)_DMRS (FRC)" on page 273

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:PASize?

Queries the payload size for the selected FRC (`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE` on page 886).

Return values:

<PayloadSize> integer

Range: 0 to 2E5
*RST: 0

Example:
`BB:EUTR:UL:UE2:FRC:TYPE A34`
Sets the FRC
`BB:EUTR:UL:UE2:FRC:PAS?`
`Response: 2216`

Usage: Query only

Manual operation: See "Payload Size (FRC)" on page 272

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:STATe <State>

Enables/disables FRC configuration.

Enabling FRC configuration sets some parameters to their predefined values, i.e. several parameters are displayed as read-only. Reconfiguration of the values of this parameters is possible only after disabling the FRC configuration.

The FRC State is disabled and cannot be enabled, if a user defined cyclic prefix (`BB:EUTR:UL:CPC USER`) is selected.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example:
`BB:EUTR:UL:UE2:FRC:STAT ON`
Enables FRC

Manual operation: See "FRC State" on page 271

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TNOBits?

Queries the total number of physical bits available for the PUSCH allocation per subframe in case the PUSCH is not shortened because of SRS or because it is transmitted in a cell-specific SRS subframe.

Return values:

<TotalBitCount> integer

Range: 0 to max
*RST: 0

Example:
`BB:EUTR:UL:UE2:FRC:TYPE A34`
Sets the FRC
`BB:EUTR:UL:UE2:FRC:TNOB?`
`Response: 7200`

Usage: Query only

Manual operation: See "Physical Bits Per Subframe (Unshortened PUSCH)" on page 273

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:TYPE <Type>

Selects a predefined fixed reference channel according to TS 36.141 and TS 36.521.

Parameters:

<Type> A11 | A12 | A13 | A14 | A15 | A21 | A22 | A23 | A31 | A32 | A33 | A34 | A35 | A36 | A37 | A41 | A42 | A43 | A44 | A45 | A46 | A47 | A48 | A51 | A52 | A53 | A54 | A55 | A56 | A57 | A71 | A72 | A73 | A74 | A75 | A76 | A81 | A82 | A83 | A84 | A85 | A86 | UE11 | UE12 | UE21 | UE22 | UE3 | A16 | A17 | A121 | A122 | A123 | A124 | A125 | A126 | A131 | A132 | A133 | A134 | A135 | A136 | A171 | A172 | A173 | A174 | A175 | A176 | A181 | A182 | A183 | A184 | A185 | A186 | A191 | A192 | A193 | A194 | A195 | A196 | A211 | A212 | A213 | A214 | A215 | A216 | A221 | A222 | A223 | A224

*RST: A11

Example: `BB:EUTR:UL:UE2:FRC:TYPE A34`

Options: A171|A172|A173|A174|A175|A176|A181|A182|A183|A184|A185|A186|A191|A192|A193|A194|A195|A196|A211|A212|A213|A214|A215|A216|A221|A222|A223|A224 require R&S SMW-K119

Manual operation: See "FRC" on page 271

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:FRC:VRBoffset <VrbOffset>

Sets the virtual resource block (VRB) offset for all PUSCH allocation of the selected UE in all subframes.

Parameters:

<VrbOffset> integer

Range: 0 to dynamic
*RST: 2

Example:

```
SOUR:BB:EUTR:UL:SUBF4:ALL0:VRB 6
SOUR:BB:EUTR:UL:UE1:FRC:STAT ON
SOUR:BB:EUTR:UL:UE1:FRC:VRB 3
SOUR:BB:EUTR:UL:SUBF4:ALL0:VRB?
Response: 3
```

Manual operation: See "Offset VRB (FRC)" on page 273

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRSTate <State>

Activates Power Ramping for the PRACH preamble. The start and the end of the preamble is cyclically extended and multiplied with a ramping function (sin^2).

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example:
```
BB:EUTR:UL:UE1:MODE PRAC
BB:EUTR:UL:UE1:PRAC:PRST ON
```

Manual operation: See "State PRACH Power Ramping" on page 320

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRTT <TransitionTime>

Defines the transition time from beginning of the extended preamble to the start of the preamble itself.

Parameters:

<TransitionTime> float

Range: 0 to 3E-5
Increment: 1E-7
*RST: 2E-5
Default unit: s

Example:
```
BB:EUTR:UL:UE1:MODE PRAC
BB:EUTR:UL:UE1:PRAC:PRST ON
BB:EUTR:UL:UE1:PRAC:PRTT 15us
```

Manual operation: See "Transition Time" on page 320

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:PRFormat?

Queries the preamble format.

Return values:

<PreaFormat> integer

Range: 0 to 3
*RST: 0

Example:
```
BB:EUTR:UL:UE1:PRAC:PRF?
```
Queries the preamble format.

Usage: Query only

Manual operation: See "Preamble Format (Burst Format)" on page 321

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:CFRames?

Queries the number of configurable frames.

Return values:

<ConfigFrameCoun> integer

Range: 1 to 10
*RST: 1

Example:
```
BB:EUTR:UL:UE1:PRAC:CRF?
```
Queries the number of frames

Usage: Query only

Manual operation: See "Number of Configurable Frames" on page 321

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RBOFfset <RbOffset>

Queries the starting RB, as set with the command [:SOURce<hw>]:BB:EUTRa:UL:PRACh:FOFFset.

Parameters:

<RbOffset> integer

Range: 0 to 109
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:RBOF?`
Queries the RB offset.

Manual operation: See "RB Offset" on page 321

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:FRINdex <FreqResIndex>

(enabled in TDD duplexing mode only)

Sets the frequency resource index f_{RA} for the selected subframe.

Parameters:

<FreqResIndex> integer

Range: 0 to dynamic
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:FRIN 2`
Sets the frequency resource index

Manual operation: See "Frequency Resource Index" on page 321

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:POWer <Power>

Sets the PRACH power relative to the UE power. The PRACH power can be adjusted independently for every configured preamble.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:POW -3`
Sets the power

Manual operation: See "Power" on page 323

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:NCSConf <NcsConfig>

Selects the Ncs configuration of the selected subframe.

Parameters:

<NcsConfig> integer

For details on the value range, see Table 4-23.

Range: 0 to 15
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:NCSC 2`
Sets the Ncs Configuration

Manual operation: See "Ncs Configuration" on page 322

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:RSEQuence <RootSequence>

Selects the logical root sequence index for the selected subframe.

Parameters:

<RootSequence> integer

Range: 0 to 838
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:RSEQ 200`
Sets the root sequence

Manual operation: See "Logical Root Sequence Index" on page 322

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:SINDex <SequenceIndex>

Selects the sequence index v.

Parameters:

<SequenceIndex> integer

Range: 0 to 63
*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:SIND 30`
Sets the sequence index

Manual operation: See "Sequence Index (v)" on page 322

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:DT <DeltaTime>

Sets the parameter delta_t in us.

Parameters:

<DeltaTime> float

Range: -500 to 500
Increment: 0.01
*RST: 0
Default unit: us

Example: `SOURce1:BB:EUTRa:UL:UE1:PRACh:SUBF2:DT 300`

Manual operation: See "Delta t/us" on page 322

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:SUBF<ch0>:STATe <State>

Enables/disables the PRACH for the selected subframe.

The subframes available for configuration depend on the selected PRACH configuration.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: `BB:EUTR:UL:UE1:PRAC:SUBF2:STAT ON`

Activates PRACH in subframe 2 for UE1.

Manual operation: See "State" on page 323

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DATA <Data>

Selects the PUSCH data source of the selected UE. For the selected UE, this data source is used for the PUSCH channel in every subframe where this channel is configured.

Parameters:

<Data> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: `SOURce1:BB:EUTRa:UL:UE3:PUSCh:DATA PN11`

Manual operation: See "Data Source (tab General)" on page 275

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:PATTern <Pattern>, <BitCount>

Sets the bit pattern.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64

*RST: 1

Example:

```
BB:EUTR:UL:UE2:PUSC:DATA PATT
BB:EUTR:UL:UE2:PUSC:PATT #H3F,8
```

Manual operation: See "Data Source (tab General)" on page 275

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:DSELect <Filename>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<Filename> string

Filename incl. file extension or complete file path

Example:

```
SOURce1:BB:EUTRa:UL:UE3:PUSCh:DATA DLISt
SOURce1:BB:EUTRa:UL:UE3:PUSCh:DSELect "/var/user/lte_data_list"
```

Manual operation: See "Data Source (tab General)" on page 275

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:INITpattern <PatInit>

Selects the starting seed for data sources for the PUSCH allocation.

Parameters:

<PatInit> integer

Range: 1 to #H7fffff
*RST: 1

Example:

```
SOURce1:BB:EUTRa:UL:UE0:PUSCh:DATA PATTern
SOURce1:BB:EUTRa:UL:UE0:PUSCh:PATTern #H1C4A9,17
SOURce1:BB:EUTRa:UL:UE0:PUSCh:INITpattern #HFF
```

Manual operation: See "Initialization (tab General)" on page 275

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:TXMode <TxMode>

For LTE-A UEs, sets the PUSCH transmission mode according to TS 36.213.

eMTC UEs support PUSCH transmission mode M1 only.

Parameters:

<TxMode> M1 | M2

M1
Spatial multiplexing not possible

M2
Spatial multiplexing possible

*RST: M1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:UE1:PUSCh:TXMode M2
```

Options: R&S SMW-K85

Manual operation: See "Transmission Mode (tab General)" on page 275

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort <NumAPs>

Sets the number of antenna ports for PUSCH transmission.

Use the command `[:SOURce<hw>]:BB:EUTRa:UL[:CELL<ccidx>][:SUBF<st0>]:ALLoc<ch0>:PUSCh:PRECoding:NAPused` on page 847 to query the number of used antenna ports.

Parameters:

<NumAPs> AP1 | AP2 | AP4

*RST: AP1

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:PUSCh:NAP AP2
SOURce1:BB:EUTRa:UL:SUBF0:ALLoc0:PUSCh:PRECoding:NAPused?
// Response: AP2
```

Options: R&S SMW-K85

Manual operation: See "Max. Number of AP for PUSCH (tab General)" on page 276

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:SCRambling:STATe <State>

Enables/disables scrambling for all PUSCH allocations of the corresponding UE.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:UE2:PUSC:SCR:STAT ON`

Enables scrambling for UE2

Manual operation: See "State (PUSCH tab Scrambling)" on page 276

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:STATe <State>

Enables/disables channel coding and multiplexing of data and control information for all PUSCH allocations of the corresponding UE.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:STAT ON`

Enables channel coding for UE2

Manual operation: See "State" on page 277

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:MODE <Mode>

Defines the information transmitted on the PUSCH.

Parameters:

<Mode> COMBined | ULSChonly | UCIonly

COMBined
Control information and data are multiplexed into the PUSCH.

ULSChonly
Only data is transmitted on PUSCH.

UCIonly
Only uplink control information is transmitted on PUSCH.

*RST: ULSChonly

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB`
Enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2

Manual operation: See "Mode" on page 277

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:ICQioffset <IcqiOffset>

Sets the CQI offset index for control information MCS offset determination according to 3GPP TS 36.213, chapter 8.6.3.

Parameters:

<IcqiOffset> integer

Range: 2 to 15
*RST: 2

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB`
Enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2
`BB:EUTR:UL:UE2:PUSC:CCOD:ICQ 5`
Sets the CQI offset index

Manual operation: See "I_CQI_offset" on page 278

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IHARqoffset <IHarqOffset>

Sets the HARQ-ACK offset index for control information MCS offset determination according to TS 36.213.

Parameters:

<IHarqOffset> integer

Range: 0 to 14
*RST: 0

Example:
```
// enable multiplexing of the control information (UCI) and data (UL-SCH)
BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB
// set the HARQ-ACK offset index
BB:EUTR:UL:UE2:PUSC:CCOD:IHAR 5
```

Manual operation: See "I_HARQ_offset" on page 277

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:IRIoffset <IRIOffset>

Sets the RI offset index for control information MCS offset determination.

Parameters:

<IRIOffset> integer

Range: 0 to 12
*RST: 0

Example: `BB:EUTR:UL:UE2:PUSC:CCOD:MODE COMB`
Enables multiplexing of the control information (UCI) and data (UL-SCH) on the PUSCH for UE2
`BB:EUTR:UL:UE2:PUSC:CCOD:IRI 5`
Sets the RI offset index

Manual operation: See "I_RI_offset" on page 277

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:CCODing:OCQimin <ChanCodOCQIMin>

For PUSCH channel coding and multiplexing mode UCI only, sets the parameter O_CQI-Min.

Parameters:

<ChanCodOCQIMin> integer

Range: 1 to 472
*RST: 1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:MODE UCI
SOURce1:BB:EUTRa:UL:UE1:PUSCh:CCODing:OCQimin 7
```

Manual operation: See "O_CQI-Min" on page 278

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:STATe <UpPtsState>

Enables PUSCH transmission in the UpTPS part of the special subframe.

Parameters:

<UpPtsState> 1 | ON | 0 | OFF

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:TDD:UDConf 0
SOURce1:BB:EUTRa:TDD:SPSConf 10
SOURce1:BB:EUTRa:STATe 1

SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:UE1:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:UPTPs:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:UPTPs:LDMRs 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:UPTPs:NSYM 5
```

Options: R&S SMW-K119

Manual operation: See "State" on page 278

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:LDMRs <UpPtsLessDMRS>

If enabled, the number of used demodulation reference signals (DMRS) is reduced.

Parameters:

<UpPtsLessDMRS> 1 | ON | 0 | OFF
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:STATe on page 894.

Options: R&S SMW-K119

Manual operation: See "Less DMRS" on page 278

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:NSYM <UpPtsNumSym>

Sets the number of symbols used for the PUSCH transmission.

Parameters:

<UpPtsNumSym> integer
Range: 1 to 472
*RST: 1

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:UPPTs:STATe on page 894.

Options: R&S SMW-K119

Manual operation: See "Number of Symbols" on page 278

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F4Naport?
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F5Naport?

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F1Naport <NumAPs>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F2Naport <NumAPs>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PUCCh:F3Naport <NumAPs>

For LTE-A UEs, sets the number of antenna ports used for every PUCCH format transmission.

Parameters:

<NumAPs> AP1 | AP2

*RST: AP1

Example: See `[:SOURce<hw>]:BB:EUTRa:UL[:SUBF<st0>]:ALLoc<ch0>:PUCCh:NAPused?` on page 856

Options: F1Naport|F2Naport|F3Naport require R&S SMW-K85
F4Naport|F5Naport require R&S SMW-K119

Manual operation: See "Number of Antenna Ports for PUCCH per PUCCH Format" on page 269

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:POWoffset <PowerOffset>

Sets the power offset of the demodulation reference signal (DMRS) relative to the power level of the PUSCH/PUCCH allocation of the corresponding subframe.

Parameters:

<PowerOffset> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:DRS:POW -2`

Manual operation: See "DMRS Power Offset" on page 279

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:DWOCc <DmrsWithOcc>

For Release 10 UEs, activate demodulation reference signal (DMRS) with an orthogonal cover code (OCC) for one antenna port.

Parameters:

<DmrsWithOcc> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:UL:UE1:RELease R10
SOURce1:BB:EUTRa:UL:UE1:REFSig:DRS:DWOCc ON
```

Options: R&S SMW-K85

Manual operation: See "Activate DMRS with OCC for One Antenna Port" on page 280

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:DRS:ENHanced <DmrsEnhanced>

Enables enhanced DMRS.

Parameters:

<DmrsEnhanced> 1 | ON | 0 | OFF

*RST: 0

Example:

```
// enabling mapping the DMRS sequence on each second subcarrier
SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:DRS:ENHanced 1
SOURce1:BB:EUTRa:UL:CELL0:SUBF0:ALLoc1:PUSCh:MAPPing 1
```

Manual operation: See "Enhanced DMRS" on page 280

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:STATe <State>

Enables sending of SRS for the corresponding UE.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0 on page 897

Manual operation: See "SRS State" on page 282

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0 <TType0>

Enables transmission of trigger type 0.

Parameters:

<TType0> 1 | ON | 0 | OFF

*RST: 1

Example:
```
:SOURce1:BB:EUTRa:LINK UP
:SOURce1:BB:EUTRa:UL:UE1:RELease LADV

:SOURce1:BB:EUTRa:UL:UE1:STATe 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:STATe 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:TT0 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:NAPort AP1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:CYCShift 3
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:ISRS 3
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:TRComb 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:BHOP 2

:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:NAPort AP2
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:NTRans 2
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:ISRS 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:SUBF1 1
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS2:SUBF2 3

:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS3:NAPort AP2
:SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS3:NTRans 1
```

Options: R&S SMW-K85

Manual operation: See "Transmit Trigger Type 0" on page 282

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:POWoffset <PowerOffset>

Sets the power offset of the Sounding Reference Signal (SRS) relative to the power of the corresponding UE.

Parameters:

<PowerOffset> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:POW -2`
Sets the sounding reference symbol power offset to -2 dB.

Manual operation: See "SRS Power Offset" on page 282

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NAPort <NumAPs>

Sets the number of antenna ports (N_{ap}) used for every SRS transmission.

Parameters:

<NumAPs> AP1 | AP2 | AP4

*RST: AP1

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:PUSCh:NAPort on page 892

Options: R&S SMW-K85

Manual operation: See "Number of Antenna Ports for SRS" on page 283

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:CYCShift <CyclicShift>

Sets the cyclic shift used for the generation of the sounding reference signal CAZAC sequence.

Parameters:

<CyclicShift> integer

Range: 0 to 11
*RST: 0
<CyclicShift> = 7 to 11 if [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NKTC 4

Example: BB:EUTR:UL:UE2:REFS:SRS:CYCS 5
Sets the SRS cyclic shift for UE2

Options: <CyclicShift> = 7 to 11 require R&S SMW-K119

Manual operation: See "SRS Cyclic Shift n_CS (First AP)" on page 283

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NTRans <Transmissions>

Sets the number of SRS transmissions.

Parameters:

<Transmissions> integer

Range: 0 to (10*SeqLengthARB - 1)
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0 on page 897

Options: R&S SMW-K85

Manual operation: See "Number of Transmissions" on page 289

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:UPPTsadd <SrsUpPtsAdd>

In TDD mode, sets the parameter `srs-UpPtsAdd` and defines the number of additional SC-FDMA symbols in UpPTS.

Parameters:

<SrsUpPtsAdd> 0 | 2 | 4

*RST: 0

Example:
```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:UPPTsadd 2
```

Options: R&S SMW-K119

Manual operation: See "SRS UpPTS Add" on page 283

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:SUBF<subfidx> <Subframe>

Sets the subframes in that SRS is transmitted.

Suffix:

<subfidx> 1 to 50

Transmission number, as set with `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:NTRans`

Parameters:

<Subframe> integer

Range: 0 to (10*SeqLengthARB - 1)

*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:TT0` on page 897

Options: R&S SMW-K85

Manual operation: See "Subframes for Transmission" on page 289

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS:BHOP <BandwidthHopp>

Sets the UE-specific parameter frequency hopping bandwidth b_{hop}.

Parameters:

<BandwidthHopp> integer

Range: 0 to 3

*RST: 0

Example:
```
BB:EUTR:UL:UE2:REFS:SRS:BHOP 2
```
Sets the SRS hopping bandwidth

Manual operation: See "Hopping Bandwidth b_hop" on page 288

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:BSRS <Bsrs>

Sets the UE-specific parameter SRS bandwidth B_{SRS}.

Parameters:
<Bsrs> integer

Range: 0 to 3
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:BSRS 2`
Sets the SRS bandwidth configuration

Manual operation: See "SRS Bandwidth B_SRS" on page 286

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]: ISRS <Isrs>

Sets the UE-specific parameter SRS configuration index I_{SRS}.

Parameters:
<Isrs> integer

Range: 0 to 1023
*RST: 0

Example: `BB:EUTR:DUPL FDD`
Sets the duplexing mode
`BB:EUTR:UL:UE2:REFS:SRS:ISRS 22`
Sets the SRS configuration index

Manual operation: See "Configuration Index I_SRS" on page 284

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]: TSRS?

Queries the UE-specific parameter SRS periodicity T_{SRS}.

The value depends on the selected SRS configuration index I_{SRS} (`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:ISRS`) and duplexing mode (`[:SOURce<hw>]:BB:EUTRa:DUPLexing`) as defined in the TS 36.213.

Return values:
<PeriodTsrs> integer

Range: 0 to 65535
*RST: 0

Example:
```
BB:EUTR:DUPL FDD
BB:EUTR:UL:UE2:REFS:SRS:ISRS 22
BB:EUTR:UL:UE2:REFS:SRS:TSRS?
// 20
```

Usage: Query only

Manual operation: See "Periodicity T_SRS" on page 284

**[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:
TOFFset?**

Queries the UE-specific parameter SRS subframe offset T_{offset}.

Return values:

<TOffset> integer

Range: 0 to 320
*RST: 0

Example: `BB:EUTR:DUPL FDD`
Sets the duplexing mode
`BB:EUTR:UL:UE2:REFS:SRS:ISRS 22`
Sets the SRS configuration index
`BB:EUTR:UL:UE2:REFS:SRS:TOFF?`
Queries the SRS subframe offset
`Response: 5`

Usage: Query only

Manual operation: See "Subframe Offset T_offset" on page 285

**[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:
TRComb** <TransmComb>

Sets the UE-specific parameter transmission comb k_{TC}.

Parameters:

<TransmComb> integer

Range: 0 to 1
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:TRC 1`

Manual operation: See "Transmission Comb k TC" on page 288

**[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]:
NKTC** <TranCombNumKTC>

In TDD mode, sets the UE-specific parameter number of combs (`transmissionCombNum`).

Parameters:

<TranCombNumKTC>2 | 4

*RST: 2

Example: `SOURce1:BB:EUTRa:DUPLexing TDD`
`SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:SRS1:NKTC 2`

Options: R&S SMW-K119

Manual operation: See "Transmission Comb Num k TC" on page 288

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>[:CELL<ccidx>]:REFSig:SRS[<srsidx>]: NRRC <Nrrc>

Sets the UE-specific parameter `frqDomainPosition` n_{RRC}

Parameters:

<Nrrc> integer

Range: 0 to 23
*RST: 0

Example: `BB:EUTR:UL:UE2:REFS:SRS:NRRC 10`
Sets the SRS frequency domain position

Manual operation: See "Freq. Domain Position n_RRC" on page 289

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP10Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP20Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP21Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP40Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP41Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP42Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP43Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP1000Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP1010Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP1020Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP100Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP200Map:ROW<bbid> <AntPortMapping>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:APMap:AP201Map:ROW<bbid> <AntPortMapping>

Sets which antenna port will be generated by which baseband.

Suffix:

<bbid> 0..7
Baseband

Parameters:

<AntPortMapping> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:UL:UE1:APMap:AP10Map:ROW0 1`

Manual operation: See "Antenna port mapping table" on page 318

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:CELL<dir0>:POFFset <UeCcPowerOffs>

Sets a power offset of the selected PCell or SCell.

Parameters:

<UeCcPowerOffs> float

Range: -80 to 10
Increment: 0.01
*RST: 0
Default unit: dB

Example: `SOURce1:BB:EUTRa:UL:UE1:CELL1:POFFset 3`

Manual operation: See "Power" on page 317

[:SOURce<hw>]:BB:EUTRa:UL:APMap:ROW<bbid>:DELay <ULBbDelay>

In advanced configuration with coupled sources, delays the signal of the selected cell. This result in signal delay between the generated baseband signals.

Parameters:

<ULBbDelay> integer

Range: 0 to 70000
*RST: 0
Default unit: ns

Example:

```
SCONfiguration:MODE ADV
SCONfiguration:OUTPut:MODE ALL
SCONfiguration:FADing MIMO2X2X2
SCONfiguration:BASeband:SOURce CPEN
SCONfiguration:APPLy

ENTity1:SOURce1:BB:EUTRa:STATe 1
ENTity1:SOURce1:BB:EUTRa:LINK UP
ENTity1:SOURce1:BB:EUTRa:UL:UE1:STATe 1
ENTity1:SOURce1:BB:EUTRa:UL:UE1:RELease LADV
ENTity1:SOURce1:BB:EUTRa:UL:APMap:ROW1:DELay 50
```

Manual operation: See "Delay" on page 317

11.26 Sidelink configuration

Option: R&S SMW-K113

Example: Enabling sidelink transmission in communucation mode

```
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:UE1:SL:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:MODE COMM
SOURce1:BB:EUTRa:UL:UE1:SL:DATA PN9
SOURce1:BB:EUTRa:UL:UE1:SL:RESTart 1

// configure the control resource pool
SOURce1:BB:EUTRa:UL:UE1:SL:RCTRl:CPERiod 40
SOURce1:BB:EUTRa:UL:UE1:SL:RCTRl:OFFSetind 1
SOURce1:BB:EUTRa:UL:UE1:SL:RCTRl:PRBStart 1
SOURce1:BB:EUTRa:UL:UE1:SL:RCTRl:PRENd 45
SOURce1:BB:EUTRa:UL:UE1:SL:RCTRl:PRBNumber 2
SOURce1:BB:EUTRa:UL:UE1:SL:RCTRl:SFBMp #HCF0AF0ACC3,40

// configure the data resource pool
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:OFFSetind 1
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:PRBStart 0
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:PRENd 49
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:PRBNumber 2
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:SFBMp #HFFFFFFFFFF,40
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:TRPTsubset #H5,3
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:HOPPingparam 1
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:NSUBbands 2
SOURce1:BB:EUTRa:UL:UE1:SL:RDATa:RBOFfset 1

// configure the synchronization signal
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:INCoverage 1
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:SLSSid 165
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:OFFSetind 1

// configure the SL control information
SOURce1:BB:EUTRa:UL:UE1:SL:NSCI 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:TXMode 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:PSCPeriod 10
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:NPSCch 10
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:SF?
// 1,2
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:FORMat?
// 0
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:FHFLag 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:RBAHoppalloc 10
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:TRP 101
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:MCS 28
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:TAINd 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:GRID 1
// configure the allocations
// PSBCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CONTent?
```

```
// PSBCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CONFlict?
// 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CYCShift 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CCODing:STATe 1

// PSCCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CONTent?
// PSCCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:SF?
// 1,2
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:PHYSbits?
// 288
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CONFlict?
// 0

// PSSCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:CONTent?
// PSSCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:PHYSbits?
// 288
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:CONFlict?
// 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CYCShift 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:TBSI?
// 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:TBSize?
// 32
```

Example: Enabling sidelink transmission in discovery mode

```
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:UE1:SL:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:MODE DISC
```

```
// configure the resource pool
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:CPERiod 64
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:OFFSetind 10
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:PRBStart 10
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:PRENd 45
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:PRBNumber 10
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:PRINdex 10
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:SFBMp #HEAAAA954AB,40
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:NRETrans 2
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:NREPetitions 2
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:N1PDsch 1
SOURce1:BB:EUTRa:UL:UE1:SL:RDISc:SFINdex 2

// configure the allocations
SOURce1:BB:EUTRa:UL:UE1:SL:NALLoc 2
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CONT?
// PSBCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:DISCtype D1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:PSDPeriod 2
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:NPDSch 5
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:SF?
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:PHYSbits?
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CONFlict?
// 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CYCShift 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:PHYSbits?
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:TBSize?

SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CONT?
// PSDCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:DISCtype D1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:PSDPeriod 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:NPDSch 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:SF?
// 10, 11,12
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:PHYSbits?
//576
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CONFlict?
// 0
```

Example: Enabling sidelink transmission in V2X mode

Option: R&S SMW-K119

```
SOURce1:BB:EUTRa:STDMode LTE
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:UE1:SL:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:MODE V2X

// configure the resource pool
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:OFFSet 1
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:BMPLength 20
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:BITLow #HFFF0F,20
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:ADJC 1
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:SUBChannels 3
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:SUBSize 5
SOURce1:BB:EUTRa:UL:UE1:SL:V2X:SRBSubchan 1

// configure the synchronization signal
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:INCoverage 1
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:SLSSid 165
SOURce1:BB:EUTRa:UL:UE1:SL:SYNC:OFFSetind 1

// configure the SL control information
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:TXMode 4
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:STARtsf 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:SUBChannel 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:SCI0:SF?
// 1,6
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:FORMat?
// 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:PRIRity 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:RREServation 2
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:FREQresloc 1
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:TIMGap 5
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:MCS 10
SOURce1:BB:EUTRa:UL:UE1:SL:SCI0:BITData?

// configure the allocations
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CONTent?
// PSBCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:SF?
// 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CYCShift 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:PHYSbits?
// 1008
```

```
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc0:CONFlict?
// 0

SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CONTent?
// PSCCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:SF?
// 1,6
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CYCShift 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc01PHYSbits?
// 480
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc1:CONFlict?
// 0

SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:CONTent?
// PSSCH
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:SF?
// 1,6
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:MOD?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:CYCShift 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:PHYSbits?
// 720
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:TBSI?
// 10
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:TBSize?
// 680
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:POWer 0
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:ALLoc2:CONFlict?
// 0
```

Example: Configuring RMC

Option: R&S SMW-K119

```
SOURce1:BB:EUTRa:STDMode LTE
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:UE1:RELease LADV
SOURce1:BB:EUTRa:UL:UE1:SL:STATe 1
SOURce1:BB:EUTRa:UL:UE1:SL:MODE V2X
```

```
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:RMC R821
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:ARBLocks?
// 48
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:MODulation?
// QPSK
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:PAYSize?
// 3496
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:PHYSbits?
// 11520
SOURce1:BB:EUTRa:UL:UE1:SL:RMC:STATe 1
```

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:STATe <State>

Enables sidelink transmission.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "State" on page 291

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:MODE <Mode>

Sets the mode of the sidelink communication.

Parameters:

<Mode> COMM | DISC | V2X

*RST: COMM

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Options: V2X requires R&S SMW-K119

Manual operation: See "Mode" on page 291

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:DATA <DataSource>

Sets the data source for the sidelink.

Parameters:

<DataSource> PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE

*RST: PN9

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Data Source" on page 291

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:DSELect <DataList>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DataList> string

Filename incl. file extension or complete file path

Example:

```
MMEM:CDIR "/var/user/"
SOURce1:BB:EUTRa:UL:UE1:SL:DATA DLISt
SOURce1:BB:EUTRa:UL:UE1:SL:DSELect "lte.dm_iqd"
```

Manual operation: See "Data Source" on page 291

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:
```
SOURce1:BB:EUTRa:UL:UE1:SL:DATA PATT
SOURce1:BB:EUTRa:UL:UE1:SL:PATTern #H2B8,11
```

Manual operation: See "Data Source" on page 291

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RESTart <RestartEveryTra>

If enabled, the data source is restarted at each SL transmission.

Parameters:

<RestartEveryTra> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Restart Data every Transmission" on page 292

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:CPERiod <ControlPeriod>

Sets the period over which resources are allocated for sidelink control period (SC period).

Parameters:

<ControlPeriod> 32 | 64 | 128 | 256 | 512 | 1024

*RST: 32

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Control Period" on page 294

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRl:CPERiod <ControlPeriod>

Sets the period over which resources are allocated for sidelink control period (SC period).

Parameters:

<ControlPeriod> 40 | 60 | 70 | 80 | 120 | 140 | 160 | 240 | 280 | 320

*RST: 40

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Control Period" on page 294

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:OFFSetind <OffsetIndicator>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:OFFSetind <OffsetIndicator>

Sets the offset from the SFN=0 after that the SL control region starts.

Parameters:

<OffsetIndicator> integer

Range: 0 to 10239
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Offset Indicator" on page 294

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:OFFSet <OffsetIndicator>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRI:OFFSetind <OffsetIndicator>

Sets the offset from the SFN=0 after that the SL control region starts.

Parameters:

<OffsetIndicator> integer

Range: 0 to 319
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Offset Indicator" on page 294

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:PRBStart <PrbStart>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:PRENd <PrbEnd>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRBStart <PrbStart>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRENd <PrbEnd>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRI:PRBStart <PrbStart>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRI:PRENd <PrbEnd>

Sets the parameters `prb-Start` and `prb-End` and define allocation of the two SL bands.

Parameters:

<PrbEnd> integer

Range: 0 to 99
*RST: 99

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "PRB Start, PRB End" on page 295

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:PRBNumber <PrbNumber>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRBNumber <PrbNumber>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRI:PRBNumber <PrbNumber>

Sets the number of resource blocks each of the SL bands occupies.

Parameters:

<PrbNumber> integer

Range: 1 to 100
*RST: 1

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "PRB Number" on page 295

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:SFBMp <Pattern>, <BitCount>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:SFBMp <Pattern>, <BitCount>
[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RCTRI:SFBMp <Pattern>, <BitCount>

Sets the subframe bitmap.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 42
*RST: 1

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Control Subframe Bitmap/Subframe Bitmap" on page 295

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:NRETrans <NumRetrans>

Sets the number of PSDCH retransmissions.

Parameters:

<NumRetrans> integer

Range: 0 to 3
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Number of Retransmission" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:NREPetitions <NumRepetitions>

Sets the number of PSDCH repetitions.

Parameters:

<NumRepetitions> integer

Range: 1 to 50
*RST: 1

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Number of Repetitions" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:N1PDsch <N1PDsch>

Sets the PDSCH resource index.

Parameters:

<N1PDsch> integer

Range: 1 to 200
*RST: 1

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "N(1)PDSCH/N(2)PDSCH/N(3)PDSCH" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:N2PDsch <N2PDsch>

Sets the PDSCH resource index.

Parameters:

<N2PDsch> integer

Range: 1 to 10
*RST: 1

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "N(1)PDSCH/N(2)PDSCH/N(3)PDSCH" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:N3PDsch <N3PDSCH>

Sets the PDSCH resource index.

Parameters:

<N3PDSCH>	1 | 5
	*RST: 1

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "N(1)PDSCH/N(2)PDSCH/N(3)PDSCH" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BMPLength <BmpLength>

Sets the bitmap length.

To set the subframe bitmap, use the commands `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITLow` and `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITHigh`.

Parameters:

<BmpLength>	10 | 16 | 20 | 30 | 40 | 50 | 60 | 100
	*RST: 16

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Subframe Bitmap Length" on page 297

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITLow <Pattern>, <BitCount>

Sets the subframe bitmap.

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITLow` is enabled, if `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BMPLength` `10|16|20|30|40|50`.

Parameters:

<Pattern>	numeric
	*RST: #H0
<BitCount>	integer
	Range: 10 to 50
	*RST: 16

Manual operation: See "Subframe Bitmap (0-49, bin)/Subframe Bitmap (50-99, bin)" on page 297

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITHigh <Pattern>, <BitCount>

Sets the subframe bitmap.

`[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BITHigh` is enabled, if `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:BMPLength` `60|100`.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 0 to 50
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Subframe Bitmap (0-49, bin)/Subframe Bitmap (50-99, bin)" on page 297

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:ADJC <Adjacency>

If enabled, the PSCCH and PSSCH channels are allocated on contiguous resources.

Parameters:

<Adjacency> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Adjacent PSCCH/PSSCH" on page 298

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:SUBChannels <NumSubchannels>

Sets the number of subchannels.

Parameters:

<NumSubchannels> 1 | 3 | 5 | 8 | 10 | 15 | 20

*RST: 1

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Number of Subchannels" on page 298

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:SRBSubchan <StartRbSubchan>

Sets the first RB in the subchannel.

Parameters:

<StartRbSubchan> integer

Range: 0 to 99
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Start RB Subchannel" on page 298

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:V2X:SUBSize <SubchannelSize>

Sets the number of resource blocks the subchannel spans.

Parameters:

<SubchannelSize> 4 | 5 | 6 | 8 | 9 | 10 | 12 | 15 | 16 | 18 | 20 | 25 | 30 | 48 | 50 | 72 | 96 | 75 | 100 | 32

*RST: 5

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Subchannel Size" on page 298

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:SFINdex <SfIndex>

Sets the subframe index.

Parameters:

<SfIndex> integer

Range: 0 to 209
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Subframe Index" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDISc:PRINdex <PrbIndex>

Sets the physical resource block index.

Parameters:

<PrbIndex> integer

Range: 0 to 49
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "PRB Index" on page 296

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:TRPTsubset <TrptSubset>

The TRTP subset is a time resources pattern that indicates the set of available sub-frames to be used for sidelink communication.

Parameters:

<TrptSubset> 5 bits

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "TRPT Subset" on page 301

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:HOPPingparam <HoppingParam>

Sets the frequency hopping parameter.

Parameters:

<HoppingParam> integer

Range: 0 to 504
*RST: 0

Manual operation: See "Hopping Parameter" on page 301

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:NSUBbands <NumSubbands>

Sets the number of subbands.

Parameters:

<NumSubbands> 1 | 2 | 4

*RST: 1

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Number of Subbands" on page 301

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RDATa:RBOFfset <RbOffset>

Shifts the band in the frequency domain by the selected number of resource blocks (RB).

Parameters:

<RbOffset> integer

Range: 0 to 98
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "RB Offset" on page 301

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:STATe <SlSyncState>

Enables the synchronization signals.

Parameters:

<SlSyncState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Synchronization State" on page 304

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:INCoverage <InCoverage>

Sets the in-coverage flag.

Parameters:

<InCoverage> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "In-coverage Flag" on page 305

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:SLSSid <SlssId>

Sets the sidelink synchronization signal ID.

Parameters:

<SlssId> integer

Range: 0 to 335
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "SLSS ID" on page 305

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SYNC:OFFSetind <OffsetInd>

Sets the parameter `syncOffsetIndicator`.

Parameters:

<OffsetInd> integer

Range: 0 to 159
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Sync Offset Indicator" on page 305

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:NSCI <SciNumConfigs>

Sets the number of SCI (SL control information) configurations.

Parameters:

<SciNumConfigs> integer

Range: 0 to 49
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Number of SCI Config" on page 306

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TXMode <SciTxMode>

Sets the transmission mode of the SL transmission.

Parameters:

<SciTxMode> 1 | 2 | 3 | 4

*RST: 1

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Options: 3|4 require R&S SMW-K119

Manual operation: See "SL Tx Mode" on page 306

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:PSCPeriod <SciPscchPeriod>

Sets the PSCCH period.

Parameters:

<SciPscchPeriod> integer

Range: 0 to 99
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "PSCCH Period" on page 307

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:NPSCch <SciNPscch>

Sets the parameter n_PSCCH and determines the resources in the time and the frequency domain that a transmitting UE uses for the PSCCH transmission.

Parameters:

<SciNPscch> integer

Range: 0 to 2100
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "n_PSCCH" on page 307

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:SF?

Queries the subframe numbers of the subframes that can be used for SL transmission.

Return values:

<SciSF> string

List of SF numbers, separated by commas

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "SF" on page 307

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:FORMat <SciFormat>

Queries the SCI (SL control information) format.

Parameters:

<SciFormat> 0

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "SCI Format" on page 308

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:STARtsf <StartSf>

Sets the first subframe used for the SL transmission.

Parameters:

<StartSf> integer

Range: 0 to 655650
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Start SF" on page 307

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:SUBChannel <Subchannel>

Sets the used subchannel.

Parameters:

<Subchannel> integer

Range: 0 to 19
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

Manual operation: See "Subchannel" on page 307

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:BITData?

Queries the resulting bit data as configured with the `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>` commands.

Return values:

<BitData> bit pattern

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "Bit Data" on page 308

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:FHFLag <SlFreqHopping>

Sets the DCI field frequency hopping flag. If enabled, frequency hopping is used for the PSSCH transmission.

Parameters:

<SlFreqHopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:RBAHoppalloc <RbaAndHoppAlloc>

Sets the DCI field resource block (RBA) and hopping resource allocation.

This field identifies which resource blocks, within the subframes indicated by the time resource pattern ITRP, are used for PSSCH transmission.

Parameters:

<RbaAndHoppAlloc> integer

Range: 0 to 8191
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TRP <TimeResPattern>

Sets the DCI field time resource pattern (ITPR).

Parameters:

<TimeResPattern> integer

Range: 0 to 127
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:MCS <ModCodScheme>

Sets the 5-bits indicator of the modulation and coding scheme (MSC) used for the PSSCH transmission.

Parameters:

<ModCodScheme> integer

Range: 0 to 31
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TAINd <TimingAdvanceIn>

Sets the 11-bits timing advance indicator.

Parameters:

<TimingAdvanceIn> integer

Range: 0 to 2047
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:GRID <GroupDestID>

Sets the 8-bits group destination ID, indicating the group for which the sidelink communication is intended.

Parameters:

<GroupDestID> integer

Range: 0 to 255
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:FREQresloc <FreqResLocation>

Sets the frequency resource location of initial transmission and retransmission field.

Parameters:

<FreqResLocation> integer

Range: 0 to 255
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:PRIRity <Priority>

Sets the priority field.

Parameters:

<Priority> integer

Range: 0 to 7
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:RREServation <ResReservation>

Sets the resource reservation field.

Parameters:

<ResReservation> integer

Range: 0 to 12
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TIMGap <TimeGap>

Sets the field time gap between initial transmission and the retransmission.

Parameters:

<TimeGap> integer

Sets the time gap Sf_{gap}, where Sf_{gap} = 0 indicates single transmission.

Range: 0 to 15
*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:SCI<ch0>:TXINdex <TxIndex>

Specifies the retransmission index field.

Parameters:

<TxIndex> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in V2X mode" on page 908.

Options: R&S SMW-K119

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:NALLoc <NumTransmission>

In discovery mode, sets the number of sidelink transmissions.

Parameters:

<NumTransmission> integer

Range: 0 to 100
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Number of Transmissions" on page 312

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CONTent?

Queries the allocation content.

Return values:

<Content> PSCCh | PSSCh | PSDCh | PSBCh

*RST: PSCCh

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "Content" on page 313

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:DISCtype <DiscoveryType>

In discovers mode, sets one of the discovery types, type 1 or type 2B.

Parameters:

<DiscoveryType> D1 | D2B

*RST: D1

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "Discovery Type" on page 313

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:PSDPeriod <PsdchPeriod>

In discovery mode, sets the period of the PSDCH.

Parameters:

<PsdchPeriod> integer

Range: 0 to 100
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "PSDCH Period" on page 313

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:NPDSch <NPsdch>

In discovery mode and depending on the discovery type, sets one of the parameters:

- n_PSDCH applies for discovery type 1
- n' - for discovery type 2B.

Parameters:

<NPsdch> integer

Range: 0 to 2100
*RST: 0

Example: See Example"Enabling sidelink transmission in discovery mode" on page 906.

Manual operation: See "n_PSDCH/n'" on page 313

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:SF?

Queries the subframe numbers of the allocated subframe.

Return values:

<SF> string

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "SF" on page 313

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:MODulation?

Queries the used modulation scheme.

Return values:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Options: R&S SMW-K119 for QAM64

Manual operation: See "Modulation" on page 314

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:PHYSbits?

Queries the number of physical bits occupied by the channel.

Return values:

<PhysBits> integer

Range: 0 to 1E5
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "Physical Bits" on page 314
See "Number of Physical Bits" on page 316

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:POWer <Power>

Sets the power of the selected channel.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "Power" on page 314

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:STATe <State>

Enables the transmission of the selected channel.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "State" on page 314

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CONFlict?

Queries if there is a conflict.

Return values:

<Conflict> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "Conflict" on page 314

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CYCShift <CyclicShift>

Sets the cyclic shift used by the generation of the DRS (discovery reference signal) sequence.

Parameters:

<CyclicShift> integer

Value range depens on the sidelink mode.
In communication mode, cyclic shift of 0 is used.
In V2X communication mode, the value for PSCCH is one of the following {0, 3, 6, 9}.

Range: 0 to 9
Increment: 3
*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "DMRS > Cyclic Shift" on page 315

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:SCRambling:STATe <ScramState>

Enables scrambling.

Parameters:

<ScramState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "State" on page 316

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CCODing:STATe <ChanCodState>

Enables channel coding.

Parameters:

<ChanCodState> 1 | ON | 0 | OFF

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Manual operation: See "State" on page 316

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CCODing:TBSI?

Queries the transport block index.

Return values:

<ChanCodTBIndex> integer

Range: 0 to 33

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "Transport Block Index" on page 316

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:ALLoc<ch0>:CCODing:TBSize?

Queries the transport block size.

Return values:

<ChanCodTBSize> integer

Range: 0 to 75376

*RST: 0

Example: See Example"Enabling sidelink transmission in communucation mode" on page 905.

Usage: Query only

Manual operation: See "Transport Block Size" on page 316

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:STATe <RmcState>

Activates the selected RMC.

Parameters:

<RmcState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring RMC" on page 909.

Manual operation: See "State" on page 303

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:RMC <Rmc>

Selects the RMC.

Parameters:

<Rmc> R821 | R822 | R823

*RST: R821

Example: See Example"Configuring RMC" on page 909.

Manual operation: See "RMC" on page 303

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:ARBLocks?

Queries the allocated resource blocks.

Return values:

<AllocResBlocks> integer

Range: 0 to 48

*RST: 0

Example: See Example"Configuring RMC" on page 909.

Usage: Query only

Manual operation: See "Allocated Resource Blocks" on page 303

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:MODulation?

Queries the used modulation scheme.

Return values:

<RmcModulation> QPSK | QAM16 | QAM64 | QAM256 | QAM1024

*RST: QPSK

Example: See Example"Configuring RMC" on page 909.

Usage: Query only

Manual operation: See "Modulation" on page 303

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:PAYSize?

Queries the payload size.

Return values:

<PayloadSize> integer

Range: 3496 to 31704
*RST: 3496

Example: See Example"Configuring RMC" on page 909.

Usage: Query only

Manual operation: See "Payload Size" on page 303

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:SL:RMC:PHYSbits?

Queries the number of physical bits per subframe.

Return values:

<RmcPhysBits> integer

Range: 11520 to 46080
*RST: 11520

Example: See Example"Configuring RMC" on page 909.

Usage: Query only

Manual operation: See "Physical Bits per Subframe" on page 303

11.27 Realtime feedback

Option: R&S SMW-K69

Example: Realtime feedback configuration (serial 3x8 mode)

```
:SOURce1:BB:EUTRa:DUPLexing FDD
:SOURce1:BB:EUTRa:LINK UP

:SOURce1:BB:EUTRa:UL:RTFB:MODE S3X8
:SOURce1:BB:EUTRa:UL:RTFB:CONNector LOC
:SOURce1:BB:EUTRa:UL:RTFB:ADUDelay 0
:SOURce1:BB:EUTRa:UL:RTFB:BBSelector 0
:SOURce1:BB:EUTRa:UL:RTFB:SERate SR115_2K
:SOURce1:BB:EUTRa:UL:RTFB:GENReports 1
:SOURce1:BB:EUTRa:UL:RTFB:LOFFset 10
```

Example: Realtime feedback configuration (binary mode)

```
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:RTFB:MODE BAN
SOURce1:BB:EUTRa:UL:RTFB:ACKDefinition LOW
SOURce1:BB:EUTRa:UL:RTFB:DMODe STD
SOURce1:BB:EUTRa:UL:RTFB:RVSequence "0,2,3,1"
SOURce1:BB:EUTRa:UL:RTFB:MAXTrans 4
SOURce1:BB:EUTRa:UL:RTFB:ITADvance 0
SOURce1:BB:EUTRa:UL:RTFB:CONNector LOC
SOURce1:BB:EUTRa:UL:RTFB:ADUDelay 0
SOURce1:BB:EUTRa:UL:RTFB:BBSelector 0
SOURce1:BB:EUTRa:UL:RTFB:SERate SR115_2K
SOURce1:BB:EUTRa:UL:RTFB:BEINsertion APR
SOURce1:BB:EUTRa:UL:RTFB:BERate 0.0001
SOURce1:BB:EUTRa:UL:RTFB:GENReports 1
SOURce1:BB:EUTRa:UL:RTFB:LOFFset 10
```


[:SOURce<hw>]:BB:EUTRa:UL:RTFB:AACK <AssumeACK>

If enabled, the signal generator will not use any external HARQ feedback from the DUT for its HARQ processes until an ACK command is received the first time.

Parameters:

<AssumeACK> 1 | ON | 0 | OFF

*RST: OFF

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Assume ACK until first received ACK command" on page 359

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ACKDefinition <AckDefinition>

(Binary ACK/NACK mode only)

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Parameters:
<AckDefinition> HIGH | LOW

*RST: HIGH

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "ACK Definition" on page 360

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ADUDelay <AddUserDelay>

Determines the point in time when the feedback can be sent to the instrument.

Mode	Value Range
Binary	3GPP Distance Mode: -1 to 2.99 subframes
	Direct Response Distance Mode: +1 to 6.99 subframes
Serial and Serial 3x8	"UE x > Config > 3GPP Release = Release 8/9 or LTE-Advanced": -1 to 1.99 subframes "UE x > Config > 3GPP Release = eMTC/NB-IoT": -18 to -0.3 subframes

Parameters:
<AddUserDelay> float

Range: depends on the feedback mode and the installed options
Increment: 0.01
*RST: 0
Default unit: Subframes

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 933.

Options: R&S SMW-K69

Manual operation: See "Additional User Delay" on page 360

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BBSelector <BasebandSelect>

In serial mode, required for multiplexing serial commands for different basebands to one feedback line.

Parameters:

<BasebandSelect> integer

Range: 0 to 3
*RST: 0 (for Baseband A); 1 (for Baseband B)

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 933.

Options: R&S SMW-K69

Manual operation: See "Baseband Selector" on page 360

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BEINsertion <BlockErrInsert>

Enables/disables the statistical insertion of block errors into PUSCH packets.

The block error insertion can be enabled for a single HARQ process or for all processes.

In the single HARQ process case, the used process is always the one that corresponds to the first activated PUSCH.

Parameters:

<BlockErrInsert> OFF | FPRocess | APRocesses

*RST: OFF

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Block Error Insertion" on page 361

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:BERate <BlockErrRate>

Block error rate for the statistical insertion of block errors.

Parameters:

<BlockErrRate> float

Range: 0.0001 to 1
Increment: 0.0001
*RST: 0.0001

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Block Error Rate" on page 362

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:CONNector <Connector>

Determines the feedback line connector.

Parameters:

<Connector> LOCal | GLOBal

LOCal
T/M 3 connector for R&S SMW-B10
T/M 2 connector for R&S SMW-B9

GLOBal
(reserved for future use)
USER 6 connector

*RST: LOCal

Example: Enabling the feedback signal at the local [TM3] or [TM2] connector of Baseband A.

```
SOURce1:INPut:TM3:DIRection INPut
SOURce1:INPut:TM3:SIGNal FEEDback
SOURce1:BB:EUTRa:UL:RTFB:CONNector LOCal
```

Options: R&S SMW-K69

Manual operation: See "Connector" on page 360

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:DMODe <DistanceMode>

Determines how the number of the uplink subframe is calculated, in which the signaled feedback has the desired effect.

Parameters:

<DistanceMode> STD | DIRect

*RST: STD

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Distance Mode" on page 360

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITADvance <InitTimAdvance>

The initial timing advance of the uplink signal (at the output of the instrument's baseband unit) in units of 16 T_S.

Parameters:

<InitTimAdvance> integer

Range: 0 to 1282
*RST: 0

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Initial Timing Advance" on page 359

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:ITAFeedback <IgnoreTimingAdj>

If enabled the instrument ignores timing adjustment feedback. For missing feedback, no error message is indicated.

If disabled, the instrument indicates error for missing TA adjustment command from the base station.

Parameters:

<IgnoreTimingAdj> 1 | ON | 0 | OFF

*RST: 0

Options: R&S SMW-K55/-K69

Manual operation: See "Ignore Timing Adjustment Feedback" on page 361

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MAXTrans <MaxTransmission>

After this maximum number of transmissions (incl. first transmission), the first redundancy version of the redundancy version sequence is used even in case of NACK.

Parameters:

<MaxTransmission> integer

Range: 1 to 20
*RST: 4

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Max. Number of Transmissions" on page 359

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:MODE <Mode>

Enables realtime feedback and determines the mode (binary or serial).

Parameters:

<Mode> OFF | SERial | S3X8 | BAN

*RST: OFF

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 933.

Options: R&S SMW-K69
BAN requires R&S SMW-K55

Manual operation: See "Realtime Feedback Mode" on page 357

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:RVSequence <RedVersSequence>

Determines the sequence of redundancy versions for the individual HARQ processes.

Unless otherwise requested by serial feedback commands, the first value in the sequence of redundancy versions is used each time an ACK is received or for the very first transmission of a process.

The sequence of redundancy versions is read out cyclically, i.e. whenever a NACK is received and a retransmission is requested, the next redundancy version in the sequence is used.

The first value in the sequence is used again even in case a NACK is received, if the maximum number of transmissions (`BB:EUTR:UL:RTFB:MAXT`) in a process was reached.

Parameters:
<RedVersSequence> string

Example: See Example"Realtime feedback configuration (binary mode)" on page 934.

Options: R&S SMW-K55/-K69

Manual operation: See "Redundancy Version Sequence" on page 358

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:SERate <SerialRate>

(Serial mode only)

Determines the bit rate of the serial transmission.

Parameters:
<SerialRate> SR115_2K | SR1_92M | SR1_6M

*RST: SR115_2K

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 933.

Options: R&S SMW-K69

Manual operation: See "Serial Rate" on page 361

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:GENReports <GenDebugReports>

Triggers the instrument to create and store transmission and/or reception realtime feedback debug reports.

Parameters:
<GenDebugReports> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 933.

Options: R&S SMW-K69

Manual operation: See "Generate Debug Reports" on page 358

[:SOURce<hw>]:BB:EUTRa:UL:RTFB:LOFFset <LoggingOffs>

Delays the start time for generation of the debug report files.

Parameters:

<LoggingOffs> integer

Range: 0 to 100000000
*RST: 0

Example: See Example"Realtime feedback configuration (serial 3x8 mode)" on page 933.

Options: R&S SMW-K69

Manual operation: See "Logging Offset" on page 362

11.28 eMTC/NB-IoT commands

Option: R&S SMW-K115

Programming examples

Example: NB-IoT anchor carrier in standalone mode

```
*RST
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW0_20

// Antenna ports configuration
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:NIOT:CONFig TX2
SOURce1:BB:EUTRa:DL:MIMO:APM:MAPCoordinates CART
SOURce1:BB:EUTRa:DL:MIMO:APM:CS:AP2000:ROW0:REAL 1
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

// PCI, NPSS and NSSS configuration
SOURce1:BB:EUTRa:DL:PLCI:CID 100
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CELL 200
SOURce1:BB:EUTRa:DL:SYNC:TXANtenna ALL
SOURce1:BB:EUTRa:DL:SYNC:NIOT:TXANtenna TX2
SOURce1:BB:EUTRa:DL:SYNC:NIOT:TXANtenna ALL
SOURce1:BB:EUTRa:DL:SYNC:NIOT:NPPWr 0
SOURce1:BB:EUTRa:DL:SYNC:NIOT:NSPWr 0

// NB-IoT carrier configuration
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE?
```

```
// ALON
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:STATe?
// 1
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:NVSF?
// N10
// enable all subframes
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SFALl
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF0:VALSf?
// 0
// reserved for NPBCH
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF1:VALSf?
// 1
// common serach space configration
SOURce1:BB:EUTRa:DL:NIOT:PAG:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:STSFrame S4
SOURce1:BB:EUTRa:DL:NIOT:RAND:SSOFfset O1_8

SOURce1:BB:EUTRa:STATe 1
```

Example: NB-IoT carriers in in-band mode

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW5_00

SOURce1:BB:EUTRa:DL:NIOT:LTECell:STATe 1

// SOURce1:BB:EUTRa:DL:NIOT:GAP:CONFig:STATe 1
// SOURce1:BB:EUTRa:DL:NIOT:GAP:PERiodicity 64
// SOURce1:BB:EUTRa:DL:NIOT:GAP:THReshold 32
// SOURce1:BB:EUTRa:DL:NIOT:GAP:DURation:COEFficent 1_8

// Enabling the anchor carrier and one dummy carrier
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:STATe 1
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:RBIDx 2
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:DFReq?
// -1807500
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:RBIDx 7
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:DFReq?
// -907500
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CRSSeq?
// 5
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CELL 200
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CIDGroup?
// 66
SOURce1:BB:EUTRa:DL:NIOT:ID?
// 2
```

```
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:NVSF N40
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SFALl
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:STATe 1
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:NVSF N10
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:SFALl

SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF0:VALSf?
// 0
// reserved for NPBCH
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:SF1:VALSf?
// 1
// common search space configration
SOURce1:BB:EUTRa:DL:NIOT:PAG:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:RMAX R4
SOURce1:BB:EUTRa:DL:NIOT:RAND:STSFrame S4
SOURce1:BB:EUTRa:DL:NIOT:RAND:SSOFfset O1_8

SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:SETTing:STORe "/var/user/iot_inband"
```

Example: NPRS part A+B configuration in in-band mode

Option: R&S SMW-K143

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW5_00


SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:NPRS:STATe 1
SOURce1:BB:EUTRa:DL:NPRS:CONF PA_AB
SOURce1:BB:EUTRa:DL:NPRS:POW 3
SOURce1:BB:EUTRa:DL:NPRS:ID 100
SOURce1:BB:EUTRa:DL:NPRS:SEIN 10
SOURce1:BB:EUTRa:DL:NPRS:BMP:CONF BMP_10
SOURce1:BB:EUTRa:DL:NPRS:BMP:VALSubframes1 0
SOURce1:BB:EUTRa:DL:NPRS:BMP:VALSubframes0 1
SOURce1:BB:EUTRa:DL:NPRS:MTIA #H6,3
// for NPRS Part B configuration
SOURce1:BB:EUTRa:DL:NPRS:PERD PD_160
SOURce1:BB:EUTRa:DL:NPRS:STSF STSF0_8
SOURce1:BB:EUTRa:DL:NPRS:SFNM SFNM_20
SOURce1:BB:EUTRa:DL:NPRS:MTIB?
```

Example: NB-IoT wake up signal

Option: R&S SMW-K146

```
SOURce1:BB:EUTRa:DL:NIOT:WUS:MAXDuration DN_256
SOURce1:BB:EUTRa:DL:NIOT:WUS:POW -40
SOURce1:BB:EUTRa:DL:NIOT:WUS:PSF?
SOURce1:BB:EUTRa:DL:NIOT:WUS:SF 0
SOURce1:BB:EUTRa:DL:NIOT:WUS:TO TO_80
SOURce1:BB:EUTRa:DL:NIOT:WUS:ACD DN_1
SOURce1:BB:EUTRa:DL:NIOT:WUS:STATe ON
```

Example: NB-IoT UE configuration

```
SOURce1:BB:EUTRa:DL:USER1:RELease NIOT
// UE-specific search space
SOURce1:BB:EUTRa:DL:USER1:NIOT:RMAX R4
SOURce1:BB:EUTRa:DL:USER1:NIOT:STSFrame S1_5
SOURce1:BB:EUTRa:DL:USER1:NIOT:SSOFfset O0
SOURce1:BB:EUTRa:DL:USER1:UEID 50
SOURce1:BB:EUTRa:DL:USER1:UEC?
// NB1
SOURce1:BB:EUTRa:DL:USER1:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:USER1:DATA PN9
// SOURce1:BB:EUTRa:DL:USER1:DATA DLIS
// SOURce1:BB:EUTRa:DL:USER1:DSELect "/var/user/UE1_NBIoT.dm_iqd"
```

Example: DCI format N0 configuration

DCI format N0 is used for scheduling of NPUSCH in one UL cell. If DCI format N0 is activated, one NPDCCH is configured and activated automatically.

```
SOURce1:BB:EUTRa:DL:USER1:STHP:STATe 1

SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1


SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT N0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF?
// 6
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0
```

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SCINd 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IRU 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDELay 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCSCheme 6
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:RVERsion 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NDINd 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPUSch:IREP 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:HPNMber 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:REP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NRUNits?
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "000 0010 0101 0011 0101 1010"

// NPDCCH allocation is the third allocation
// NPBCH is always the first allocation
// NPDSCH carring SIB1-NB is the second one
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONType?
// NPDC
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SFList?
// "6, 7, 8, 11"
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STSYmbol SYM1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PHYSbits?
// 232
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STATe?
// 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:TBSize?
// 88
```

Example: NPDCCH and NPDSCH DCI-based configuration (DCI format N1)

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT N1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 6
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:OIND 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPRach:SNUMber 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPRach:SCINd 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "111 0000 0101 1111 1111 1111"

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:OIND 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDELay 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:ISF 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCScheme 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:IREP 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NDINd 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:HACK 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NREP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:TBSZ?
// 208
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "100 1001 0010 0001 0100 0110"

SOURce1:BB:EUTRa:DL:NIOT:NALLoc?
// 4
// NPDCCH allocation is the third allocation
// NPBCH is always the first allocation
// NPDSCH carring SIB1-NB is the second one
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:RBIDx?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONType?
// NPDC
```

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SFList?
// "6, 7, 8, 11"
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STSYmbol SYM1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PHYSbits?
// 256
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONFlict?
// 0

SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:TBSize?
// 208

// NPDSCH allocation is the fourth allocation
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CONType?
// NPDS
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SFList?
// "26, 27, 28, 31..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PHYSbits?
// 232
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:STSYmbol SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PRECoding:SCHeme NONE
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:STATe 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:LEGacy:STATe 0

SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:ISF?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:TBSI?
// 4
```

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:TBSize?
// 208
```

Example: DCI format N2 configuration

DCI format N2 is paging and direct indication. If DCI format N2 is activated, one NPDCCH is configured and activated automatically.

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 65534
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT?
// N2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP?
// T1CM
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:PAG 0
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SIME 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SINF 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:PAG 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:ISF 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCScheme 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:IREP 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:TBSZ?
// 208
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NREP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:REP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "101 0010 0001 0010"
```

Example: NPBCH and SIB1-NB configuration

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:SFList?
// "0, 10, 20, 30..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:STSYmbol?
// SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:PHYSbits?
// 200
// NPBCH always uses 200 bits
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:DATA?
// MIB
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:POWer 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:STATe?
// 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:PRECoding:SCHeme NONE
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:SCRambling:SROT 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:PHYSbits?
// 200
SOURce1:BB:EUTRa:DL:NIOT:CCODing:MIB 1
SOURce1:BB:EUTRa:DL:NIOT:CCODing:SOFFset 16
SOURce1:BB:EUTRa:DL:NIOT:CCODing:SIB 0
SOURce1:BB:EUTRa:DL:NIOT:CCODing:RSIB?
// 4
SOURce1:BB:EUTRa:DL:NIOT:CCODing:NCID?
// 200
// as set for the anchor carrier with the command
// SOURce1:BB:EUTRa:DL:CARRier1:NIOT:CELL
SOURce1:BB:EUTRa:DL:NIOT:CCODing:STFSib1?
// 0
SOURce1:BB:EUTRa:DL:NIOT:CCODing:MSPare #H000,11
SOURce1:BB:EUTRa:DL:NIOT:ALLoc0:CCODing:TBSize?
// 34

SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:SFList?
// "4, 24, 44, 64..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:STSYmbol?
// SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:PHYSbits?
// 208
// numer of bits used by NPDSCH carring SIB-NB
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:DATA?
// SIB1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc1:STATe?
// 1
```

Example: NPDCCH and NPDSCH DCI-based configuration (DCI format N1)

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:NALLoc 1

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:FMT N1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:STSF 6
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:FMT?
// 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:CCES?
// 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:OIND 1
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPRach:SNUMber 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPRach:SCINd 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
// SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "111 0000 0101 1111 1111 1111"

SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDCch:OIND 0
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:IDELay 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:ISF 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:MCScheme 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:IREP 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NDINd 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:HACK 1
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:SFRPt 2
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NREP?
// 4
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:NPDSch:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:TBSZ?
// 208
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:BITS?
// "100 1001 0010 0001 0100 0110"

SOURce1:BB:EUTRa:DL:NIOT:NALLoc?
// 4
// NPDCCH allocation is the third allocation
// NPBCH is always the first allocation
// NPDSCH carring SIB1-NB is the second one
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:RBIDx?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONType?
// NPDC
```

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SFList?
// "6, 7, 8, 11"
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STSYmbol SYM1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PHYSbits?
// 256
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CONFlict?
// 0

SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc2:CCODing:TBSize?
// 208

// NPDSCH allocation is the fourth allocation
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CONType?
// NPDS
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SFList?
// "26, 27, 28, 31..."
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PHYSbits?
// 232
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA?
// USER1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:STSYmbol SYM3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:POWer 0
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PRECoding:SCHeme NONE
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:STATe 1

SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:LEGacy:STATe 0

SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:SCRambling:UEID?
// 50
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:ISF?
// 2
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:NSF?
// 3
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:TBSI?
// 4
```

```
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:CCODing:TBSize?
// 208
```

Example: NPUSCH and NDRS configuration

```
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:BW BW1_40

SOURce1:BB:EUTRa:UL:UE1:STATe 1
SOURce1:BB:EUTRa:UL:UE1:RELease NIOT
SOURce1:BB:EUTRa:UL:UE1:MODE STD
SOURce1:BB:EUTRa:UL:UE1:NIOT:SCSPacing S375
SOURce1:BB:EUTRa:UL:UE1:NIOT:MODE INBD
SOURce1:BB:EUTRa:UL:UE1:NIOT:RBINdex 5
SOURce1:BB:EUTRa:UL:UE1:NIOT:DFReq?
// 450000
SOURce1:BB:EUTRa:UL:UE1:NIOT:NTRansmiss 2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:FORMat F1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:MODulation PI4Q
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:STSFrame 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:REPetitions R1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:NRUNits RU1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:SIRF 10
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:POW 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:NSCarriers?
// 1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:NSLTs?
// 16
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:STSCarrier?
// 10
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:STSLot?
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:FORMat F2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:MODulation PI2B
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:STSFrame 32
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:REPetitions R2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:SIRF 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:ARB:SUGGested?
// 5
SOURce1:BB:EUTRa:SLENgth 5

SOURce1:BB:EUTRa:UL:UE2:STATe 1
SOURce1:BB:EUTRa:UL:UE2:MODE STD
SOURce1:BB:EUTRa:UL:UE2:RELease NIOT
SOURce1:BB:EUTRa:UL:UE2:NIOT:SCSPacing S15
SOURce1:BB:EUTRa:UL:UE2:NIOT:MODE INBD
SOURce1:BB:EUTRa:UL:UE2:NIOT:RBINdex 5
SOURce1:BB:EUTRa:UL:UE2:NIOT:NTRansmiss 2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:FORMat F1
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:MODulation QPSK
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:REPetitions R2
```

```
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:NRUNits RU3
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs1:SIRF 17
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:FORMat F2
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:STSFrame 12
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:REPetitions R4
SOURce1:BB:EUTRa:UL:UE2:NIOT:TRANs2:SIRF 0

SOURce1:BB:EUTRa:UL:UE1:NIOT:NPSSim 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:DATA PN9
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:PATTern #H1,1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:BITS?
// 1
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:CBITs?
// 16

SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs2:HARQ:SR 0

SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:TBINdex 10
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:RVINdex 2
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:PHYSbits?
// 192
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:RUINdex?
// 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:TBSize?
// 144

SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:ESUPport ON
SOURce1:BB:EUTRa:UL:UE1:NIOT:TRANs1:PUSCh:ETBS 88

SOURce1:BB:EUTRa:UL:UE1:CELL0:REFSig:DRS:POWoffset 0
SOURce1:BB:EUTRa:UL:UE1:NIOT:GHDisable 0


SOURce1:BB:EUTRa:UL:REFSig:DRS:GHOPping 1
SOURce1:BB:EUTRa:UL:REFSig:DRS:DSEQshift 1
SOURce1:BB:EUTRa:UL:REFSig:DRS:TTCShift 2
SOURce1:BB:EUTRa:UL:REFSig:DRS:STCShift 3
SOURce1:BB:EUTRa:UL:REFSig:DRS:USEBase 1
SOURce1:BB:EUTRa:UL:REFSig:DRS:TTBSequence 10
SOURce1:BB:EUTRa:UL:REFSig:DRS:STBSequence 11
SOURce1:BB:EUTRa:UL:REFSig:DRS:TWBSequence 20
```

Example: NPRACH configuration

```
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:BW BW5_00
SOURce1:BB:EUTRa:UL:PRACh:NIOT:PFMT F0
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:PERD 80
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:STTM 8
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:REP R2
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:SUBC 24
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG0:SCOF 2
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG1:REP R2
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG1:SUBC 24
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG1:SCOF 12
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG2:REP R16
SOURce1:BB:EUTRa:UL:PRACh:NIOT:CFG2:SUBC 48
SOURce1:BB:EUTRa:UL:UE1:RELease NIOT
SOURce1:BB:EUTRa:UL:UE1:MODE PRAC
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:MOD INBD
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:RBID 24
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:DFReq?
// 2.16  (value in MHz)
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:PRATtempts 1
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:CONFig 0
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:SFSTart 8
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:POWer 0
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:INIT 13
SOURce1:BB:EUTRa:UL:UE1:PRACh:ATT0:NIOT:STRT?
// 14
SOURce1:BB:EUTRa:UL:UE1:PRACh:NIOT:ARB:SUGGested?
// 2
SOURce1:BB:EUTRa:SLENgth 2
SOURce1:BB:EUTRa:STATe 1
```

Example: Using FRC

Activate a predefined fixed reference channel.

```
SOURce1:BB:EUTRa:UL:UE1:RELease NIOT
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:STATe 1
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:TYPE A141
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:SCSPacing?
// S15
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:NOSCarriers?
// 1
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:MODulation?
// PI2Bpsk
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:NNPRep?
// 1
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:TBSSindex?
// 0
```

```
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:PASize?
// 32
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:ALResunits?
// 2
SOURce1:BB:EUTRa:UL:UE1:NOIT:FRC:BPResunit?
// 96
```

Example: eMTC valid subframes and hopping configuration

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:SLENgth 40
SOURce1:BB:EUTRa:DL:BW BW5_00

// set cell-specific settings
SOURce1:BB:EUTRa:DL:PLCI:CID 110
SOURce1:BB:EUTRa:DL:PLCI:CIDGroup 36
SOURce1:BB:EUTRa:DL:PLCI:PLID 2
SOURce1:BB:EUTRa:DL:CPC NORM
SOURce1:BB:EUTRa:DL:PDSCh:PB 1
SOURce1:BB:EUTRa:DL:PBCH:RATBa 0
SOURce1:BB:EUTRa:DL:CSETtings:RARNti 25
SOURce1:BB:EUTRa:DL:REFSig:FPOWer 0

// PSS and SS settings
SOURce1:BB:EUTRa:DL:SYNC:TXANtenna ALL
SOURce1:BB:EUTRa:DL:SYNC:PPOWer 0
SOURce1:BB:EUTRa:DL:SYNC:SPOWer 0

// eMTC valid subframes
SOURce1:BB:EUTRa:DL:EMTC:BMP:SUBFrames 10
SOURce1:BB:EUTRa:DL:EMTC:BMP:STARt 2
SOURce1:BB:EUTRa:DL:EMTC:BMP:VALSubframes0 OFF
SOURce1:BB:EUTRa:DL:EMTC:BMP:VALSubframes1 ON
// Alternatively, select all subframe setting them as valid.
SOURce1:BB:EUTRa:DL:EMTC:BMP:SELectlall
// Deselect all subframe setting them to invalid.
SOURce1:BB:EUTRa:DL:EMTC:BMP:DESelectlall

// PBCH scheduling and hopping
SOURce1:BB:EUTRa:DL:EMTC:BMP:SIBBr 1
SOURce1:BB:EUTRa:DL:EMTC:BMP:PBCHrep 1

// PDSCH and MPDCC hopping
SOURce1:BB:EUTRa:DL:EMTC:NB:NNBands?
// 4
SOURce1:BB:EUTRa:DL:EMTC:NB:HOPPing 2
SOURce1:BB:EUTRa:DL:EMTC:NB:HOFFset 1
SOURce1:BB:EUTRa:DL:EMTC:NB:IVLA H1
SOURce1:BB:EUTRa:DL:EMTC:NB:IVLB H2
SOURce1:BB:EUTRa:DL:EMTC:NB:RHOPpping 1
SOURce1:BB:EUTRa:DL:EMTC:NB:PHOPping 1
```

```
SOURce1:BB:EUTRa:DL:EMTC:NB:RSTNb 2
SOURce1:BB:EUTRa:DL:EMTC:NB:PSTNb 2

// common search space configuration
SOURce1:BB:EUTRa:DL:EMTC:SSP:MPD1 8
SOURce1:BB:EUTRa:DL:EMTC:SSP:MPD2 16
SOURce1:BB:EUTRa:DL:EMTC:SSP:STSF S1
SOURce1:BB:EUTRa:DL:EMTC:SSP:PDSA 16
SOURce1:BB:EUTRa:DL:EMTC:SSP:PDSB NON

// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

SOURce1:BB:EUTRa:STATe 1
SOURce1:BB:EUTRa:SETTing:STORe "/var/user/emtc_hopping"
```

Example: eMTC widebands configuration

Option: R&S SMW-K143

```
// UL
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:BW BW10_00
SOURce1:BB:EUTRa:UL:EMTC:WBCFg 1
SOURce1:BB:EUTRa:UL:EMTC:NWBands?
// 2
SOURce1:BB:EUTRa:UL:EMTC:VALid:SUBFrame1 1
SOURce1:BB:EUTRa:UL:EMTC:RSYMbol 2
SOURce1:BB:EUTRa:UL:UE1:RELease EMTC
SOURce1:BB:EUTRa:UL:UE1:STATe 1

SOURce1:BB:EUTRa:UL:UE1:EMTC:NTRansmiss 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CONTent PUSC
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:MODulation QPSK
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STSFrame 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:REPetitions R2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STWBand 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:WRBLocks CN6
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:WBRBoffset OS0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:POW 0

// DL
// SOURce1:BB:EUTRa:STDMode IOT
// SOURce1:BB:EUTRa:LINK DOWN
// SOURce1:BB:EUTRa:DL:BW BW10_00
// SOURce1:BB:EUTRa:DL:EMTC:WBCFg BW5
// SOURce1:BB:EUTRa:DL:EMTC:NWBands?
// 2
```

Example: eMTC UE configuration

```
// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:DL:USER1:RELease EM_A
SOURce1:BB:EUTRa:DL:USER1:UEID 10
SOURce1:BB:EUTRa:DL:USER1:UEC?
// M1
SOURce1:BB:EUTRa:DL:USER1:CELL0:TXM M6
SOURce1:BB:EUTRa:DL:USER1:CCODing:STATe?
// 1
SOURce1:BB:EUTRa:DL:USER1:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:USER1:DATA PN11
// SOURce1:BB:EUTRa:DL:USER1:DATA DLIS
// SOURce1:BB:EUTRa:DL:USER1:DSELect "/var/user/UE1_eMTC.dm_iqd"
```

Example: Configuring the MPDCCH sets

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode IOT

// enable an eMTC UE, e.g. supporting eMTC CE Mode A
SOURce1:BB:EUTRa:DL:USER1:RELease EM_A

SOURce1:BB:EUTRa:DL:USER1:EPDCch1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET2:STATe 1

SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:TTYP LOC
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:PRBS PRB2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:RBA 2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:NID 22
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:POWer 0
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:HOPPing 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STNB 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:REPMpdcch 16
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STSF S1

// MPDCCH allocations are configured automatically,
// depending on the eMTC DCI configuration
```

Example: MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)

The user UE1 is configured as described in Example"eMTC UE configuration" on page 956.

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
// DCI configuration
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEID?
// 10
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:MPDCchset MPD1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STSFrame 0
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDCCh 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:IDCCe 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CCES?
// 4
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NDCCes?
// 4

// UE-specific search space for MPDCCH
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:HOPPing 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STNB 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:REPMpdcch 16
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STSF S1

// PDSCH configuration via DCI format 6-1A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEMode STD
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PFRHopp 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RBA 32
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:MCS 5
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NREP 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:HARQ 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NDINd 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RVER 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TPCPusch 1
// SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:DAINdex 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TPCPusch 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PMIConfirm 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TPMPrec 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CSIRequest 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SRSRequest 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:HRESoffset 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SFRNumber 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:BITS?
// "011 0101 0101 0101 0110 1010 1000 0011"
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TBS?
// 72
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:REPMpdcch?
// 4
```

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:REPPdsch?
// 16
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDSHopping?
// 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STRV?
// 3

SOURce1:BB:EUTRa:DL:EMTC:NALLoc?
// 4
// MPDCCH allocation is the third allocation
// PBCH is always the first allocation
// if activated, PDSCH carring SIB1-BR is the second one

// MPDCCH allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:CONType?
// MPD
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STSFrame?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:ABSFrame?
// 4
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STNB?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STSYmbol?
// 2
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:PHYSbits?
// 436
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:DATA?
// USER1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:POWer 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:STATe?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc2:CONFlict?
// 0

// PDSCH allocation not carrying SIB-BR is the fourth allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CONType?
// PDSC
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PHYSbits?
// 264
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DATA?
// USER1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:ABSFrame?
// 16
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:STSFrame?
// 5
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:NORB?
// 6
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:OVRB?
// 0
```

```
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:STSYmbol?
// 2
...
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:POWer 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:STATe?
// 1

SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:SCHeme?
// SPM
// because User 1 uses Tx mode TM6
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:NOLayers?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:CCD NOCD
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:CBINdex 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:SCRambling:UEID?
// 10
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CCODing:TBSI?
// 5
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CCODing:TBSize?
// 72
```

Example: PBCH and SIB1-BR configuration

```
// PBCH scheduling and hopping
SOURce1:BB:EUTRa:DL:EMTC:BMP:SIBBr 1
SOURce1:BB:EUTRa:DL:EMTC:BMP:PBCHrep 1

SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER USER1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEID?
// 10
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SSP UE
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STSFrame 0
// first allowed subframe number is calculated automatically
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDCCh 2
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:IDCCe 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CCES?
// 2

SOURce1:BB:EUTRa:DL:EMTC:NALLoc?
// 4
// PBCH is always the first allocation
// if enabled, PDSCH carring SIB1-BR is the second one

// PBCH allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CONType?
// PBCH
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:MODulation?
// QPSK
```

```
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:STSFrame?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:STSYmbol?
// 2
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:PHYSbits?
// 480
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:DATA?
// MIB
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:POWer 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:STATe?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CONFlict?
// 0

// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1


// Precoding for two Tx antennas
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:PRECoding:SCHeme TXD
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:PRECoding:NOLayers?
// 2
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:SCRambling:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:SCRambling:UEID?
// 10

SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:STATe 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:MIB 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:SOFFset 60

SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:SRPeriod PER3gpp

SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:SIB?
// 1
// resembles the value set with SOURce1:BB:EUTRa:DL:EMTC:BMP:SIBBr
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:RSIB?
// 4
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:MSPare #H00,5
SOURce1:BB:EUTRa:DL:EMTC:ALLoc0:CCODing:TBSize?

SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:CONType?
// PSIB
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:MODulation?
// QPSK
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STSFrame?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:ABSFrame?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STNB?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STSYmbol?
```

```
// 3
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:NORB?
// 6
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:PHYSbits?
// 1510
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:DATA?
// SIBB
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:STATe?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc1:CONFlict?
// 0
```

Example: DCI format 6-2 configuration

DCI format 6-2 carries paging and direct indication. If DCI format 6-2 is used, one MPDCCH is configured and activated automatically.

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEID?
// 65534
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT?
// F62
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:SSP?
// T1CM
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:STSF 0
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PDCCh?
// 5
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:CCES?
// 10
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:IDCCe?
// 0

// SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PAGNg 0
// SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:DIINfo 100

SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PAGNg 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RBA 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:MCScheme 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:NREP 3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:BITS?
// "000 1100 0111"
```

Example: eMTC PUSCH configuration

```
SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:LINK UP
SOURce1:BB:EUTRa:UL:EMTC:VALid:SUBFrame1 1
SOURce1:BB:EUTRa:UL:BW BW5_00
SOURce1:BB:EUTRa:UL:EMTC:NNBands?
// 4
SOURce1:BB:EUTRa:UL:UE1:RELease EMTC
SOURce1:BB:EUTRa:UL:UE1:STATe 1

SOURce1:BB:EUTRa:UL:UE1:MODE STD
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:REPetitions R4
SOURce1:BB:EUTRa:UL:PUSCh:NHOPping 1
SOURce1:BB:EUTRa:UL:PUSCh:NHOFfset 2

SOURce1:BB:EUTRa:UL:UE1:EMTC:HOPP H4
SOURce1:BB:EUTRa:UL:UE1:EMTC:CELevel CE01
SOURce1:BB:EUTRa:UL:UE1:EMTC:NTRansmiss 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CONTent PUSC
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:MODulation QPSK
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STSFrame 61
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:REPetitions R16
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:STNBand 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:NRBLocks 5
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:RBOFfset 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:POW 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:ASFRrame?
// 16

SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:DATA PN9
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:SCRambling:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:STATe 1
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:MODE COMB
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:IHARqoffset 0
SOURce1:BB:EUTRa:UL:UE1:CELL0:PUSCh:CCODing:ICQioffset 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:DRS:CYCShift?
// 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:NDMRs?
// 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:MODE MUX
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:BITS 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:PATTern #H2,2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:HARQ:CBITs?
// 144
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PUSCh:CQI:BITs 12
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PUSCh:CQI:PATTern #HC,4
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PUSCh:CQI:CBITs?
// 810
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CCODing:TBSize 16
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:CCODing:RVINdex 2
```

```
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:PHYSbits?
// 1440
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs1:ULSCh:BITS?
// 584

SOURce1:BB:EUTRa:UL:UE1:EMTC:ARB:SUGGested?
SOURce1:BB:EUTRa:SLENgth 10
SOURce1:BB:EUTRa:STATe 1
```

Example: eMTC PUCCH configuration

```
SOURce1:BB:EUTRa:UL:PUCCh:NORB 4
SOURce1:BB:EUTRa:UL:PUCCh:N1CS 1
SOURce1:BB:EUTRa:UL:PUCCh:DESHift 1
SOURce1:BB:EUTRa:UL:PUCCh:N2RB 0

SOURce1:BB:EUTRa:UL:UE1:MODE STD
SOURce1:BB:EUTRa:UL:UE1:EMTC:NTRansmiss 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:CONTent PUCC
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:FORMat F2B
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:STSFrame 77
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:REPetitions R8
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:ASFRrame?
// 8
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:POWer 0
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:NAPused?
// 1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:NPUCch 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:HARQ:PATTern #H3,2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:CQI:BITS 2
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:CQI:PATTern #H1,1
SOURce1:BB:EUTRa:UL:UE1:EMTC:TRANs2:PUCCh:CQI:CBITs?
// 20
SOURce1:BB:EUTRa:SLENgth 10
```

Example: eMTC PRACH configuration

```
SOURce1:BB:EUTRa:UL:PRACh:EMTC:HOFF 6
SOURce1:BB:EUTRa:UL:PRACh:EMTC:RSET OFF
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV0:FOFFset 2
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV0:SSFPeriod 2
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:CONFig 48
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:FOFFset 16
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:HOPPing 1
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:REPetit R2
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV1:SSFPeriod NONE
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:CONFig 9
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:FOFFset 10
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:REPetit R8
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV2:SSFPeriod NONE
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:CONFig 22
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:FOFFset 6
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:HOPPing 1
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:REPetit R4
SOURce1:BB:EUTRa:UL:PRACh:EMTC:CELV3:SSFPeriod NONE

SOURce1:BB:EUTRa:UL:UE2:STATe 1
SOURce1:BB:EUTRa:UL:UE2:RELease EMTC
SOURce1:BB:EUTRa:UL:UE2:MODE PRAC
SOURce1:BB:EUTRa:UL:UE2:PRACh:EMTC:PRATtempts 4
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:SFSTart 21
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:NCSConf 0
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:RSEQuence 10
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:SINDex 12
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:DT 0
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:POWer 0
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT1:EMTC:CELV 1
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT1:EMTC:SFSTart 41
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT2:EMTC:CELV 2
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT2:EMTC:SFSTart 81
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT3:EMTC:CELV 3
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT3:EMTC:SFSTart 121

SOURce1:BB:EUTRa:UL:UE2:PRACh:EMTC:ARB:SUGGested?
SOURce1:BB:EUTRa:SLENgth 14
```

11.28.1 General IoT downlink

11.28.1.1 Physical settings

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NNBands?

Queries the number of narrowbands.

Return values:
<NumNarrowbands> integer

Range: 0 to 18
*RST: 1

Example: `SOURce1:BB:EUTRa:DL:EMTC:NNBands?`

Usage: Query only

Manual operation: See "Number of eMTC Narrowbands" on page 102

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:WBCFg <WideBandCfg>

If enabled, the available channel bandwidth is split into eMTC widebands with the selected bandwidth.

Parameters:
<WideBandCfg> OFF | BW5_00 | BW20_00

*RST: OFF

Example: See Example"eMTC widebands configuration" on page 955.

Options: R&S SMW-K143

Manual operation: See "Wideband Config" on page 103

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NWBands?

Queries the number of widebands.

Return values:
<NumWideBands> integer

Range: 0 to 4
*RST: 1

Example: See Example"eMTC widebands configuration" on page 955.

Usage: Query only

Options: R&S SMW-K143

Manual operation: See "Number of eMTC Widebands" on page 103

11.28.1.2 DL reference and synchronization signals

[:SOURce<hw>]:BB:EUTRa:DL:REFSig:NIOT:POWer <NbRefSigSymPowe>

Sets the power of the narrowband reference signal (NRS).

Parameters:

<NbRefSigSymPowe>float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Narrowband Reference Signal Power" on page 112

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:TXANtenna <NpNsSyncTxAnt>

Defines on which antenna the NPSS/NSSS are transmitted.

Parameters:

<NpNsSyncTxAnt> NONE | ANT1 | ANT2 | ALL

*RST: ALL

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "NP-/NS-Sync Tx Antenna" on page 112

[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NPPWr <NPSyncPower>
[:SOURce<hw>]:BB:EUTRa:DL:SYNC:NIOT:NSPWr <NsSyncPower>

Sets the power of the NPSS/NSSS allocations.

Parameters:

<NsSyncPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "NP-SYNC Power/NS-SYNC Power" on page 112

11.28.1.3 NPRS

Option: R&S SMW-K143

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STATe <NprsState>

Enables the NPRS transmission.

Parameters:

<NprsState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS State" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:CONF <NprsParaCfg>

Defines which type of NPRS is used.

Parameters:

<NprsParaCfg> PA_A | PA_B | PA_AB

*RST: PA_A

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Parameter" on page 129

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:POW <NprsPower>

Sets the power of the narrowband positioning reference signal (NPRS).

Parameters:

<NprsPower> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Power" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:ID <NprsId>

Sets the NPRS-ID used for the generation of the NPRS.

Parameters:

<NprsId> Integer

Range: 0 to 4095
Increment: 1
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS ID" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SEIN <NprsSeqInfo>

Specifies the index of the physical ressource block (PRB) containing the NPRS.

Parameters:

<NprsSeqInfo> integer

Range: 0 to 174
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Sequence Information" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:CONF <NprsBmp>

Sets if the NPRS subframe Part A configuration lasts 10 ms or 40 ms.

Parameters:

<NprsBmp> 10 | 40

*RST: 10

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Bitmap" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:BMP:VALSubframes<ch> <NprsBmpValidSf>

Sets a subframe as valid and used for NPRS transmission.

Suffix:
<dir> 0 to 9
Subframe number

Parameters:
<NprsBmpValidSf> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Bitmap Config" on page 130

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIA <NprsMutingInfoA>, <BitCount>
[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:MTIB <NprsMutingInfoB>, <BitCount>

Sets the `nprs-MutingInfoA`/`nprs-MutingInfoB` parameter, required if muting is used for the NPRS part A (and Part B) configurations.

Parameters:
<NprsMutingInfoB> numeric
"1" indicates that the NPRS is transmitted in the corresponding occasion; a "0" indicates a muted NPRS.
*RST: #H3

<BitCount> integer
Sets the length of the periodically repeating NPRS bit sequence in number of NPRS position occurrences.
Allowed are the following values: 2, 4, 8 or 16
Range: 2 to 16
*RST: 2

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Muting Information A/B" on page 131

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:PERiod <NprsPeriod>

For NPRS Part B configuration, sets the NPRS occasion period T_{NPRS}.

Parameters:
<NprsPeriod> PD_160 | PD_320 | PD_640 | PD_1280
*RST: PD_160

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Period" on page 131

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:STSFrame <NprsStartSf>

For NPRS Part B configuration, sets the subframe offset α_{NPRS}.

Parameters:

<NprsStartSf> STSF0_8 | STSF1_8 | STSF2_8 | STSF3_8 | STSF4_8 | STSF5_8 | STSF6_8 | STSF7_8

*RST: STSF0_8

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Start Subframe" on page 131

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NPRS:SFNM <NprsSfNumber>

For NPRS Part B configuration, sets the number of consecutive DL subframes N_{NPRS} within one NPRS positioning occasion.

Parameters:

<NprsSfNumber> SFNM_10 | SFNM_20 | SFNM_40 | SFNM_80 | SFNM_160 | SFNM_320 | SFNM_640 | SFNM_1280

*RST: SFNM_10

Example: See Example"NPRS part A+B configuration in in-band mode" on page 942.

Manual operation: See "NPRS Number of Subframes" on page 131

11.28.1.4 NB-IoT wake-up signal

Option: R&S SMW-K146

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:ACD <NwusActD>

Sets the duration of WUS in subframes.

Parameters:

<NwusActD> DN_1 | DN_2 | DN_4 | DN_8 | DN_16 | DN_32 | DN_64 | DN_128 | DN_256 | DN_512 | DN_1024

*RST: DN_1

Example: See Example"NB-IoT wake up signal" on page 943

Options: R&S SMW-K146

Manual operation: See "NWUS Actual Duration" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:MAXDuration <NwusMaxDur>

Sets the maximum WUS duration in subframes.

Parameters:
<NwusMaxDur> DN_1 | DN_2 | DN_4 | DN_8 | DN_16 | DN_32 | DN_64 | DN_128 | DN_256 | DN_512 | DN_1024
*RST: DN_1

Example: See Example"NB-IoT wake up signal" on page 943

Options: R&S SMW-K146

Manual operation: See "NWUS Max Duration" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:POW <NwusPower>

Sets the transmit power of NB-IoT wake up signal

Parameters:
<NwusPower> float
Range: -80 to 10
Increment: 0.001
*RST: 0
Default unit: dB

Example: See Example"NB-IoT wake up signal" on page 943

Options: R&S SMW-K146

Manual operation: See "NWUS Power" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:PSF?

Queries the first paging occasion in subframes associated with WUS.

Return values:
<NwusPSF> integer
Range: 0 to 534593
*RST: 40

Example: See Example"NB-IoT wake up signal" on page 943

Usage: Query only

Options: R&S SMW-K146

Manual operation: See "Paging Start Subframe" on page 133

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:SF <NwusSF>

Specifies the first subframe for paging associated with a WUS transmission.

Parameters:

<NwusSF> Integer

Range: 0 to 533329
Increment: 1
*RST: 0

Example: See Example"NB-IoT wake up signal" on page 943

Options: R&S SMW-K146

Manual operation: See "NWUS Start Subframe" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:STATe <NwusState>

Enables or disables the NB-IoT wake up signal.

Parameters:

<NwusState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NB-IoT wake up signal" on page 943

Options: R&S SMW-K146

Manual operation: See "NWUS State" on page 132

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:WUS:TO <NwusTO>

Sets the offset in ms from the end of the configured maximum WUS duration to the associated paging occasion.

Parameters:

<NwusTO> TO_40 | TO_80 | TO160 | TO240

*RST: TO_40

Example: See Example"NB-IoT wake up signal" on page 943

Options: R&S SMW-K146

Manual operation: See "NWUS Time Offset" on page 133

11.28.1.5 NB-IoT carrier allocation

[:SOURce<hw>]:BB:EUTRa:DL:MIMO:NIOT:CONFig <NbiotMimoConf>

Set the number of transmit antennas used for the simulated NB-IoT system.

Parameters:

<NbiotMimoConf> TX2 | TX1

*RST: TX1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "NB-IoT MIMO Configuration" on page 135

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PUNCture <PunctureInband>

Punctures the LTE signal at the NB-IoT in-band or guard band carriers.

Parameters:

<PunctureInband> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode LIOT
SOURce1:BB:EUTRa:DL:BW BW5_00
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:STATe 1
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE INBD
SOURce1:BB:EUTRa:DL:NIOT:PUNCture 1
```

Manual operation: See "Puncture LTE at Inband Carriers" on page 405

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:LTECell:STATe <LTECell>

In in-band mode, defines how the LTE channels are handled.

If enabled, all LTE channels are deactivated. However, LTE reference signals are still transmitted.

Parameters:

<LTECell> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "LTE Cell" on page 404

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:CONFig:STATe <GapConfig>

If activated, a gap between the NPDCCH and NPDSCH with the specified duration is applied.

Parameters:

<GapConfig> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "Gap Configuration" on page 404

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:THReshold <GapThreshold>

Sets the gap threshold.

Parameters:

<GapThreshold> 32 | 64 | 128 | 256

*RST: 32

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "Gap Threshold" on page 404

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:PERiodicity <GapPeriodicity>

Sets the number of subframes after that the configured gap is repeated.

Parameters:

<GapPeriodicity> 64 | 128 | 256 | 512

*RST: 64

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "Gap Periodicity" on page 405

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:GAP:DURation:COEFficent <GapDurCoeff>

Sets the gap duration coefficient.

Parameters:

<GapDurCoeff> 1_8 | 1_4 | 3_8 | 1_2

*RST: 1_8

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "Gap Duration Coefficient" on page 405

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:MODE <Mode>

Sets the operating mode.

Parameters:

<Mode> INBD | ALON | GBD

*RST: INBD

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Mode" on page 405

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:RBIDx <RbIndex>

Sets the resource block number in that the NB-IoT transmissions are allocated.

Parameters:

<RbIndex> 2 | 4 | 7 | 9 | 12 | 14 | 17 | 19 | 22 | 27 | 24 | 29 | 30 | 32 | 34 | 35 | 39 | 42 | 44 | 40 | 45 | 47 | 52 | 55 | 57 | 60 | 62 | 65 | 67 | 70 | 72 | 75 | 80 | 85 | 90 | 95 | USER

*RST: 40

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "RB Index" on page 406

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:DFReq <DeltaFreq>

Sets the frequency offset between the NB-IoT carrier and the LTE center frequency.

Parameters:

<DeltaFreq> float

Range: -10000000 to 10000000
*RST: 0
Default unit: MHz

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "Delta Frequency to DC, MHz" on page 407

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CRSSeq <CrsSeqInfo>

Sets the CRS sequence info.

Parameters:

<CrsSeqInfo> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "CRS Sequence Info" on page 406

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CELL <CellID>

Sets the narrowband physical cell identifier.

Parameters:

<CellID> integer

Range: 0 to 503
*RST: 0

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "NCell ID" on page 407

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:CIDGroup <CellIdGr>

Queries the physical cell identity group.

Parameters:

<CellIdGr> integer

Range: 0 to 111
*RST: 0

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Manual operation: See "NCell ID Group" on page 407

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ID?

Queries the physical layer identity.

Return values:

<Identity> integer

Range: 0 to 111
*RST: 0

Example: See Example"NB-IoT carriers in in-band mode" on page 941.

Usage: Query only

Manual operation: See "Identity" on page 407

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSF <NoValidSubframe>

Sets the subframes bitmap.

Parameters:

<NoValidSubframe> N10 | N40

*RST: N10

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Valid Subframes" on page 408
See "Bitmap Subframes" on page 409

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:GBRBidx <RbIndexGB>

In guardband opration, sets the resource block number in that the NB-IoT transmissions are allocated.

Parameters:
<RbIndexGB> integer

Example:
```
SOURce1:BB:EUTRa:DL:BW BW5_00
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:MODE GBD
SOURce1:BB:EUTRa:DL:CARRier1:NIOT:GBRBidx 26
```

Manual operation: See "RB Index" on page 406

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFALI

Sets all SFs to valid.

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Usage: Event

Manual operation: See "Select All/Deselect All" on page 409

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SFNN

Sets all SFs to invalid.

Example:
```
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:SFNN
SOURce1:BB:EUTRa:DL:CARRier2:NIOT:SF1:VALSf?
// 0
```

Usage: Event

Manual operation: See "Select All/Deselect All" on page 409

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:SF<st0>:VALSf <Valid>

Sets the valid subframes.

Suffix:

<st0>
: 0 to 9/ 0 to 39
Subframe number, where the max number of subframes depends on the selected bitmap
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSFN10`: 0 to 9
`[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:NVSFN40`: 0 to 39

Parameters:

<Valid>
: 1 | ON | 0 | OFF

1
Valid subframe

0
Not valid subframe

*RST: 1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Valid Subframes" on page 408

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:PAG:RMAX <PagingRmax>

Sets the maximum number NPDCCH is repeated R_{Max} (paging).

Parameters:

<PagingRmax>
: R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R256 | R512 | R1024 | R2048

*RST: R1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Max. Repetitions of NPDCCH (Rmax) for Type 1 common search space" on page 413

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:RMAX <RandomRmax>

Sets the maximum number NPDCCH is repeated R_{Max} (random access).

Parameters:

<RandomRmax>
: R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R256 | R512 | R1024 | R2048

*RST: R1

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Max. Repetitions of NPDCCH (Rmax) for Type 2 common search space" on page 413

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:SSOFfset <RandomOffset>

Sets the serach space offset (α_{offset}).

Parameters:

<RandomOffset> O0 | O1_8 | O1_4 | O3_8

*RST: O0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Search Space Offset (α_{offset})" on page 413

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:RAND:STSFrame <StartSf>

Sets the start SF for the random access common search space.

Parameters:

<StartSf> S1_5 | S2 | S4 | S8 | S16 | S32 | S48 | S64

*RST: S4

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Search Space Start Subframe (G)" on page 413

[:SOURce<hw>]:BB:EUTRa:DL:CARRier<ch>:NIOT:STATe <State>

Enables the selected NB-IoT carrier.

To enable the NB-IoT configuration, enable the anchor carrier (`SOURce1:BB:EUTRa:DL:CARRier0:NIOT:STATe 1`)

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NB-IoT anchor carrier in standalone mode" on page 940.

Manual operation: See "Activate NB-IoT" on page 404
See "State" on page 409

11.28.1.6 eMTC bitmap, valid subframes, hopping and common search space

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SUBFrames <BitmapSubframes>

Sets the valid subframes configuration over 10ms or 40ms.

Parameters:

<BitmapSubframes> 10 | 40

*RST: 10

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Bitmap Subframes" on page 464

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:STARt <StartingSymbol>

Defines the first symbol within a frame that can be used for eMTC.

Parameters:

<StartingSymbol> 1 | 2 | 3 | 4

*RST: 2

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Starting Symbol" on page 464

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SIBBr <SchedInfoSIB1BR>

Sets the number of times the PDSCH allocation carrying the SIB1-BR is repeated.

Parameters:

<SchedInfoSIB1BR> integer

Range: 0 to 18
*RST: 0

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Scheduling Info SIB1-BR" on page 464

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:PBCHrep <PbchRepetitions>

Configures the cell for PBCH repetition.

Parameters:

<PbchRepetitions> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "PBCH Repetition" on page 465

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:SELectlall|DESelectall

Sets all SFs as valid or invalid.

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Usage: Event

Manual operation: See "Select All/Deselect All" on page 465

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:BMP:VALSubframes<ch> <ValidSubFrames>

Sets a SF as valid or invalid.

Parameters:

<ValidSubFrames> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "SF State" on page 465

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:NNBands?

Queries the number of narrowbands.

Return values:

<NumNarrowBands> integer

Range: 1 to 16
*RST: 8

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Usage: Query only

Manual operation: See "Number of eMTC Narrowbands" on page 465

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOPPing <NumNBHopping>

Sets the number of narrowbands over which MPDCCH or PDSCH hops.

Parameters:

<NumNBHopping> 2 | 4

*RST: 2

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Number of Narrowbands for Hopping" on page 465

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:HOFFset <HoppingOffset>

Sets the number of narrowbands between two consecutive MPDCCH or PDSCH hops.

Parameters:

<HoppingOffset> integer

Range: 1 to 16
*RST: 8

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Hopping Offset" on page 465

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLA <HoppingIvlA>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:IVLB <HoppingIvlB>

Sets the number of consecutive subframes during which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband.

Parameters:

<HoppingIvlB> H1 | H2 | H4 | H5 | H8 | H10 | H16 | H20 | H40

*RST: H2

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Hopping Interval for CE Mode A/B" on page 466

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PHOPping <PagingHopping>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RHOPpping <RaHopping>

Enables hopping for the random access.

Parameters:

<RaHopping> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "RA Hopping" on page 466

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:PSTNb <PagingStartingN>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NB:RSTNb <RaStartingNB>

Sets the first used narrowband, if hoping is enabeld.

Parameters:

<RaStartingNB> integer

Range: 0 to 15
*RST: 8

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "RA Starting NB" on page 466

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD1 <MaxRepMPDCCH1>
[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:MPD2 <MaxRepMPDCCH2>

Sets the maximum number of MPDCCH repetitons for type 1 and type 2 common seach spaces.

Parameters:

<MaxRepMPDCCH2> 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256

*RST: 1

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Max. Repetitions of MPDCCH (Rmax) for Type 2 common search space" on page 467

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:STSF <SpStartSf>

Sets the start SF for the random access common search space.

Parameters:

<SpStartSf> S1 | S1_5 | S2 | S2_5 | S5 | S8 | S10 | S20 | S4

*RST: S1

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Search Space Start Subframe" on page 467

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSA <MaxRepPDSCHA>

Sets the parameter `pdsch-maxNumRepetitionCEmodeA` that defines the PDSCH subframe assigment.

Parameters:

<MaxRepPDSCHA> 16 | 32 | 64 | NON | 192 | 256 | 384 | 512 | 786 | 1024 | 1536 | 2048

*RST: NON

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Max. Repetitions of PDSCH for CE Mode A/B" on page 468

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:SSP:PDSB <MaxRepPDSCHB>

Sets the parameter `pdsch-maxNumRepetitionCEmode`**`B`** that defines the PDSCH subframe assigment.

Parameters:

<MaxRepPDSCHB> 16 | 32 | 64 | NON | 192 | 256 | 384 | 512 | 786 | 1024 | 1536 | 2048

*RST: NON

Example: See Example"eMTC valid subframes and hopping configuration" on page 954.

Manual operation: See "Max. Repetitions of PDSCH for CE Mode A/B" on page 468

11.28.2 DL IoT frame configuration

11.28.2.1 NB-IoT DCI configuration

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:NALLoc <NoAlloc>

Sets the number of configurable DCIs.

Parameters:

<NoAlloc> integer

Range: 0 to 100
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Number of DCI Allocations" on page 415

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:AWARound <AllocWrapAround>

If enabled, the NPDSCH allocations are relocated at the beginning of the ARB sequence to ensure a consistent signal.

Parameters:

<AllocWrapAround> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:NIOT:DCI:AWARound 1`

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:USER <User>

Selects the user the DCI is dedicated to.

Parameters:

<User> USER1 | USER2 | USER3 | USER4 | PRNTi | RARNti

*RST: USER1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "User" on page 416

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:UEID?

Queries the UE_ID or the n_RNTI for the selected DCI.

Return values:

<UeID> integer

Range: 0 to 65535
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "UE_ID/n_RNTI" on page 416

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:FMT <Format>

Sets the DCI format for the selected allocation.

Parameters:

<Format> N0 | N1 | N2

*RST: N0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format" on page 416

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SSP <SearchSpace>

Sets the search space for the selected DCI.

Parameters:

<SearchSpace> UE | T1CM | T2CM

*RST: UE

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Search Space" on page 416

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:STSFrame <StartSf>

Sets the next valid starting subframe for the selected allocation.

Parameters:

<StartSf> integer

Range: 1 to 20
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Start Sufbrame" on page 427

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:FMT <NPdcchFmt>

Sets the NPDCCH format.

Parameters:

<NPdcchFmt> integer

Range: 0 to 1
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "NPDCCH Format" on page 427

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CCES?

queries the number NCCEs.

Return values:

<NoCCEs> integer

Range: 1 to 2
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Number NCCEs" on page 428

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDCCe <NcceIndex>

Sets the NCCE start index.

Parameters:

<NcceIndex> integer

Range: 0 to 1
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "NCCE Index" on page 428

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:CONFlict?

Queries if there is a conflict between two DCI formats.

Return values:
<Conflict> 1 | ON | 0 | OFF
*RST: 0

Example: `SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc1:CONFlict?`

Usage: Query only

Manual operation: See "Conflict" on page 428

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:BITS?

Queries the resulting bit data as selected with the DCI format parameters.

Return values:
<BitData> string

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Bit Data" on page 417

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IRU <DciIRU>

Sets the DCI field resource assignment field of NPUSCH (I_{RU}).

Parameters:
<DciIRU> integer
Range: 0 to 7
*RST: 0

Example: See Example"DCI format N0 configuration" on page 943.

Manual operation: See "DCI Format N0" on page 417

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HACK <HackResource>

Sets the DCI field HARQ-ACK resource field.

Parameters:
<HackResource> integer
Range: 0 to 15
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:IDELay <SchedDelay>

Sets the DCI field scheduling delay field (I_{Delay}).

Parameters:

<SchedDelay> integer

Range: 0 to 7
*RST: 0

Example: See Example"DCI format N0 configuration" on page 943.

Manual operation: See "DCI Format N0" on page 417
See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:MCSCheme <Scheme>

Sets the DCI field modulation and coding scheme (I_{MSC}).

Parameters:

<Scheme> integer

Range: 0 to 13
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N0" on page 417
See "DCI Format N1" on page 420
See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd <NewDataInd>

Sets the DCI field new data indicator.

Parameters:

<NewDataInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N0" on page 417
See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:OIND <OrderInd>

Sets the DCI field NPDCCH order indicator.

Parameters:

<OrderInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDCch:REP?

Queries the number of repetitions of NPDCCH (R).

Return values:

<NPdcchRpt> integer

Range: 1 to 2048
*RST: 1

Example: See Example"DCI format N2 configuration" on page 947.

Usage: Query only

Manual operation: See "Repetitions of NPDCCH (R)" on page 427

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:IREP <DciINPDSCH>

Sets the DCI field number of NPDSCH repetition fields (I_{Rep}).

Parameters:

<DciINPDSCH> integer

Range: 0 to 15
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N1" on page 420
See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:ISF <DciISF>

Sets the DCI feild resource assignment field (I_{SF}).

Parameters:

<DciISF> integer

Range: 0 to 7
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N1" on page 420
See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NREP?

Queries the number of repetitions of NPDSCH (N_{Rep}.)

Return values:

<NPdschRpt> integer

Range: 1 to 2048
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Repetitions of NPDSCH (N_{Rep})" on page 427

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPDSch:NSF?

queries the number of NPDSCH subframes (N_{SF}).

Return values:

<NoSubframes> integer

Range: 1 to 10
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Number of NPDSCH Subframes (N_{SF})" on page 427

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SCINd <SubcarrierInd>

Sets the DCI field subcarrier indication field of NPRACH (I_{SC}).

Parameters:

<SubcarrierInd> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPRach:SNUMber <StartingNumber>

Sets the DCI field starting number of NPRACH repetitions (I_{Rep}).

Parameters:

<StartingNumber> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NPUSch:IREP <DciINPUSCH>

Sets the DCI field number of NPUSCH repetition fields (I_{Rep}).

Parameters:

<DciINPUSCH> integer

Range: 0 to 7
*RST: 0

Example: See Example"DCI format N0 configuration" on page 943.

Manual operation: See "DCI Format N0" on page 417

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NRUNits?

Queries the number of resource units (N_{RU}).

Return values:

<NoResUnits> integer

Range: 1 to 10
*RST: 1

Example: See Example"DCI format N0 configuration" on page 943.

Usage: Query only

Manual operation: See "Number of Resource Units (N_{RU})" on page 426

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:NDINd <NewDataInd>

Sets the DCI field new data indicator.

Parameters:

<NewDataInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N0" on page 417
See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:HPNMber <HarqProcessNum>

Sets the HARQ processes number, for UEs for that `[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:STHP:STATe1`.

Parameters:

<HarqProcessNum> integer
Range: 0 to 1
*RST: 0

Example: See Example"DCI format N0 configuration" on page 943.

Options: R&S SMW-K143

Manual operation: See "DCI Format N0" on page 417
See "DCI Format N1" on page 420

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:PAG <Paging>

Sets the DCI field flag for paging/direct indication.

Parameters:

<Paging> 1 | ON | 0 | OFF

1
Paging

0
Direct indication

*RST: 0

Example: See Example"DCI format N2 configuration" on page 947.

Manual operation: See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:RVERsion <RedundancyVers>

Sets the DCI field redundancy version.

Parameters:

<RedundancyVers> integer
Range: 0 to 1
*RST: 0

Example: See Example"DCI format N0 configuration" on page 943.

Manual operation: See "DCI Format N0" on page 417

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SCINd <SubcarrierInd>

Sets teh DCI field subcarrier identification field of NPUSCH (I_{SC}).

Parameters:

<SubcarrierInd> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N0" on page 417

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SFRPt <SfRepetition>

Sets the DCI field repetitions of DCI subframes.

Parameters:

<SfRepetition> integer

Range: 0 to 7
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "DCI Format N0" on page 417
See "DCI Format N1" on page 420
See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SIME <SysInfModExt>

Sets the DCI field system info modification - extended discontinuous reception.

Parameters:

<SysInfModExt> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"DCI format N2 configuration" on page 947.

Manual operation: See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:SINF <SysInfMod>

Sets the DCI field system info modification.

Parameters:

<SysInfMod> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"DCI format N2 configuration" on page 947.

Manual operation: See "DCI Format N2" on page 424

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:TBSZ?

Queries the transport block size.

Return values:

<TransportBlockS> integer

Max transport block size depends on the installed options
Option:R&S SMW-K115: Max = 680
Option:R&S SMW-K143: Max = 2536

Range: 16 to max
*RST: 16

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "DCI Format N1" on page 420
See "Transport Block Size" on page 426

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:DCI:ALLoc<ch0>:DIST <DistNpdcchNpdsc>

Sets how the distance between the NPDCCH to NPDSCH is determined.

Parameters:

<DistNpdcchNpdsc> STD | MIN | ZERO

`ZERO` disables the NPDSCH SIB1-NR and NPUCCH transmissions. The NPDSCH is transmitted immediately after the NPDCCH.
Use this value to increase the number of NPDSCH allocations.

*RST: STD

Example:

```
SOURce1:BB:EUTRa:DL:NOIT:DCI:ALLoc0:FMT N1
SOURce1:BB:EUTRa:DL:NOIT:DCI:ALLoc0:DIST STD
```

Manual operation: See "Distance from NPDCCH to NPDSCH" on page 426

11.28.2.2 NB-IoT allocation

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:NALLoc?

Queries the number of NB-IoT allocations.

Return values:

<NbIoTNAlloc> integer

Range: 0 to 42
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Allocation number" on page 429

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONType?

Queries the channel type.

Return values:

<ContentType> NPBCh | NSIB | NPDCch | NPDSch

*RST: NPBCh

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Content Type" on page 429

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:MODulation?

Queries the used modulation scheme.

Return values:

<Modulation> QPSK

*RST: QPSK

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Modulation" on page 430

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SFList?

Queries the subframes in that the channel is allocated.

Return values:

<SubframeList> "<SF#>, <SF#>, <SF#>, <SF#>..."

String of four comma-separated integer values, indicating subframe numbers

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Suframe List" on page 430

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STSYmbol <StartSymbol>

Sets the first symbol in a subframe where NB-IoT channels can be allocated.

Parameters:

<StartSymbol> SYM0 | SYM1 | SYM2 | SYM3

*RST: SYM0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Start Symbol" on page 430

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PHYSbits?

Queries the used number of physical bits.

Return values:

<PhysicalBits> integer

Range: 0 to 320
*RST: 200

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Phys. Bits" on page 431
See "Number of Physical Bits" on page 435
See "Number of Physical Bits" on page 440

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:POWer <Power>

Sets the power of the selected allocation.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "ρ A" on page 432

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DATA <DataSource>

Queries the data source or sets the data source for NPDSCH allocations configured for P-RNTI or RA-RNTI.

Parameters:

<DataSource> USER1 | USER2 | USER3 | USER4 | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE | MIB | SIB1nb | PRNTi | RARNti

*RST: MIB

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Data Source" on page 431

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:DSELect <DataList>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DataList> string

Filename incl. file extension or complete file path

Example:

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA DLIS
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DSELect "/var/user/IoT.dm_iqd"
```

Manual operation: See "Data Source" on page 431

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:

```
SOURce1:BB:EUTRa:DL:NIOT:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:DATA PATT
SOURce1:BB:EUTRa:DL:NIOT:ALLoc3:PATTern #H735,12
```

Manual operation: See "Data Source" on page 431

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:STATe?

Queries the allocation state.

Return values:

<State>
1 | ON | 0 | OFF
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "State" on page 432

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CONFlict?

Queries if there is a conflict between allocations.

Return values:

<Conflict>
1 | ON | 0 | OFF
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Conflict" on page 432

11.28.2.3 NPBCH, NPDCCH, NPDSCH enhanced settings

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:SCHeme <PrecAntScheme>

Sets the precoding scheme.

Parameters:

<PrecAntScheme> NONE | TXD

*RST: NONE

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Precoding Scheme" on page 434
See "Precoding Scheme" on page 438

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:PRECoding:NOLayers?

Queries the number of layers for the selected allocation.

Return values:

<NoLayers> integer

Range: 1 to 2
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Number of Layers" on page 434
See "Number of Layers" on page 438

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:STATe <ScramblingState>

Enables scrambling.

Parameters:

<ScramblingState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Scrambling State" on page 438

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:SROT <SymbolRotation>

Enables NPBCH scrambling with symbol rotation.

Parameters:

<SymbolRotation> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Manual operation: See "NPBCH Symbol Rotation" on page 434

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:UEID?

Queries the user equipment identifier (n_RNTI) or UE ID of the user to which the NPDSCH transmission is intended.

Return values:

<UEIDnRNTI> integer

Range: 0 to 65535
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "UE ID/n_RNTI" on page 438

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:SCRambling:LEGacy:STATe <ScramState>

If disabled, scrambling according to LTE Rel. 14 is applied.

Parameters:

<ScramState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Options: R&S SMW-K143

Manual operation: See "Legacy Scrambling" on page 439

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:STATe <ChanCodState>

Enables channel coding.

Parameters:

<ChanCodState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Channel Coding State" on page 435
See "Channel Coding State" on page 439

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:ISF?

Queries the resource assignment field (I_{SF}).

Return values:
<RAssinField> integer

Range: 0 to 100
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Resource Assignment Field (I_{SF})" on page 440

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:NSF?

Queries the number of NPDSCH subframes (N_{SF}).

Return values:
<NumSF> integer

Range: 1 to 100
*RST: 1

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Usage: Query only

Manual operation: See "Number of NPDSCH Subframes (N_{SF})" on page 440

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSI <TBSindex>

Sets the transport block size index.

Parameters:
<TBSindex> integer

Range: 0 to 15
*RST: 0

Example: See Example"NPDCCH and NPDSCH DCI-based configuration (DCI format N1)" on page 945.

Manual operation: See "Transport Block Size Index (I_{TBS})" on page 440

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:ALLoc<ch0>:CCODing:TBSize?

Queries the size of the transport block/payload in bits.

Return values:
<TranBlckSize> integer

Range: 16 to 1500
*RST: 16

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Usage: Query only

Manual operation: See "Transport Block Size/Payload (DL)" on page 437
See "Transport Block Size/Payload (DL)" on page 440

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MIB <MibState>

Enables transmission of MIB data.

Parameters:

<MibState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Manual operation: See "MIB (including SFN)" on page 435

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:MSPare <MibSpareBits>

Sets the 11 spare bits in the NPBCH transmission.

Parameters:

<MibSpareBits> 11-bits

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Manual operation: See "MIB Spare Bits" on page 437

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:NCID?

Queries the NCell ID.

Return values:

<NCellId> integer

Range: 0 to 503

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Usage: Query only

Manual operation: See "NCell ID" on page 436

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:RSIB?

Queries the number of repetitions of the NDPSCH that carries SIB1-NB.

Return values:

<RepetitionSIB1> integer

Range: 0 to 16
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Usage: Query only

Manual operation: See "NPDSCH repetition carrying SIB1" on page 436

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SIB <SchedulingSIB1>

Sets the parameter scheduling info SIB1.

Parameters:

<SchedulingSIB1> integer

Range: 0 to 15
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Manual operation: See "Scheduling SIB1" on page 435

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:SOFFset <SfnOffset>

Sets the start SFN value.

Parameters:

<SfnOffset> float

Range: 0 to 1020
Increment: 4
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Manual operation: See "SFN Offset" on page 435

[:SOURce<hw>]:BB:EUTRa:DL:NIOT:CCODing:STFSib1?

Queries the first frame in that the NPDSCH transmission carrying SIB1-NB is allocated.

Return values:

<SIB1StartFrame> integer

Range: 0 to 11
*RST: 0

Example: See Example"NPBCH and SIB1-NB configuration" on page 948.

Usage: Query only

Manual operation: See "Starting Frame carrying SIB1" on page 436

11.28.2.4 NB-IoT user configuration

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:RELease <Release>

Sets the 3GPP release version the UE supports.

Parameters:

<Release> R89 | LADV | EM_A | NIOT | EM_B

*RST: R89 (in LTE/eMTC/NB-IoT mode)/
EM_A (in eMTC/NB-IoT mode)

`EM_A` = eMTC CE: A and `EM_B` = eMTC CE: B

Options: R89 requires R&S SMW-K55
LADV requires R&S SMW-K85
EM_A|NIOT|EM_B require R&S SMW-K115

Manual operation: See "3GPP Release" on page 141

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:RMAX <MaxRepNPDCCH>

Sets the maximum number NPDCCH is repeated R_{Max}.

Parameters:

<MaxRepNPDCCH> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R256 | R512 | R1024 | R2048

*RST: R1

Example: See Example"NB-IoT UE configuration" on page 943.

Manual operation: See "Max. Repetitions of NPDCCH (Rmax) (UE-specific search space)" on page 413

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:STSFrame <SearchSpStartSF>

Sets the serach space start subframe (G).

Parameters:

<SearchSpStartSF> S1_5 | S2 | S4 | S8 | S16 | S32 | S48 | S64

*RST: S4

Example: See Example"NB-IoT UE configuration" on page 943.

Manual operation: See "Search Space Start Subframe (G)" on page 414

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:NIOT:SSOFfset <SearchSpaceOffs>

Shifts the search space start.

Parameters:

<SearchSpaceOffs> O0 | O1_8 | O1_4 | O3_8

*RST: O0

Example: See Example"NB-IoT UE configuration" on page 943.

Manual operation: See "Search Space Offset (α_{offset})" on page 414

11.28.2.5 eMTC DCI configuration

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:NALLoc <DciNumberAlloc>

Sets the number of configurable DCIs.

Parameters:

<DciNumberAlloc> integer

Range: 0 to 400
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Number of DCI Allocations" on page 469

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:AWARound <AllocWrapAround>

If enabled, the PDSCH allocations are relocated at the beginning of the ARB sequence to ensure a consistent signal.

Parameters:

<AllocWrapAround> 1 | ON | 0 | OFF

*RST: 0

Example: `SOURce1:BB:EUTRa:DL:EMTC:DCI:AWARound 1`

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:USER <DciUser>

Selects the user the DCI is dedicated to.

Parameters:

<DciUser> USER1 | USER2 | USER3 | USER4 | PRNTi | RARNti

USER1|USER2|USER3|USER4
Available are only eMTC users (`[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:RELease EM_A|EM_B`).

PRNTi|RARNti
Selects a group of users.

*RST: USER1

Example: See Example"DCI format 6-2 configuration" on page 961.

Manual operation: See "User" on page 469

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEID?

Queries the UE_ID of the selected user or the n_RNTI for the selected DCI.

Return values:

<DciUeID> integer

Range: 0 to 65535
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "UE_ID/n_RNTI" on page 470

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MPDCchset <DciMpdcchSet>

Selects the MPDCCH set by which the DCI is carried.

Parameters:

<DciMpdcchSet> MPD1 | MPD2

*RST: MPD1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "MPDCCH Set" on page 470

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:FMT <DciFormat>

Sets the DCI format for the selected allocation.

Parameters:

<DciFormat> F3 | F3A | F60A | F60B | F61A | F61B | F62

*RST: F60A

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "DCI Format" on page 470

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SSP <DciSearchSpace>

Sets the search space for the selected DCI.

Parameters:

<DciSearchSpace> UE | T1CM | T2CM | T0CM

*RST: UE

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Search Space" on page 470

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STSFrame <DciStartSf>

Sets the next valid starting subframe for the particular MPDCCH.

Parameters:

<DciStartSf> integer

Range: 1 to 1E6

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Start Sufbrame" on page 478

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDCCh <DciPdcchFmt>

Selects one of the five MPDCCH formats

Parameters:

<DciPdcchFmt> 0 | 1 | 2 | 3 | 4 | 5

The available values depend on the search space.

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "MPDCCH Format" on page 479

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CCES?

Queries the number of consecutive control channel elements (ECCE) on that MPDCCH is transmitted.

Return values:

<DciNumCCEs> integer

Range: 1 to 24
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Number ECCEs" on page 479

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:IDCCe <DciCCEIndex>

For UE-specific search space, sets the ECCE start index.

Parameters:

<DciCCEIndex> integer

Range: 0 to 24
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "ECCE Index" on page 479

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:BITS?

Queries the resulting bit data as selected with the DCI format parameters.

Return values:

<DciBitData> string

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Bit Data" on page 471

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDCCes?

Queries the number of dummy ECCEs that are appended to the corresponding MPDCCH.

Return values:

<NoDummyCCEs> integer

Range: 0 to 1E5
*RST: 25

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "No. Dummy ECCEs" on page 479

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CONFlict?

Queries whether a conflict between allocations occurs.

Return values:

<Conflict> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc2:CONFlict?
// 0
```

Usage: Query only

Manual operation: See "Conflict" on page 479

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TBS?

Queries the resulting transport block size.

Return values:

<DciTranBlkSize> integer

Range: 0 to 2000
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Transport Block Size" on page 478

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPMpdcch?

Queries the resulting number of MPDCCH repetitions.

Return values:
<DciRepMPDCCH> integer
Range: 1 to 256
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Repetitions of MPDCCH" on page 478

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:REPPdsch?

Queries the resulting number of PDSCH repetitions.

Return values:
<DciRepPDSCH> integer
Range: 1 to 2048
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Repetitions of PDSCH" on page 478

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PDSHopping?

Queries if PDSCH hopping is enabled or not.

Return values:
<DciPDSCHHopping> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "PDSCH Hopping" on page 478

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:STRV?

Queries the starting redundancy version (RV).

Return values:

<DciStartingRV> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Starting Redundancy Version" on page 478

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TCMD <TpcCmd3>

Sets the TCP command field of the DCI format 3/3A.

Parameters:

<TpcCmd3> 64 bits

Example:

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F3
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:TCMD #H0,64
```

Manual operation: See "DCI Format 3/3A" on page 471

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PFRHopp <DciPuschFreqHop>

Sets the DCI format 6-0A and 6-1A filed frequency hopping flag that applies to PUSCH and PDSCH respectively.

Parameters:

<DciPuschFreqHop> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBAF?

If `[:SOURce<hw>]:BB:EUTRa:DL:BW` on page 716 `BW20_00` and `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:WBCFg` on page 965 `BW20` sets the DCI format 6-1A field resource block assignment index.

Return values:

<DciPuschRBAF> 1 | ON | 0 | OFF

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc1:RBAF 1
```

Usage: Query only

Options: R&S SMW-K143

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RBA <DciRBA>

Sets the DCI filed resource block assignment.

Parameters:

<DciRBA> integer

Range: 0 to depends on the installed options*
*RST: 0
max = 2047 (R&S SMW-K115)
max = 4095 (R&S SMW-K143)

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:MCS <DciMCS>

Sets the DCI field modulation and coding scheme.

Parameters:

<DciMCS> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NREP <DciRepNum>

Sets the DCI field repetition number.

Parameters:

<DciRepNum> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HARQ <DciHarqProcNum>

Sets the DCI field HARQ process number.

Parameters:

<DciHarqProcNum> integer

In FDD mode: 0 to 7
In TDD mode: 0 to 15

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:NDINd <DciNewDataInd>

Sets the DCI field new data indicator.

Parameters:

<DciNewDataInd> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:RVER <DciRedVersion>

Sets the DCI field redundancy version.

Parameters:

<DciRedVersion> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPCPusch <DciTpcCmdPusch>

Sets the DCI field TPC command for scheduled PUSCH.

Parameters:

<DciTpcCmdPusch> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:ULINdex <DciUlIndex>

In TDD mode and if UL/DL Configuration 0 is used, sets the DCI field UL index.

Parameters:

<DciUlIndex> integer

Range: 0 to 3
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:TDD:UDConf 0
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F60A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:ULINdex 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:DAINdex 1
```

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DAINdex <DLAssignIndex>

In TDD mode and if UL/DL Configuration 0 is used, sets the DCI field downlink assignment index (DAI).

Parameters:

<DLAssignIndex> integer

Range: 0 to 3
*RST: 0

Example: See `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:ULINdex` on page 1014.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:CSIRequest <DciCSIRequest>

Sets the DCI field CSI request.

Parameters:

<DciCSIRequest> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SRSRequest <DciSRSRequest>

Sets the DCI field SRS request.

Parameters:

<DciSRSRequest> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:SFRNumber <DciSfRepNumber>

If [:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:REPMpdcch ≥ 2, sets the DCI field DCI subframe repetition number.

Parameters:

<DciSfRepNumber> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:UEMode <UEMode>

Sets the DCI field mode and defines if the DCI format 6-1A/B is used for PDSCH or PRACH.

Parameters:

<UEMode> STD | PRACh

*RST: STD

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:HRESoffset <DciHarqResOffs>

Sets the DCI field HARQ-ACK ressource offset.

Parameters:

<DciHarqResOffs> integer

Range: 0 to 3
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:APSI <DciAPsSI>

For users working in transmission mode TM9 and if UE-specific search space is used, sets the DCI format 6-1A field antenna ports and scrambling identity.

Parameters:

<DciAPsSI> integer

Range: 0 to 3
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:USER1:TXM TM9
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:APSI 1
```

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PMIConfirm <DciPmiConfirm>

Sets the DCI field PMI confirmation for precoding.

Parameters:

<DciPmiConfirm> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:TPMPrec <DciTpmiPrec>

Sets the DCI field TPMI information for precoding.

Parameters:

<DciTpmiPrec> integer

Range: 0 to 15

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble <DciPrachPreambl>

Sets the DCI field preamble index.

Parameters:

<DciPrachPreambl> integer

Range: 0 to 63

*RST: 0

Example:

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:UEMode PRACh
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:RBA 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PRAPreamble 8
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PRAMask 5
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:PRAStart 1
```

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAMask <DciPrachMaskIdx>

Sets the DCI field PRACH mask index.

Parameters:

<DciPrachMaskIdx> integer

Range: 0 to 15
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble on page 1017.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAStart <DciPrachStartCe>

Sets the DCI field starting CE level.

Parameters:

<DciPrachStartCe> integer

Range: 0 to 3
*RST: 0

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PRAPreamble on page 1017.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:PAGNg <DciPaging>

Sets the DCI bit that defines if the DCI format 6-2 is used for paging or for direct indication.

Parameters:

<DciPaging> 1 | ON | 0 | OFF

*RST: 0

Firmware/software: See Example"DCI format 6-2 configuration" on page 961.

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:DCI:ALLoc<ch0>:DIInfo <DciDiInfo>

Sets the DCI field direct indication information.

Parameters:

<DciDiInfo> integer

Range: 0 to 255
*RST: 0

Example: SeeExample"DCI format 6-2 configuration" on page 961 .

11.28.2.6 eMTC allocations

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:NALLoc?

Queries the number of automatically configured allocations.

Return values:

<NoAlloc> integer

Range: 0 to 100
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONType?

Queries the channel type.

Return values:

<ContentType> MPD1 | MPD2 | PSIB | PDSCh | PBCH

*RST: PDSCh

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Content Type" on page 480

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:MODulation?

Queries the used modulation scheme.

Return values:

<Modulation> QAM16 | QPSK

*RST: QPSK

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Modulation" on page 481

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSFrame?

Queries the first subframe where the channel can be allocated.

Return values:

<StartSf> integer

Range: 0 to 39
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Start SF" on page 481

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:ABSFrames?

Queries the number of absolute subframes.

Return values:

<NumAbsSf> integer

Range: 0 to 39
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Num. Abs. SF" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STNB?

Queries the first narrowband where the channel can be allocated.

Return values:

<StartNarrowBand> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Start NB" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STSYmbol?

Queries the first symbol where the channel can be allocated.

Return values:

<StartSymbol> 1 | 2 | 3 | 4

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Start Symbol" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:NORB?

Queries the number of resource blocks the allocation spans.

Return values:

<NumberResBlk> integer

Range: 1 to 6
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "No. RB" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:OVRB?

Queries the start resource block of the selected allocation.

Return values:

<OffsetVRB> integer

Range: 0 to 5
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Offset VRB" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PHYSbits?

Queries the allocation size in bits.

Return values:

<PhysBits> integer

Range: 0 to 4032
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Phys. Bits" on page 482
See "Number of Physical Bits" on page 486
See "Number of Physical Bits" on page 492

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DATA <DataSource>

Queries the data source or sets the data source for the following allocations:

- PBCH if MIB is disabled
- PDSCH SIB1-BR allocation
- PDSCH allocations configured for P-RNTI or RA-RNTI.

Parameters:

<DataSource> USER1 | USER2 | USER3 | USER4 | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | PATTern | DLISt | ZERO | ONE | MIB | PRNTi | RARNti | SIBBr

*RST: MIB

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Data Source" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:DSELect <DataList>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DataList> string

Filename incl. file extension or complete file path

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DATA DLIS
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DSELect "/var/user/IoT.dm_iqd"
```

Manual operation: See "Data Source" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PATTern <Pattern>, <BitCount>

Sets a bit pattern as data source.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:
```
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER PRNT
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:DATA PATT
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PATTern #H735,12
```

Manual operation: See "Data Source" on page 482

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:POWer <Power>

Sets the power of the selected allocation.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.01
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "ρ A" on page 483

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:STATe?

Queries whether the allocation is activated.

Return values:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "State" on page 483

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CONFlict?

Queries if there is a conflict between the allocations.

Return values:

<Conflict> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Conflict" on page 483

11.28.2.7 PBCH and PDSCH enhanced settings

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCHeme <PrecMultAntSche>

Selects the precoding scheme.

Parameters:

<PrecMultAntSche> NONE | SPM | TXD | BF

*RST: NONE

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Precoding Scheme" on page 485
See "Precoding Scheme" on page 488

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CODWords?

Queries the number of the codewords.

Return values:

<CodeWord> CW11 | CW12

*RST: CW11

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme? on page 1026.

Usage: Query only

Manual operation: See "Codeword" on page 489

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:NOLayers?

Queries the number of layers for the selected allocation.

Return values:

<PrecLayCnt> integer

Range: 1 to 2
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Number of Layers" on page 485
See "Number of Layers" on page 489

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CCD <CycDelDiv>

Sets the cyclic delay diversity for the selected allocation.

Parameters:

<CycDelDiv> NOCDd | LADelay

*RST: NOCDd

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Cyclic Delay Diversity" on page 489

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:CBINdex <PrecCodeBookIdx>

Sets the codebook index.

Parameters:

<PrecCodeBookIdx> integer

Range: 0 to 15
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Codebook Index" on page 489

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme?

Queries the transmsission scheme.

Return values:

<TranScheme> TM9

*RST: TM9

Example:

```
// Transmission antennas and antenna port mapping
SOURce1:BB:EUTRa:DL:MIMO:CONFiguration TX2
SOURce1:BB:EUTRa:DL:MIMO:ANTenna ANT1

SOURce1:BB:EUTRa:STDMode IOT
SOURce1:BB:EUTRa:DL:USER4:RELease EM_A
SOURce1:BB:EUTRa:DL:USER4:UEC?
// M1
SOURce1:BB:EUTRa:DL:USER4:CELL0:TXM M9

SOURce1:BB:EUTRa:DL:EMTC:DCI:NALLoc 1
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:USER USER4
SOURce1:BB:EUTRa:DL:EMTC:DCI:ALLoc0:FMT F61A

SOURce1:BB:EUTRa:DL:EMTC:NALLoc?
// 4
// PDSCH allocation not carrying SIB-BR is the fourth allocation
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CONType?
// PDSC

SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:SCHeme?
// BF
// because User 1 uses Tx mode TM9
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:TRSCheme?
// TM9
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:CODWords?
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:NOLayers?
// 1
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:AP?
// AP7
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:SCID?
// 0
SOURce1:BB:EUTRa:DL:EMTC:ALLoc3:PRECoding:APM?
// FW
```

Usage: Query only

Manual operation: See "Transmission Scheme" on page 489

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP?

Queries the used antenna ports.

Return values:

<AntPorts> AP7 | AP5 | AP8 | AP78 | AP79 | AP710 | AP711 | AP712 | AP713 | AP714 | AP107 | AP108 | AP109 | AP110 | AP107108 | AP107109

*RST: AP7

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme? on page 1026.

Usage: Query only

Manual operation: See "Antenna Ports" on page 489

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:SCID?

Queries the scrambling identity.

Return values:

<ScramIdent> integer

Range: 0 to 1
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Scrambling Identity n_SCID" on page 490

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:APM?

Queries the antenna port mapping method.

Return values:

<AntPortMap> CB | RCB | FW

`CB` = codebook
`RCB` = random codebook
`FW` = fixed weights

*RST: CB

Example: See [:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:TRSCheme? on page 1026.

Usage: Query only

Manual operation: See "Antenna Port Mapping" on page 490

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:DAFormat <CoordMapMode>

Switches between the cartesian and cylindrical coordinates representation.

Parameters:

<CoordMapMode> CARTesian | CYLindrical

*RST: CARTesian

Manual operation: See "Mapping Coordinates" on page 490

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:REAL?

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Return values:

<DataReal> float

The `REAL` (Magnitude) and `IMAGinary` (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|`REAL`+j*`IMAGinary`| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 1
Increment: 0.001
*RST: 0

Usage: Query only

Manual operation: See "Mapping Table" on page 490

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:PRECoding:AP<dir0>:BB<st0>:IMAGinary?

Defines the mapping of the antenna ports to the physical antennas.

Suffix:

<dir0> 5 | 7 to 14
antenna port

<st0> 0 to 3
available basebands

Return values:
<DataImag> float

The REAL (Magnitude) and IMAGinary (Phase) values are interdependent. Their value ranges change depending on each other and so that the resulting complex value is as follows:
|REAL+j*IMAGinary| ≤ 1
Otherwise, the values are normalized to Magnitude = 1.

Range: -1 to 360
Increment: 0.001
*RST: 0

Usage: Query only

Manual operation: See "Mapping Table" on page 490

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:STATe <ScramState>

Enables scrambling.

Parameters:
<ScramState> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Scrambling State" on page 485
See "Scrambling State" on page 491

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:SCRambling:UEID?

Queries the user equipment identifier (n_RNTI) or UE ID of the user to which the PDSCH transmission is intended.

Return values:
<UEID> integer

Range: 0 to 65535
*RST: 0

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "UE ID/n_RNTI" on page 485
See "UE ID/n_RNTI" on page 491

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:STATe <ChanCodState>

Enables channel coding.

Parameters:
<ChanCodState> 1 | ON | 0 | OFF
*RST: 1

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Channel Coding State" on page 485
See "Channel Coding State" on page 491

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSize?

Queries the size of the transport block/payload in bits.

Return values:
<ChanCodTranBlck> integer
Range: 34 to 1E4
*RST: 16

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Usage: Query only

Manual operation: See "Transport Block Size/Payload (DL)" on page 487
See "Transport Block Size/Payload (DL)" on page 492

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:TBSI <ChanCodTBSIndex>

Queries the resulting transport block size index.

Parameters:
<ChanCodTBSIndex> integer
Range: 34 to 34
*RST: 34

Example: See Example"MPDCCH and PDSCH DCI-based configuration (DCI format 6-1A)" on page 957.

Manual operation: See "Transport Block Size I_{TBS}" on page 492

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MIB <ChanCodMibState>

Enables transmission of real MIB (master information block) data.

Parameters:
<ChanCodMibState> 1 | ON | 0 | OFF
*RST: 1

Example: See Example"PBCH and SIB1-BR configuration" on page 959.

Manual operation: See "MIB (including SFN)" on page 486

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SIB <SchedulingSIB1>

Sets the parameter `schedulingInfoSIB1-RB` and defines the PDSCH number of repetitions.

Query the resulting number of repetitions with the command `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:RSIB?`.

Parameters:

<SchedulingSIB1> integer

Range: 0 to 18
*RST: 0

Example: See Example"PBCH and SIB1-BR configuration" on page 959.

Manual operation: See "Scheduling Info SIB1-RB" on page 487

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:RSIB?

Queries the number of PDSCH repetitions N_{Rep}^{PDSCH}, as defined with the command `[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SIB`.

Return values:

<PDSCHRepSIB1> integer

Range: 0 to 11
*RST: 0

Example: See Example"PBCH and SIB1-BR configuration" on page 959.

Usage: Query only

Manual operation: See "PDSCH Repetitions SIB1-RB" on page 487

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:MSPare <MibSpareBits>

Sets the spare bits in the PBCH transmission.

Parameters:

<MibSpareBits> 5 bits

Example: See Example"PBCH and SIB1-BR configuration" on page 959.

Manual operation: See "MIB Spare Bits" on page 487

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SOFFset <ChanCodSfnOffse>

Sets the start SFN value.

Parameters:

<ChanCodSfnOffse> float

Range: 0 to 1020
Increment: 4
*RST: 0

Example: See Example"PBCH and SIB1-BR configuration" on page 959.

Manual operation: See "SFN Offset" on page 486

[:SOURce<hw>]:BB:EUTRa:DL:EMTC:ALLoc<ch0>:CCODing:SRPeriod <SfnRestPeriod>

Determines the time span after which the SFN (System Frame Number) restarts.

Parameters:

<SfnRestPeriod> PERSlength | PER3gpp

`PER3gpp` = "3GPP (1024 Frames)"
`PERSlength` = SFN restart period to the ARB sequence length

*RST: PERSlength

Example: See Example"PBCH and SIB1-BR configuration" on page 959.

Options: R&S SMW-K84

Manual operation: See "SFN Restart Period" on page 486

11.28.2.8 MPDCCH configuration

This section lists the MPDCCH-specific commands; for description of the commands common to EPDDCH and MPDCCH, see Chapter 11.22, "EPDCCH", on page 872.

Example: Configuring the MPDCCH sets

```
SOURce1:BB:EUTRa:DUPLexing FDD
SOURce1:BB:EUTRa:LINK DOWN
SOURce1:BB:EUTRa:STDMode IOT

// enable an eMTC UE, e.g. supporting eMTC CE Mode A
SOURce1:BB:EUTRa:DL:USER1:RELease EM_A

SOURce1:BB:EUTRa:DL:USER1:EPDCch1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET1:STATe 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch1:SET2:STATe 1

SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:TTYP LOC
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:PRBS PRB2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:RBA 2
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:NID 22
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:POWer 0
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:HOPPing 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STNB 1
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:REPMpdcch 16
SOURce1:BB:EUTRa:DL:USER1:EPDCch:CELL0:SET1:STSF S1

// MPDCCH allocations are configured automatically,
// depending on the eMTC DCI configuration
```

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:
HOPPing <Hopping>

Enables MPDCCH hopping.

Parameters:

<Hopping> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"Configuring the MPDCCH sets" on page 956.

Options: R&S SMW-K115

Manual operation: See "Hopping" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:
REPMpdcch <MaxRepMPDCCH>

Sets the maximum number the MPDCCH is repeated.

Parameters:

<MaxRepMPDCCH> 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256

*RST: 1

Example: See Example"Configuring the MPDCCH sets" on page 956.

Options: R&S SMW-K115

Manual operation: See "Max. Repetitions MPDCCH (Rmax)" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STNB <StartingNB>

Sets the first narrowbands in which MPDCCH is allocated.

Parameters:

<StartingNB> integer

Range: 0 to 15
*RST: 0

Example: See Example"Configuring the MPDCCH sets" on page 956.

Options: R&S SMW-K115

Manual operation: See "Starting NB" on page 160

[:SOURce<hw>]:BB:EUTRa:DL:USER<ch>:EPDCch:CELL<st0>:SET<dir>:STSF <SearchSpStartSf>

Sets the first subframe of the search space.

Parameters:

<SearchSpStartSf> S1 | S1_5 | S2 | S2_5 | S5 | S8 | S10 | S20 | S4

*RST: S1

Example: See Example"Configuring the MPDCCH sets" on page 956.

Options: R&S SMW-K115

Manual operation: See "Search Space Start Subframe" on page 161

11.28.3 General IoT uplink

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NNBands?

Queries the number of eMTC narrowbands N_{RB}^{UL} available within the selected channel bandwidth.

Return values:

<NumNarrowbands> integer

Range: 0 to 18
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Number of eMTC Narrowbands" on page 239

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:NWBands?

Queries the number of widebands.

Return values:

<NumWideBands> integer

Range: 0 to 4
*RST: 1

Example: See Example"eMTC widebands configuration" on page 955.

Usage: Query only

Options: R&S SMW-K143

Manual operation: See "Number of eMTC Widebands" on page 240

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:WBCFg <WBConfig>

If enabled, the available channel bandwidth is split into eMTC widebands.

Parameters:

<WBConfig> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"eMTC widebands configuration" on page 955.

Options: R&S SMW-K143

Manual operation: See "Wideband Config" on page 240

[:SOURce<hw>]:BB:EUTRa:UL:EMTC:RSYMbol <RetuningSymbol>

Sets the number of retuning symbols.

Parameters:

<RetuningSymbol> integer

Range: 0 to 2
*RST: 2

Example: See Example"eMTC widebands configuration" on page 955.

Options: R&S SMW-K143

Manual operation: See "Retuning Symbols" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:NIOT:SUBConfig <SfConfig>

Sets the number of subframes in the bitmap.

Parameters:

<SfConfig> N10 | N40

*RST: N10

Options: R&S SMW-K146

[:SOURce<hw>]:BB:EUTRa:UL:NIOT:VALid:SUBFrame<dir> <ValidSubframe>
[:SOURce<hw>]:BB:EUTRa:UL:EMTC:VALid:SUBFrame<dir> <ValidSubFrames>

Sets a subframe as valid and used for eMTC transmission.

Suffix:

<dir> 0 to 9
Subframe number

Parameters:

<ValidSubFrames> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Valid Subframes" on page 244

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOPping <NBHopping>

Enables narrowband hopping.

Parameters:

<NBHopping> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Narrowband Hopping" on page 495

[:SOURce<hw>]:BB:EUTRa:UL:PUSCh:NHOFfset <NBHoppingOffset>

Sets the narrowband hopping offset.

Parameters:

<NBHoppingOffset> integer

Range: 1 to 16
*RST: 3

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Hopping Offset" on page 495

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:GHOPping <GroupHopping>

Enables NDRS group hopping.

Parameters:

<GroupHopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Group Hopping" on page 444

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:DSEQshift <DeltaSeqShift>

Sets the delta sequence shift for NPUSCH required for the calculation of the NDRS group hopping pattern.

Parameters:

<DeltaSeqShift> integer

Range: 0 to 29
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Delta Sequence Shift for NPUSCH" on page 444

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTCShift <ThreeToneCycShi>

Sets the three tone cyclic shift.

Parameters:

<ThreeToneCycShi> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Three/Six-Tone Cyclic Shift" on page 444

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STCShift <SixToneCycShift>

Sets the six tone cyclic shift.

Parameters:

<SixToneCycShift> integer

Range: 0 to 3
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Three/Six-Tone Cyclic Shift" on page 444

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:USEBase <UseBaseSequence>

Enables using base sequences for the generation of the NB-IoT DMRS sequence hopping pattern.

Parameters:

<UseBaseSequence> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Use Base Sequences" on page 444

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TTBSequence <ThreeToneBaseSq>

Sets the three tone base sequence.

Parameters:

<ThreeToneBaseSq> integer

Range: 0 to 12
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Three/Six/Twelve-Tone Base Sequence" on page 445

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:STBSequence <SixToneBaseSeq>

Sets the six tone base sequence.

Parameters:

<SixToneBaseSeq> integer

Range: 0 to 14
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Three/Six/Twelve-Tone Base Sequence" on page 445

[:SOURce<hw>]:BB:EUTRa:UL:REFSig:DRS:TWBSequence <TwelfeToneBaseS>

Sets the 12 tone base sequence.

Parameters:

<TwelfeToneBaseS> integer

Range: 0 to 30
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Three/Six/Twelve-Tone Base Sequence" on page 445

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:PFMT <PreambleFormat>

Select the preamble format.

Parameters:

<PreambleFormat> F0 | F1 | 0 | 1 | F2 | F0A | F1A

`0|1` backward compatibility; use `F0|F1` instead.

*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Options: 2|0A|1A require R&S SMW-K146

Manual operation: See "Preamble Format" on page 459

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:PERD <Periodicity>

Sets NPRACH periodicity.

Parameters:

<Periodicity> 40 | 80 | 160 | 240 | 320 | 640 | 1280 | 2560 | 5120 | 10240

*RST: 40

Example: See Example"NPRACH configuration" on page 953.

Options: 5120|10240 require R&S SMW-K146

Manual operation: See "Periodicity, ms" on page 459

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:STTM <StartTime>

Sets the start time of the specific NPRACH configuration.

Parameters:

<StartTime> 8 | 16 | 64 | 128 | 32 | 256 | 512 | 1024 | 10 | 20 | 40 | 80 | 160 | 320 | 640 | 1280 | 2560 | 5120

*RST: 8

Example: See Example"NPRACH configuration" on page 953.

Options: 10|20|40|80|160|320|640|1280|2560|5120 require R&S SMW-K146

Manual operation: See "Starting Time, ms" on page 459

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:REP <Repetitions>

Queries the number of NPRACH repetitions per preamble attempt.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R192 | R256 | R384 | R512 | R768 | R1024 | R1536 | R2048 | R12 | R24

*RST: R1

Example: See Example"NPRACH configuration" on page 953.

Options: R192|R256|R384|R512|R768|R1024|R1536|R2048|R12|R24 require R&S SMW-K146

Manual operation: See "Number of Repetitions" on page 460

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SUBC <Subcarriers>

Sets the number of NPRACH subcarriers.

Parameters:

<Subcarriers> 12 | 24 | 36 | 48

*RST: 12

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Number of Subcarriers" on page 460

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:NIOT:CFG<ch0>:SCOF <SubcarrierOffse>

Sets the NPRACH subcarrier offset.

Parameters:

<SubcarrierOffse> 0 | 2 | 12 | 18 | 24 | 34 | 36 | 6 | 42 | 48 | 54 | 60 | 72 | 78 | 84 | 90 | 102 | 108

*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Options: 6|42|48|54|60|72|78|84|90|102|108 require R&S SMW-K146

Manual operation: See "Subcarrier Offset" on page 460

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:RSET <RestrictedSet>

Enables using the restricted set.

Parameters:

<RestrictedSet> URES | ARES | BRES | OFF | ON

URES|OFF
Unrestricted preamble set.

ARES|ON
Restricted set type A.

BRES
Restricted set type B.

*RST: URES

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Restricted Set" on page 514

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:HOFF <HoppingOffset>

Sets a PRACH hopping offset as number of resource blocks (RB).

Parameters:

<HoppingOffset> integer

Range: 1 to 110
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Hopping Offset" on page 514

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:CONFig <Config>

Selects the PRACH configuration index.

Parameters:

<Config> integer

Range: 0 to 63
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "PRACH Configuration" on page 514

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:HOPPing <Hopping>

Enables frequency hopping.

Parameters:

<Hopping> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Hopping" on page 515

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:REPetit <Repetitions>

Sets the PRACH number of repetitions.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128

*RST: R1

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Number of Repetitions" on page 515

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:FOFFset <FrequencyOffset>

Sets a frequency offset in terms of resource blocks.

Parameters:

<FrequencyOffset> integer

Range: 0 to 94

*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Freq. Offsets" on page 515

[:SOURce<hw>]:BB:EUTRa:UL:PRACh:EMTC:CELV<ch0>:SSFPeriod <StartSfPeriod>

Sets the starting subframe periodicity.

Parameters:

<StartSfPeriod> NONE | 4 | 2 | 8 | 16 | 32 | 64 | 128 | 256

*RST: NONE

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Starting SF Periodicity" on page 515

11.28.4 IoT UE configuration

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:GHDisable <NbiotDisGH>

Disables NDRS group hopping for the selected UE.

Parameters:

<NbiotDisGH> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Disable Group Hopping" on page 445

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:SCSPacing <SubcarrSpacing>

Sets the subcarrier spacing.

Parameters:

<SubcarrSpacing> S15 | S375

*RST: S15

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Subcarrier Spacing" on page 449

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:RBINdex <ResBlkIndex>

Sets the resource block number in that the NB-IoT transmissions are allocated.

Parameters:

<ResBlkIndex> integer

Range: Depends on other values
*RST: 20

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Resource Block Index" on page 449

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:DFReq <DeltaFreq>

Sets the frequency offset between the NB-IoT carrier and the LTE center frequency.

Parameters:

<DeltaFreq> float

Range: -1E7 to 1E7
Increment: 1000
Default unit: MHz

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Delta Frequency to DC, MHz" on page 449

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:MODE <Mode>

Selects the operating mode.

Parameters:

<Mode> INBD | ALON | GBD

*RST: INBD

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Mode" on page 450

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NTRansmiss <NumTransmission>

Sets the number of NPUSCH transmissions.

Parameters:

<NumTransmission> integer

Range: 1 to 20
*RST: 1

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Number of Transmissions" on page 450

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:FORMat <Format>

Sets the NPUSCH transmission format.

Parameters:

<Format> F1 | F2

*RST: F1

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "NPUSCH Format" on page 450

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:MODulation <Modulation>

Sets the modulation scheme for the NPUSCH transmission.

Parameters:

<Modulation> QPSK | PI2Bpsk | PI4Qpsk | QAM16

*RST: PI2Bpsk

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Modulation" on page 450

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSFrame <StartSubframe>

Sets the NPUSCH starting subframe.

Parameters:

<StartSubframe> integer

Range: 0 to 10000
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Starting Subframe (SF)" on page 450

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:REPetitions <Repetitions>

Sets the number of repetitions.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128

*RST: R1

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Repetitions" on page 451

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NRUNits <ResourceUnits>

Sets the number of allocated resource units.

Parameters:

<ResourceUnits> RU1 | RU2 | RU3 | RU4 | RU5 | RU6 | RU8 | RU10

*RST: RU1

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Number of Resource Units N_{RU}" on page 451

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:SIRF <SCarrIndAckNack>

Sets the subcarrier indication field.

Parameters:

<SCarrIndAckNack> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Subcarrier Indication or ACK/NACK Resource Field" on page 451

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSCarriers?

Queries the allocated number of subcarriers.

Return values:
<NumSubcarriers> integer

Range: 0 to 63
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Number of Subcarriers" on page 452

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:NSLTs?

Queries the allocated number of slots per RU.

Return values:
<NumSlots> integer

Range: 1 to 16
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Slots" on page 452

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSCarrier?

Queries the starting subcarrier.

Return values:
<NbiotStartSc> integer

Range: 0 to 1000
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Starting Subcarrier" on page 452

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:STSLot?

Queries the starting slot.

Return values:

<StartSlot> integer

Range: 0 to 2E5
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Starting Slot" on page 451

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:POWer <Power>

Sets the power of the NPUSCH transmission.

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Power, dB" on page 453

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:ARB:SUGGested?

Queries the ARB sequence length that is required for the selected NPUSCH transmissions.

Return values:

<NbiotSuggSeqLen> integer

Range: 0 to 1E4
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Suggested" on page 453

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:NPSSim <NPuschAllSymb>

Enables simultaneous transmission of NPUSCH and SRS.

Parameters:

<NPuschAllSymb> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "NPUSCH + SRS simultaneous Tx" on page 274

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:BITS?

Queries the number of used ACK/NACK bits.

NPUSCH format F2 uses 1 ACK/NACK bit.

Return values:

<NbiotAnBits> integer

Range: 1 to 1
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Number of A/N Bits" on page 456

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:CBITs?

Queries the number of coded bits.

NPUSCH format F2 uses 16 coded bits.

Return values:

<NbiotCodANBits> integer

Range: 16 to 16
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Number of Coded A/N Bits" on page 456

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:PATTern <NbiotANPat>, <BitCount>

Set the ACK/ANCK pattern.

Parameters:

<NbiotANPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 1
*RST: 1

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "ACK/NACK Pattern" on page 456

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:HARQ:SR <NbSchedulingReq>

If enabled, the SR symbols are block-wise multiplied with the C_{SR} sequence.

Parameters:

<NbSchedulingReq> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Options: R&S SMW-K146

Manual operation: See "Scheduling Request (SR) Support" on page 456

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ESUPport <EdtSupport>

Enables or disables early data transmission.

Parameters:

<EdtSupport> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951

Options: R&S SMW-K146

Manual operation: See "Early Data Transmission (EDT) Support" on page 455

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETBS <EdtTbs>

Sets the maximum transport block size for early data transmission in UL.

Parameters:

<EdtTbs> 88 | 328 | 408 | 504 | 584 | 680 | 808 | 936 | 1000
*RST: 88
Default unit: bit

Example: See Example"NPUSCH and NDRS configuration" on page 951

Options: R&S SMW-K146

Manual operation: See "EDT-TBS" on page 455

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:ETRSize <EdtTranBlckSize>

Specifies the used transport block size for early data transmission in UL.

Parameters:

<EdtTranBlckSize> 88 | 328 | 408 | 456 | 504 | 536 | 584 | 680 | 712 | 776 | 808 | 936 | 1000

*RST: 88
Default unit: bit

Example: See Example"NPUSCH and NDRS configuration" on page 951

Options: R&S SMW-K146

Manual operation: See "EDT-TBS" on page 455

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:PHYSbits?

Queries the number of physical bits of the selected NPUSCH transmission.

Return values:

<NBiotPhysBits> integer

Range: 1 to 1E5
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Total Number of Physical Bits" on page 454

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RUINdex?

Queries the resource unit (RU) field index.

Return values:

<NbiotRuFInd> integer

Range: 1 to 16
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Resource Unit Field Index I_{RU}" on page 454

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:RVINdex <NbiotRVIdx>

Sets the starting redundancy version index.

Parameters:

<NbiotRVIdx> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Starting Redundancy Version Idex (rv_ix)" on page 455

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBINdex <NbiotTBSizeIdx>

Sets the transport block size index.

Parameters:

<NbiotTBSizeIdx> integer

Range: 0 to 12
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Manual operation: See "Transport Block Size Index I_{TBS}" on page 455

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:TRANs<ch>:PUSCh:TBSize?

Queries the transport block size.

Return values:

<NbiotTBSize> integer

Max transport block size depends on the installed options
Option:R&S SMW-K115: Max = 1000
Option:R&S SMW-K143: Max = 2536

Range: 16 to max
*RST: 0

Example: See Example"NPUSCH and NDRS configuration" on page 951.

Usage: Query only

Manual operation: See "Transport Block Size/Payload" on page 456

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TYPE <FrcID>

Selects the FRC.

Parameters:

<FrcID> A141 | A142 | A143 | A151 | A144 | A152 | A161 | A162 | A163 | A164 | A165 | A241 | A242 | A243 | A244 | A245 | A246 | A247

*RST: A141

Example: See Example"Using FRC" on page 953.

Manual operation: See "FRC" on page 441

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:STATe <State>

Enables the FRC.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Using FRC" on page 953.

Manual operation: See "FRC State" on page 441

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:ALResunits?

Queries the number of allocated resource units.

Return values:

<AllocResUnits> integer

Range: 1 to 2

*RST: 2

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Allocated Resource Units" on page 443

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:BPResunit?

Queries the number of bits per resource unit.

Return values:

<BitsPerResUnit> integer

Range: 96 to 288

*RST: 96

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Total Number of Bits per Resource Unit" on page 443

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:MODulation?

Queries the modulation scheme.

Return values:

<Modulation> QPSK | PI2Bpsk | PI4Qpsk

*RST: PI2Bpsk

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Modulation" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NNPRep <NoNPUSCHRep>

Queries the number of NPUSCH repetitions.

Parameters:

<NoNPUSCHRep> 1 | 2 | 16 | 64
*RST: 1

Example: See Example"Using FRC" on page 953.

Manual operation: See "Number of NPUSCH Repetitions" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NOSCarriers?

Queries the number of allocated subcarriers.

Return values:

<NoSubCarriers> integer
Range: 1 to 12
*RST: 1

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Number of Allocated Subcarriers" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:PASize?

Queries the payload size.

Return values:

<PayloadSize> integer
Range: 32 to 136
*RST: 32

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Payload Size" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:SCSPacing?

Queries the subcarrier spacing.

Return values:

<SubCarrSpacing> S15 | S375
*RST: S15

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Subcarriers Spacing" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TBSSindex?

Queries the transport block size index.

Return values:

<TBSSizeIndex> integer

Range: 0 to 9
*RST: 0

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Transport Block Size Index I_{TBS}" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:MOD <Mode>

Selects the operating mode.

Parameters:

<Mode> INBD | ALON | GBD

*RST: INBD

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Mode" on page 460

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:PRATtempts <PreambleAttempt>

Sets the number of preamble attempts.

Parameters:

<PreambleAttempt> integer

Range: 0 to 30
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Number of Preamble Attempts" on page 461

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:RBID <RbIndex>

Sets the resource block in that the NPRACH is allocated.

Parameters:

<RbIndex> integer

Range: 0 to 100
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Resource Block Index" on page 460

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:DFReq <DeltaFreq>

Sets the frequency offset between the NB-IoT carrier and the LTE center frequency.

Parameters:

<DeltaFreq> float

Range: -1E7 to 1E7
Increment: 1000
Default unit: MHz

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Delta Frequency to DC, MHz" on page 461

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:CONFig <Configuration>

Selects the NPRACH configuration.

Parameters:

<Configuration> integer

Range: 0 to 2
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "NPRACH Configuration" on page 461

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:SFSTart <StartingSf>

Sets the starting subframe.

Parameters:

<StartingSf> integer

Range: 0 to 1E4
*RST: 8

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Starting Subframe" on page 461

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:INIT <Ninit>

Sets the subcarrier index.

Parameters:

<Ninit> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "n_{int}" on page 462

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:STRT?

Queries the value n_{start}.

Return values:

<Nstart> integer

Range: 0 to 47
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Usage: Query only

Manual operation: See "n_{start}" on page 462

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:NIOT:POWer <Power>

Sets the preamble attempt power relative to the UE power.

Parameters:

<Power> float

Range: -80.000 to 10.000
Increment: 0.001
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Manual operation: See "Power" on page 462

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:NIOT:ARB:SUGGested?

Queries the ARB sequence length that is required for the selected NPRACH transmissions.

Return values:

<PracNbiotSugg> integer

Range: 0 to 1E4
*RST: 0

Example: See Example"NPRACH configuration" on page 953.

Usage: Query only

Manual operation: See "ARB Sequece Length > Sugested" on page 462

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TYPE <FrcID>

Selects the FRC.

Parameters:

<FrcID> A141 | A142 | A143 | A151 | A144 | A152 | A161 | A162 | A163 | A164 | A165 | A241 | A242 | A243 | A244 | A245 | A246 | A247

*RST: A141

Example: See Example"Using FRC" on page 953.

Manual operation: See "FRC" on page 441

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:STATe <State>

Enables the FRC.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Using FRC" on page 953.

Manual operation: See "FRC State" on page 441

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:ALResunits?

Queries the number of allocated resource units.

Return values:

<AllocResUnits> integer

Range: 1 to 2
*RST: 2

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Allocated Resource Units" on page 443

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:MODulation?

Queries the modulation scheme.

Return values:

<Modulation> QPSK | PI2Bpsk | PI4Qpsk

*RST: PI2Bpsk

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Modulation" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:PASize?

Queries the payload size.

Return values:

<PayloadSize> integer

Range: 32 to 136
*RST: 32

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Payload Size" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:TBSSindex?

Queries the transport block size index.

Return values:

<TBSSizeIndex> integer

Range: 0 to 9
*RST: 0

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Transport Block Size Index I_{TBS}" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:SCSPacing?

Queries the subcarrier spacing.

Return values:

<SubCarrSpacing> S15 | S375

*RST: S15

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Subcarriers Spacing" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:PASize?

Queries the payload size.

Return values:

<PayloadSize> integer

Range: 32 to 136
*RST: 32

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Payload Size" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NOSCarriers?

Queries the number of allocated subcarriers.

Return values:

<NoSubCarriers> integer

Range: 1 to 12
*RST: 1

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Number of Allocated Subcarriers" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:NNPRep <NoNPUSCHRep>

Queries the number of NPUSCH repetitions.

Parameters:

<NoNPUSCHRep> 1 | 2 | 16 | 64

*RST: 1

Example: See Example"Using FRC" on page 953.

Manual operation: See "Number of NPUSCH Repetitions" on page 442

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:NIOT:FRC:BPResunit?

Queries the number of bits per resource unit.

Return values:

<BitsPerResUnit> integer

Range: 96 to 288
*RST: 96

Example: See Example"Using FRC" on page 953.

Usage: Query only

Manual operation: See "Total Number of Bits per Resource Unit" on page 443

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:CELevel <CeLevel>

Set the coverage extension level (CE).

Parameters:

<CeLevel> CE01 | CE23

*RST: CE01

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "CE Level" on page 496

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:HOPP <HoppingInterval>

Sets the narrowband hopping interval.

Parameters:

<HoppingInterval> H1 | H2 | H4 | H5 | H8 | H10 | H16 | H20 | H40

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Narrowband Hopping Interval" on page 497

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:NTRansmiss <NumTransmission>

Sets the number of PUSCH and PUCCH eMTC transmission for the selected UE.

Parameters:

<NumTransmission> integer

Range: 1 to 20

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Number of Transmissions" on page 497

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CONTent <ContentType>

Sets the channel type.

Parameters:

<ContentType> PUSCh | PUCCh

*RST: PUSCh

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Content" on page 497

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:MODulation <Modulation>

Sets the modulation scheme of the PUSCH transmission.

Parameters:

<Modulation> QPSK | QAM16 | QAM64

*RST: QPSK

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Modulation/Format" on page 497

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:FORMat <Format>

Sets the PUCCH format.

Parameters:

<Format> F1 | F1A | F1B | F2 | F2A | F2B

*RST: F1

Example: See Example"eMTC PUCCH configuration" on page 963.

Manual operation: See "Modulation/Format" on page 497
See "Format" on page 510

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STSFrame <StartSubframe>

Sets the subframe number in that the PUSCH/PUCCH allocation is scheduled for the first time.

Parameters:

<StartSubframe> integer

Range: 0 to 10000
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Start Subframe" on page 498

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ASFRrame?

Queries the number of absolute subframes.

Return values:

<NumAbsSubframe> integer

Range: 1 to 10000
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "No. Absolute Subframes" on page 499

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:REPetitions <Repetitions>

Sets the number of repetitions.

Parameters:

<Repetitions> R1 | R2 | R4 | R8 | R16 | R32 | R64 | R128 | R192 | R256 | R384 | R512 | R768 | R1024 | R1536 | R2048 | R12 | R24

*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Repetitions" on page 498

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STNBand <StartNarrowBand>

Sets the start NB of the PSUCH/PUCCH transmission.

Parameters:

<StartNarrowBand> integer

Range: 0 to number of available narrowbands
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Start Narrowband" on page 499

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NRBLocks <NumberResBlocks>

Sets the number of used resource blocks (RB) within one narrowband.

Parameters:

<NumberResBlocks> integer

Range: 1 to 6
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "No. RB" on page 499

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:RBOFfset <ResBlockOffset>

For allocations that span less than 6 RB, this parameter shifts the allocated RBs within the NB.

Parameters:

<ResBlockOffset> integer

Range: 0 to 5
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Offset VRB" on page 500

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:STWBand <StartWideBand>

Sets the first wideband used for the PSUCH/PUCCH transmission.

Parameters:

<StartWideBand> integer

*RST: 1

Example: See Example"eMTC widebands configuration" on page 955.

Options: R&S SMW-K143

Manual operation: See "Start Wideband" on page 500

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WBRBoffset <WideBandRBOffs>

Shifts the selected number of resource blocks within the wideband.

Parameters:

<WideBandRBOffs> OS0 | OS3 | OS6 | OS9 | OS12 | OS15 | OS18 | OS21

Example: See Example"eMTC widebands configuration" on page 955.

Options: R&S SMW-K143

Manual operation: See "Offset VRB" on page 500

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:WRBLocks <NumberRBWB>

Sets the number of used resource blocks (RB) within one wideband.

Parameters:

<NumberRBWB> CN3 | CN6 | CN9 | CN12 | CN15 | CN18 | CN21 | CN24

*RST: CN3

Example: See Example"eMTC widebands configuration" on page 955.

Options: R&S SMW-K143

Manual operation: See "No. RB" on page 500

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:POWer <Power>

Sets the power of the eMTC PUSCH and PUCCH transmission

Parameters:

<Power> float

Range: -80 to 10
Increment: 0.001
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Power, dB" on page 500

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:ARB:SUGGested?

Queries the ARB sequence length that is required for the selected PUSCH transmissions.

Return values:

<Suggested> integer

Range: 0 to 10000
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Suggested" on page 453

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:DRS:CYCShift?

Sets the cyclic shift field.

Return values:

<Cyclicshift> integer

Range: 0 to 7
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Cyclic Shift Filed" on page 502

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NDMRs?

Queries the parameter n(2)_DMRS,λ (Layer λ).

Return values:

<Ndmrs> integer

Range: 0 to 10
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "n(2)_DMRS,0 (Layer 0)" on page 502

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:BITS <NumCQIBits>

Sets the number of CQI bits before channel coding.

Parameters:

<NumCQIBits> integer

Range: 0 to 1024
*RST: 10

Example: See Example"eMTC PUCCH configuration" on page 963.

Manual operation: See "Number of CQI Bits" on page 504

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:PATTern <EmtcCqiPat>, <BitCount>

Sets the CQI pattern for the PUSCH.

The length of the pattern is determined by the number of CQI bits as set with the command `[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:BITS`.

Parameters:

<EmtcCqiPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 1024
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "CQI Pattern" on page 504

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUSCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<NumCodedCQIBits> integer

Range: 0 to 1E5
*RST: 20

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 504

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:MODE <Mode>

Sets the ACK/NACK mode.

Parameters:

<Mode> MUX

*RST: MUX

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "ACK/NACK Mode" on page 503

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:ULSCh:BITS?

Queries the number of physical bits used for UL-SCH transmission.

Return values:

<PhysBitULSCH> integer

Range: 0 to 1E5
*RST: 1500

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Number of Coded UL-SCH Bits" on page 505

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:TBSize <TranspBlockSize>

Sets the size of the transport block.

Parameters:

<TranspBlockSize> integer

Range: 1 to 1E5
*RST: 16

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Transport Block Size/Payload" on page 505

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NAPused?

Queries the number of antenna ports used for transmissions of the selected PUCCH format.

Return values:

<NumAntennaPorts> integer

Range: 1 to 1
*RST: 1

Example: See Example"eMTC PUCCH configuration" on page 963.

Usage: Query only

Manual operation: See "Number of Used Antenna Port" on page 510

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:NPUCch <NPucchAP100>

Sets the PUCCH resource index.

Parameters:
<NPucchAP100> integer

Range: 0 to 65535
*RST: 0

Example: See Example"eMTC PUCCH configuration" on page 963.

Manual operation: See "n_PUCCH Antenna Port 100" on page 511

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:BITS <Bits>

Sets the number of ACK/NACK bits.

Parameters:
<Bits> integer

Range: 0 to 20
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Number of A/N Bits" on page 503

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:CBITs?

Queries the number of coded ACK/NACK bits.

Return values:
<Codedbits> integer

Range: 0 to 1E5
*RST: 20

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Number of Coded A/N Bits" on page 504

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:HARQ:PATTern <EmtcAckNackPat>, <BitCount>

Sets the ACK/NACK pattern for the PUSCH.

Parameters:
<EmtcAckNackPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "ACK/NACK Pattern" on page 503

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PHYSbits?

Queries the number of physical bits of the selected PUSCH transmission.

Return values:

<PuscPhysBits> integer

Range: 1 to 1E5
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Usage: Query only

Manual operation: See "Total Number of Physical Bits" on page 505

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:CCODing:RVINdex <RedundVersIndex>

Sets the redundancy version index.

Parameters:

<RedundVersIndex> integer

Range: 0 to 3
*RST: 0

Example: See Example"eMTC PUSCH configuration" on page 962.

Manual operation: See "Starting Redundancy Version Index (rv_idx)" on page 505

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:HARQ:PATTern <EmtcAckNackPat>, <BitCount>

Sets the PUCCH ACK/NACK pattern.

Parameters:

<EmtcAckNackPat> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"eMTC PUCCH configuration" on page 963.

Manual operation: See "A/N Pattern" on page 511

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:BITS <NumCQIBits>

Sets the number of CQI bits before channel coding.

Parameters:

<NumCQIBits> integer

Range: 0 to 1024
*RST: 10

Example: See Example"eMTC PUCCH configuration" on page 963.

Manual operation: See "Number of CQI Bits" on page 511

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:PATTern <Pattern>, <BitCount>

Sets the CQI pattern for the PUCCH.

Parameters:

<Pattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 13
*RST: 1

Example: See Example"eMTC PUCCH configuration" on page 963.

Manual operation: See "CQI Pattern" on page 511

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:EMTC:TRANs<ch>:PUCCh:CQI:CBITs?

Queries the number of coded CQI bits.

Return values:

<NumCodedCQIBits> integer

Range: 0 to 1E5
*RST: 20

Example: See Example"eMTC PUCCH configuration" on page 963.

Usage: Query only

Manual operation: See "Number of Coded CQI Bits" on page 512

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:PRATtempts <PreambleAttempt>

Sets the number of preamble attempts.

Parameters:

<PreambleAttempt> integer

Range: 0 to 40
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Number of Preamble Attempts" on page 515

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:CELV <CeLevel>

Sets the CE level.

Parameters:

<CeLevel> integer

Range: 0 to 3
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "CE Level" on page 516

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SFSTart <StartingSf>

Sets the starting subframe.

Parameters:

<StartingSf> integer

Range: 0 to 1E5
*RST: 1

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Starting Subframe" on page 516

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:FRINdex <FreqResIndex>

For "Duplexing > TDD", sets the frequency resource index.

Parameters:

<FreqResIndex> integer

Range: 0 to 1E5
*RST: 0

Example:

```
SOURce1:BB:EUTRa:DUPLexing TDD
SOURce1:BB:EUTRa:UL:UE2:PRACh:ATT0:EMTC:FRINdex 10
```

Manual operation: See "Frequency Resource Index" on page 516

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:NCSConf <NcsConfig>

Selects the Ncs configuration.

Parameters:

<NcsConfig> integer

For detail on the value range, see Table 6-50.

Range: 0 to 15
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Ncs Configuration" on page 516

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:RSEQuence <RootSequence>

Sets the logical root sequence index.

Parameters:

<RootSequence> integer

Range: 0 to 838
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Logical Root Sequence Index" on page 517

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:SINDex <SequenceIndex>

Sets the sequence index **v**.

Parameters:

<SequenceIndex> integer

Range: 0 to 63
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Sequence Index (v)" on page 517

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:DT <DeltaTime>

Sets the parameter Delta_t in us.

Parameters:

<DeltaTime> float

Range: -500 to 500
Increment: 0.01
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Delta t /us" on page 517

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:ATT<ch0>:EMTC:POWer <Power>

Sets the preamble attempt power relative to the UE power.

Parameters:

<Power> float

Range: -80.000 to 10.000
Increment: 0.001
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Manual operation: See "Power, dB" on page 517

[:SOURce<hw>]:BB:EUTRa:UL:UE<st>:PRACh:EMTC:ARB:SUGGested?

Queries the ARB sequence length that is required for the PRACH configuration.

Return values:

<Suggested> integer

Range: 0 to 10000
*RST: 0

Example: See Example"eMTC PRACH configuration" on page 964.

Usage: Query only

Manual operation: See "ARB Sequece Length > Sugested" on page 517

11.29 Test case wizard remote-control commands

The signal generator gives you the opportunity to generate predefined settings which enable tests on base stations in conformance with the 3G standard EUTRA/LTE. It offers a selection of predefined settings according to Test Cases in TS 36.141. The settings take effect only after execution of command `[:SOURce<hw>]:BB:EUTRa:TCW:APPLysettings`.

[:SOURce<hw>]:BB:EUTRa:TCW:APPLysettings

Activates the current settings of the test case wizard.

Note: The settings of the selected test case become active only after executing this command.

Usage: Event

Manual operation: See "Apply Settings" on page 551

[:SOURce<hw>]:BB:EUTRa:TCW:AWGN:PLEVel?

Queries the AWGN power level.

Return values:

<PowerLevel> string

Usage: Query only

Manual operation: See "Power Level" on page 571
See "Power Level" on page 592

[:SOURce<hw>]:BB:EUTRa:TCW:CS:DIP <DIPSet>

Selects the dominant interferer proportion (DIP) set.

Parameters:

<DIPSet> SET1 | SET2
*RST: SET2

Example: `SOURce1:BB:EUTRa:TCW:CS:DIP SET2`

Options: R&S SMW-K119

Manual operation: See "DIP" on page 551

[:SOURce<hw>]:BB:EUTRa:TCW:CS:RPOW?

Selects the power configuration according to dominant interferer proportion (DIP) set.

Return values:

<RelativePower> SET1 | SET2
*RST: SET1

Example: `SOURce1:BB:EUTRa:TCW:CS:RPOW SET2`

Usage: Query only

Options: R&S SMW-K119

Manual operation: See "Relative Power" on page 551

[:SOURce<hw>]:BB:EUTRa:TCW:FA:FRALlocation <FrequencyAlloc>
[:SOURce<hw>]:BB:EUTRa:TCW:FA:RBALlocation <ResBlockAlloc>

Determines the frequency position of the wanted and interfering signal.

Parameters:

<ResBlockAlloc> HIGHer | LOWer
*RST: HIGHer

Manual operation: See "Frequency Allocation of the Interfering signal" on page 547

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SPEC <GsSpec>

Selects the 3GPP test specification used as a guideline for the test cases.

Parameters:

<GsSpec> TS36141

*RST: TS36141

Example: `SOURce1:BB:EUTRa:TCW:GS:SPEC TS36141`

Manual operation: See "Test Specification" on page 544

[:SOURce<hw>]:BB:EUTRa:TCW:GS:RELease <Release>

Sets the 3GPP test specification used as a guideline for the test cases.

Parameters:

<Release> REL8 | REL9 | REL10 | REL11 | REL12 | REL13TO15

*RST: REL8

Manual operation: See "Release" on page 544

[:SOURce<hw>]:BB:EUTRa:TCW:GS:ANTSubset <AntennaSubset>

Enabled for test setups with eight Rx antennas

Determines the signal of which antenna couple, Antenna 1 and 2 (`AS12`), Antenna 3 and 4 (`AS34`), Antenna 5 and 6 (`AS56`) or Antenna 7 and 8 (`AS78`), is generated by the instrument.

Parameters:

<AntennaSubset> AS34 | AS12 | ALL | AS56 | AS78

*RST: AS12

Manual operation: See "Antenna Subset" on page 547

[:SOURce<hw>]:BB:EUTRa:TCW:GS:GENSignals <GeneratedSignal>

Determines the signal generated by the instrument.

Parameters:

<GeneratedSignal> WSIF1AWGN | IF23 | ALL | WSUE1UE2AWGN | WSUE3UE4 | IF

WSIF1AWGN
Wanted Signal, Interferer 1 and AWGN only; required in test setup with two instruments

IF23
Interferes 2 and 3 only; required in test setup with two instruments

ALL
The instrument generates all required signals

WSUE1UE2AWGN
Only Wanted Signal UE 1, Wanted Signal UE 2 and AWGN

WSUE3UE4
Only Wanted Signal UE 3 and Wanted Signal UE 4

IF
Interferer signal only

*RST: WSIF1AWGN

Manual operation: See "Generated Signal" on page 622

[:SOURce<hw>]:BB:EUTRa:TCW:GS:INSTsetup <InstrumentSetup>

Determines whether one or both paths are used.

Parameters:

<InstrumentSetup> U2PATH | U1PATH

*RST: U2PATH

Manual operation: See "Instrument Setup" on page 546

[:SOURce<hw>]:BB:EUTRa:TCW:GS:MODE <Mode>

Determines the measurements type, Pfa or Pd, the signal is generated for, see "Mode" on page 644.

Parameters:

<Mode> DRATe | FDRate | ADRate

FDRate
False Detection Rate (Pfa)

DRATe
Detection Rate (Pd)

ADRate
Alternating Pd and Pfa

*RST: DRATe

Example: `SOUR:BB:EUTR:TCW:GS:MODE ADRate`

Manual operation: See "Mode" on page 644

[:SOURce<hw>]:BB:EUTRa:TCW:GS:MARKerconfig <MarkerConfig>

Selects the marker configuration. The marker can be used to synchronize the measuring equipment to the signal generator.

Parameters:

<MarkerConfig> UNCHanged | FRAMe

FRAMe
The marker settings are customized for the selected test case. "Radio Frame Start" markers are output; the marker delays are set equal to zero.

UNCHanged
The current marker settings of the signal generator are retained unchanged.

*RST: FRAMe

Manual operation: See "Marker Configuration" on page 546

[:SOURce<hw>]:BB:EUTRa:TCW:GS:BSCLass <BsClass>

Sets the base station class.

Parameters:

<BsClass> WIDE | LOCal | HOME | MEDium

*RST: WIDE

Example:
```
SOURce1:BB:EUTRa:TCW:GS:RELease REL10
SOURce1:BB:EUTRa:TCW:TC TS36141_TC72
SOURce1:BB:EUTRa:TCW:GS:BSCLass LOCal
SOURce1:BB:EUTRa:TCW:WS:PLevel?
```
Response: "-98.10 dBm"

Manual operation: See "Base Station Class" on page 544

[:SOURce<hw>]:BB:EUTRa:TCW:GS:RXANtennas <NumOfRXAntennas>

For performance requirement tests, determines the number of the Rx antennas.

Parameters:

<NumOfRXAntennas> ANT4 | ANT2 | ANT1

*RST: ANT1

Manual operation: See "Number of Rx Antennas" on page 545

[:SOURce<hw>]:BB:EUTRa:TCW:GS:TXANtennas <NumOfTxAntennas>

For performance requirement tests, determines the number of the Tx antennas.

Parameters:

<NumOfTxAntennas> ANT1 | ANT2

*RST: ANT1

Example:
```
SOURce1:BB:EUTRa:TCW:GS:TXANtennas ANT1
```

Manual operation: See "Number of Tx Antennas" on page 545

[:SOURce<hw>]:BB:EUTRa:TCW:GS:SIGRout <SignalRouting>

Selects the signal routing for baseband A signal which usually represents the wanted signal.

Parameters:

<SignalRouting> PORTA | PORTB

*RST: PORTA

Example: `SOURce1:BB:EUTRa:TCW:GS:SIGRout PORTA`

Manual operation: See "Signal Routing" on page 547

[:SOURce<hw>]:BB:EUTRa:TCW:GS:TRIGgerconfig <TriggerConfig>

Selects the trigger configuration. The trigger is used to synchronize the signal generator to the other equipment.

Parameters:

<TriggerConfig> UNCHanged | AAUTo

UNCHanged
The current trigger settings of the signal generator are retained unchanged.

AAUTo
The trigger settings are customized for the selected test case.
The trigger setting "Armed Auto" with external trigger source is used; the trigger delay is set to zero.
Thus, the base station frame timing is able to synchronize the signal generator by a periodic trigger.

*RST: AAUTo

Manual operation: See "Trigger Configuration" on page 546

[:SOURce<hw>]:BB:EUTRa:TCW:GS:OPTion <Option>

Selects one of the two test case options.

Parameters:

<Option> OPT1 | OPT2

*RST: OPT1

[:SOURce<hw>]:BB:EUTRa:TCW:GS:STC <SubtestCase>

Selects the subtest case.

Parameters:

<SubtestCase> STC1 | STC2 | STC4 | STC3

*RST: STC1

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:CHBW?
[:SOURce<hw>]:BB:EUTRa:TCW:IS:CHBW?

Queries the channel bandwidth of the interfering signal in MHz: 20, 10, 5, 3, 1.4, 15, or 0.2 MHz.

Return values:

<ChanBandwidth> BW20_00 | BW10_00 | BW5_00 | BW3_00 | BW1_40 | BW15_00 | BW00_20

Usage: Query only

Manual operation: See "Channel Bandwidth" on page 558
See "Channel Bandwidth" on page 566

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:CLID?

Sets the Cell ID for the second interfering signal.

Return values:

<IS2CELLID> integer

Range: 0 to 503
*RST: 2

Usage: Query only

Options: R&S SMW-K119

Manual operation: See "Cell ID" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS:CLID <CellID>

Sets the Cell ID for the interfering signal.

Parameters:

<CellID> integer

Range: 0 to 503
*RST: 1

Manual operation: See "Cell ID" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:DUPLex <Duplexing>
[:SOURce<hw>]:BB:EUTRa:TCW:IS:DUPLex <Duplex>

Selects whether TDD or FDD duplexing mode is used.

Parameters:

<Duplex> TDD | FDD

*RST: FDD

Manual operation: See "Duplexing" on page 558
See "Duplexing" on page 566

[:SOURce<hw>]:BB:EUTRa:TCW:IS:FRSHift <FrequencyShift>

Sets the value of the parameter Frequency Shift m.

Parameters:

<FrequencyShift> FS24 | FS19 | FS14 | FS13 | FS10 | FS9 | FS7 | FS5 | FS4 | FS3 | FS2 | FS1 | FS0

*RST: FS0

Manual operation: See "Frequency Shift m" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:IFTYpe?
[:SOURce<hw>]:BB:EUTRa:TCW:IS:IFTYpe <InterfererType>

Selects the type of the interfering signal:

- For **Blocking** tests, the interfering signal can be an in-band EUTRA/LTE signal (`EUTra`) or out-of-band CW signal (`CW`).
- For **Receiver Intermodulation** tests, the first interfering signal can be an EUTRA/LTE signal (`EUTra`) or narrowband EUTRA signal (`NEUTra`).
  The second interfering signal is always a CW signal (`CW`).

Parameters:

<InterfererType> NEUTra | EUTra | CW | UTRA

*RST: EUTra

Manual operation: See "Interferer Type" on page 565

[:SOURce<hw>]:BB:EUTRa:TCW:IS:NRBLock?

Queries the number of RBs used by the LTE interfering signal.

Return values:

<NumResBlock> integer

Range: 3 to 25
*RST: 3

Usage: Query only

Manual operation: See "Number of Resource Blocks" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS:NTAOffset <SigAdvNTAoffset>

Sets the parameter $N_{TAoffset}$.

Parameters:

<SigAdvNTAoffset> NTA624 | NTA0

*RST: NTA624

Manual operation: See "Signal Advance N_TA_offset" on page 566

[:SOURce<hw>]:BB:EUTRa:TCW:IS:OCEDge <OffsChannelEdge>

Defines the offset of the interfering signal center frequency relative to edge of the wanted channel bandwidth.

Parameters:

<OffsChannelEdge> OCE12_5 | OCE7_5 | OCE2_5
*RST: OCE2_5

Manual operation: See "Offset to Channel Edge" on page 557

[:SOURce<hw>]:BB:EUTRa:TCW:IS:OVRB?

Queries the offset VRB.

Return values:

<OffsetVRB> integer
Range: 0 to 75
*RST: 0

Usage: Query only

Manual operation: See "Offset VRB" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PLEVel?
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PLEVel?
[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?

Queries the power level of the interfering signal.

Return values:

<PowerLevel> string

Usage: Query only

Manual operation: See "Power Level/Power Level P-CPICH" on page 559
See "Power Level" on page 568

[:SOURce<hw>]:BB:EUTRa:TCW:IS:RBCFrequency <RBlockCentFreq>

Queries the center frequency of the single resource block interfering signal.

Parameters:

<RBlockCentFreq> integer
Range: 100E3 to 6E9
*RST: 1.95E9

Manual operation: See "Interfering RB Center Frequency" on page 568

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:RFFRequency <RfFrequency>
[:SOURce<hw>]:BB:EUTRa:TCW:IS:RFFRequency <RfFrequency>

Queries the center frequency of the interfering signal.

Parameters:
<RfFrequency> integer

Range: 100E3 to 6E9
*RST: 1.95E9

Manual operation: See "RF Frequency" on page 557
See "RF Frequency" on page 565

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TDDConfig <TddConfig>

For TDD mode, selects the UL/DL Configuration number.

Parameters:
<TddConfig> integer

Range: 0 to 6
*RST: 0

Manual operation: See "TDD UL/DL Configuration" on page 566

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TMODel?

Queries the test model. The interfering signal is generated according to E-TM1.1 test model.

Return values:
<TestModel> TM1_1

Usage: Query only

Manual operation: See "Test Model" on page 558

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TREQuire <TestRequire>

Selects whether the standard out-of-band blocking requirements test is performed (BLPE) or the optional blocking scenario, when the BS is co-located with another BS in a different operating band (COBS).

Parameters:
<TestRequire> COBS | BLPE

*RST: BLPE

Manual operation: See "Test Requirement" on page 582

[:SOURce<hw>]:BB:EUTRa:TCW:IS2:UEID <IS2UEID>

Sets the UE ID/n_RNTI for the second interfering signal.

Parameters:
<IS2UEID> integer

Range: 0 to 65535
*RST: 1

Options: R&S SMW-K119

Manual operation: See "UE ID/n_RNTI" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS:UEID <UE_ID_nRNTI>

Sets the UE ID/n_RNTI for the interfering signal.

Parameters:

<UE_ID_nRNTI> integer

Range: 0 to 65535
*RST: 1

Manual operation: See "UE ID/n_RNTI" on page 567

[:SOURce<hw>]:BB:EUTRa:TCW:IS:PLEVel?

Queries the power level of the AWGN signal (I_{oh})

Return values:

<PowerLevel> string

Usage: Query only

[:SOURce<hw>]:BB:EUTRa:TCW:IS:TMCodes <TestModel1Codes>

Selects a predefined test model 1 signal.

Parameters:

<TestModel1Codes> COD4 | COD8 | COD16 | COD32 | COD64

*RST: COD4

[:SOURce<hw>]:BB:EUTRa:TCW:MUE:TSRS <TransmitSRS>
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:TSRS <TransmitSRS>

Enables/disables the transmission of the SRS.

The SRS transmission is optional for this test case.

Parameters:

<TransmitSRS> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "Transmit SRS" on page 599

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:ACKDefinition <AckDefinition>

Determines whether a high or a low binary level on the feedback line connector represents an ACK.

Parameters:

<AckDefinition> LOW | HIGH

*RST: HIGH

Manual operation: See "ACK Definition" on page 592

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:AUSDelay <AddUserDelay>

Determines the point in time when the feedback can be sent to the instrument.

Parameters:

<AddUserDelay> float

Range: -1 to 2.99
Increment: 0.01
*RST: 0

Manual operation: See "Additional User Delay" on page 592

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSMue <BBSelectMovUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSSue <BBSelectStatUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:BBSelector <BBSelector>

This parameter is required for multiplexing serial commands for different baseband units to one feedback line. If the selector n is configured in the GUI for a specific base-band unit, the baseband unit will listen only to serial commands containing the selector n.

Parameters:

<BBSelector> integer

Range: 0 to 3
*RST: 0

Manual operation: See "Baseband Selector" on page 592

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONMue <ConnectorMovUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONSue <ConnectorStatUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONNector <Connector>

Determines the feedback line connector (LEVATT or USER1).

Parameters:

<Connector> LEVatt | USER1 | NOFB

*RST: USER1

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONMue <ConnectorMovUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONSue <ConnectorStatUE>
[:SOURce<hw>]:BB:EUTRa:TCW:RTF:CONNector <Connector>

Determines the feedback line connector.

Parameters:
<Connector> NOFB | LOCal | GLOBal
*RST: LOCal

Manual operation: See "Connector" on page 591

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:MODE <Mode>

Determines the feedback mode.

Parameters:
<Mode> SER3X8 | SER | BIN

BIN
Binary ACK/NACK

SER
Serial

SER3X8
Serial 3x8

*RST: SER

Manual operation: See "Realtime Feedback Mode" on page 591

[:SOURce<hw>]:BB:EUTRa:TCW:RTF:SERRate <SerialRate>

Sets the bit rate of the serial transmission. Possible rates are 115.2 kbps, 1.6 Mbps and 1.92 Mbps.

Parameters:
<SerialRate> SR1_92M | SR1_6M | SR115_2K
*RST: SR115_2K

Manual operation: See "Serial Rate" on page 592

[:SOURce<hw>]:BB:EUTRa:TCW:TC <TestCase>

Selects the test case.

Parameters:
<TestCase> TS36141_TC839 | TS36141_TC834 | TS36141_TC835 | TS36141_TC836 | TS36141_TC67 | TS36141_TC72 | TS36141_TC73 | TS36141_TC74 | TS36141_TC75A | TS36141_TC75B | TS36141_TC76 | TS36141_TC78 | TS36141_TC821 | TS36141_TC822 | TS36141_TC823 | TS36141_TC824 | TS36141_TC831 | TS36141_TC832 | TS36141_TC833 | TS36141_TC841 | TS36141_TC838 | TS36141_TC837 | TS36141_TC826 | TS36141_TC826A | TS36141_TC827 | TS36141_TC829 | TS36141_TC8310 | TS36141_TC8311 | TS36141_TC8312 | TS36141_TC8313 | TS36141_TC851 | TS36141_TC852 | TS36141_TC853
*RST: TS36141_TC72

Manual operation: See "Test Case" on page 545

[:SOURce<hw>]:BB:EUTRa:TCW:WS:INTRacell:UE<ch>:FRC?

Queries the intra cell fixed reference channel used for UE wanted signal.

Return values:
<IntraCellUEFrc> A11 | A12 | A13 | A14 | A15 | A21 | A22 | A23 | A31 | A32 | A33 | A34 | A35 | A36 | A37 | A41 | A42 | A43 | A44 | A45 | A46 | A47 | A48 | A51 | A52 | A53 | A54 | A55 | A56 | A57 | A71 | A72 | A73 | A74 | A75 | A76 | A81 | A82 | A83 | A84 | A85 | A86 | UE11 | UE12 | UE21 | UE22 | UE3 | A16 | A17 | A121 | A122 | A123 | A124 | A125 | A126 | A131 | A132 | A133 | A134 | A135 | A136 | A171 | A172 | A173 | A174 | A175 | A176 | A181 | A182 | A183 | A184 | A185 | A186 | A191 | A192 | A193 | A194 | A195 | A196 | A211 | A212 | A213 | A214 | A215 | A216 | A221 | A222 | A223 | A224

*RST: A11

Example:

```
SOURce1:BB:EUTRa:TCW:WS:INTRacell:UE1:FRC A211
SOURce1:BB:EUTRa:TCW:WS::INTRacell:UE2:FRC A211
```

Usage: Query only

Options: R&S SMW-K119

Manual operation: See "FRC" on page 614

[:SOURce<hw>]:BB:EUTRa:TCW:WS:INTRacell:UE<ch>:PLEVel?

Queries the intra cell power level used for UE wanted signal.

Return values:
<IntraCellPowLev> string

Example:

```
SOURce1:BB:EUTRa:TCW:WS:INTRacell:UE1:PLEVel?
SOURce1:BB:EUTRa:TCW:WS::INTRacell:UE2:PLEVel?
```

Usage: Query only

Options: R&S SMW-K119

Manual operation: See "Power Level" on page 614

[:SOURce<hw>]:BB:EUTRa:TCW:WS:INTRacell:UE<ch>:UEID <IntracellUEID>

Sets the intra cell UE ID/n_RNTI for the wanted signal UE.

Parameters:
<IntracellUEID> integer

Range: 0 to 65535
*RST: 1

Example:
```
SOURce1:BB:EUTRa:TCW:WS:INTRacell:UE1:UEID 1
SOURce1:BB:EUTRa:TCW:WS::INTRacell:UE2:UEID 10
```

Options: R&S SMW-K119

Manual operation: See "UE ID / n_RNTI" on page 614

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ACPucch <AddConfigPUCCH>

Enables the optional transmission of PUCCH format 2.

Parameters:

<AddConfigPUCCH> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "Additionally Configure PUCCH" on page 606

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANBits <AckNackBits>

In performance requirement test cases, sets the number of encoded ACK/NACK bits per subframe.

Parameters:

<AckNackBits> ANB4 | ANB16 | ANB24 | ANB64

*RST: ANB4

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC836
SOURce1:BB:EUTRa:TCW:WS:ANBits?
Response: ANB16
```

Manual operation: See "Number of ACK/NACK bits" on page 627

[:SOURce<hw>]:BB:EUTRa:TCW:WS:ANPattern? <BitCount>

In performance requirement test cases, queries the ACK/NACK + SR pattern bits.

Parameters:

<BitCount> integer

Range: 17 to 17

*RST: 17

Return values:

<AckNackPattern> numeric

*RST: #H00000

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC836
SOURce1:BB:EUTRa:TCW:WS:ANPattern?
// "00000000000000000"
```

Usage: Query only

Manual operation: See "ACK/NACK + SR Pattern" on page 628

[:SOURce<hw>]:BB:EUTRa:TCW:WS:BFORmat <BurstFormat>

Sets the burst format.

Parameters:

<BurstFormat> BF4 | BF3 | BF2 | BF1 | BF0

*RST: BF0

Manual operation: See "Burst Format" on page 645

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CHBW <ChanBandwidth>

Selects the channel bandwidth in MHz: 20, 10, 5, 3, 1.4, 15, or 0.2 MHz.

Parameters:

<ChanBandwidth> BW20_00 | BW10_00 | BW5_00 | BW3_00 | BW1_40 | BW15_00 | BW00_20

*RST: BW1_40

Manual operation: See "Channel Bandwidth" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CLID <CellId>

Sets the Cell ID.

Parameters:

<CellId> integer

Range: 0 to 503

*RST: 150

Manual operation: See "Cell ID" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CYCPrefix <CyclicPrefix>

Selects normal or extended cyclic prefix.

Parameters:

<CyclicPrefix> EXTended | NORMal

*RST: NORMal

Manual operation: See "Cyclic Prefix" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CQIPattern:PORT<ch0> <Pattern>, <BitCount>

In performance test cases, sets the CQI Pattern.

Parameters:

<Pattern> numeric

*RST: #HF

<BitCount> integer

Range: 4 to 4
*RST: 4

Example:
```
SOURce1:BB:EUTRa:TCW:TC TS36141_TC839
SOURce1:BB:EUTRa:TCW:GS:TXANtennas ANT2
SOURce1:BB:EUTRa:TCW:WS:CQIPattern:PORT0 #H5,4
SOURce1:BB:EUTRa:TCW:WS:CQIPattern:PORT1 #H5,4
```

Manual operation: See "CQI Pattern Port 0/1 (bin)" on page 635

[:SOURce<hw>]:BB:EUTRa:TCW:WS:DUPLex <Duplex>

Selects whether TDD or FDD duplexing mode is used.

Parameters:
<Duplex> TDD | FDD

*RST: FDD

Manual operation: See "Duplexing" on page 549

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FMTHroughput <FractMaxThrough>

Selects the fraction of maximum throughput.

Parameters:
<FractMaxThrough> FMT70 | FMT30

*RST: FMT30

Manual operation: See "Fraction of Max. Throughput" on page 595

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FRC <FRC>

Queries the fixed reference channel used.

Parameters:
<FRC> A11 | A12 | A13 | A14 | A15 | A21 | A22 | A23 | A31 | A32 | A33 | A34 | A35 | A36 | A37 | A41 | A42 | A43 | A44 | A45 | A46 | A47 | A48 | A51 | A52 | A53 | A54 | A55 | A56 | A57 | A71 | A72 | A73 | A74 | A75 | A76 | A81 | A82 | A83 | A84 | A85 | A86 | UE11 | UE12 | UE21 | UE22 | UE3 | A16 | A17 | A121 | A122 | A123 | A124 | A125 | A126 | A131 | A132 | A133 | A134 | A135 | A136 | A171 | A172 | A173 | A174 | A175 | A176 | A181 | A182 | A183 | A184 | A185 | A186 | A191 | A192 | A193 | A194 | A195 | A196 | A211 | A212 | A213 | A214 | A215 | A216 | A221 | A222 | A223 | A224

*RST: A11

Example:
```
SOURce1:BB:EUTRa:TCW:WS:FRC?
```

Manual operation: See "FRC" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:FROFfset <FreqOffset>

Sets the frequency offset.

Parameters:

<FreqOffset> FO_1340 | FO_625 | FO_270 | FO_0 | FO_200

*RST: FO_0

Manual operation: See "Frequency Offset" on page 645

[:SOURce<hw>]:BB:EUTRa:TCW:WS:HSMode <HighSpeedMode>

Enables/disables high-speed mode.

Parameters:

<HighSpeedMode> 1 | ON | 0 | OFF

*RST: 0

Manual operation: See "High Speed Mode" on page 645

[:SOURce<hw>]:BB:EUTRa:TCW:WS:NTAOffset <SigAdvNTAoffset>

Sets the parameter $N_{TAoffset}$.

Parameters:

<SigAdvNTAoffset> NTA624 | NTA0

*RST: NTA624

Manual operation: See "Signal Advance N_TA_offset" on page 549

[:SOURce<hw>]:BB:EUTRa:TCW:IS:ORTCover?
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:ORTCover?
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:ORTCover?
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover[:PORT<ch0>]?
[:SOURce<hw>]:BB:EUTRa:TCW:WS:ORTCover?

Queries the used resource index n_PUCCH.

Return values:

<OrthoCover> integer

Range: 2 to 2
Increment: 1
*RST: 2

Usage: Query only

Manual operation: See "Orthogonal Cover (Res. Index n_PUCCH) / Orthogonal Cover (Res. Index n_PUCCH) Port 0/1" on page 622

[:SOURce<hw>]:BB:EUTRa:TCW:WS:OUPLevel <OutPowerLevel>

The settings of the selected test case become active only after selecting "Apply Settings".

Parameters:

<OutPowerLevel> float

Range: -115 to 0
Increment: 0.01
*RST: -30

Manual operation: See "Output Power Level" on page 560

[:SOURce<hw>]:BB:EUTRa:TCW:MUE:OVRB <OffsetVRB>
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:OVRB <OffsetVRB>
[:SOURce<hw>]:BB:EUTRa:TCW:WS:OVRB <OffsetVRB>

Sets the number of RB the allocated RB(s) are shifted with.

Parameters:

<OffsetVRB> integer

Range: 0 to 75
*RST: 0

Manual operation: See "Offset VRB" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLEVel?

Queries the Power Level.

Return values:

<PowerLevel> string

Usage: Query only

Manual operation: See "Power Level" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPC?

Queries the resulting PUCCH power level by activated optional transmission of PUCCH format 2.

Return values:

<PowerLevelPUCCH>string

Usage: Query only

Manual operation: See "PUCCH Power Level" on page 606

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PLPS?

Queries the resulting PUSCH power level.

Return values:
<PowerLevelPUSCH>string

Usage: Query only

Manual operation: See "Power Level (PUSCH)" on page 606

[:SOURce<hw>]:BB:EUTRa:TCW:IS:PRCOndition?
[:SOURce<hw>]:BB:EUTRa:TCW:IS2:PRCOndition?
[:SOURce<hw>]:BB:EUTRa:TCW:IS3:PRCOndition?
[:SOURce<hw>]:BB:EUTRa:TCW:WS:PROCondition <PropagationCond>

Selects a predefined multipath fading propagation conditions. The settings of the fading simulator are adjusted according to the corresponding channel model as defined in 3GPP TS 36.141, Annex B.

Parameters:
<PropagationCond> AWGNonly | HST3 | HST1 | PDMov | ETU200Mov | ETU300 | EVA70 | EVA5 | EPA5 | ETU70 | ETU5 | ETU200 | ETU1 | EPA1

*RST: EPA5

Manual operation: See "Propagation Conditions" on page 592

[:SOURce<hw>]:BB:EUTRa:TCW:WS:RFFRequency <RfFrequency>

Sets the RF frequency of the wanted signal.

Parameters:
<RfFrequency> integer

Range: 100E3 to 6E9
*RST: 1.95E9

Manual operation: See "RF Frequency" on page 549

[:SOURce<hw>]:BB:EUTRa:TCW:WS:SPSFrame <SpecSubframe>

In TDD duplexing mode, sets the Special Subframe Configuration number.

Parameters:
<SpecSubframe> integer

Range: 0 to 8
*RST: 0

Manual operation: See "Configuration of Special Subframe" on page 645

[:SOURce<hw>]:BB:EUTRa:TCW:WS:TDDConfig <TddConfig>

For TDD mode, selects the UL/DL Configuration number.

Parameters:

<TddConfig> integer

Range: 0 to 6
*RST: 0

Manual operation: See "TDD UL/DL Configuration" on page 549

[:SOURce<hw>]:BB:EUTRa:TCW:WS:TIOBase?

Queries the timing offset base value.

Return values:

<TimingOffsBase> float

Range: 0 to 500
Increment: 0.01
*RST: 0

Usage: Query only

Manual operation: See "Timing Offset Base Value" on page 646

[:SOURce<hw>]:BB:EUTRa:TCW:MUE:UEID <UE_ID_nRNTI>
[:SOURce<hw>]:BB:EUTRa:TCW:SUE:UEID <UE_ID_nRNTI>
[:SOURce<hw>]:BB:EUTRa:TCW:WS:UEID <UE_ID_nRNTI>

Sets the UE ID/n_RNTI.

Parameters:

<UE_ID_nRNTI> integer

Range: 0 to 65535
*RST: 1

Manual operation: See "UE ID/n_RNTI" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:VDRFrequency <VirtDlRF>

Sets the virtual downlink frequency, used to calculate the UL Doppler shift.

Parameters:

<VirtDlRF> integer

Range: 100E+03 to 6E+09
*RST: 1E+09

Manual operation: See "Virtual Downlink RF Frequency" on page 605

[:SOURce<hw>]:BB:EUTRa:TCW:WS:CEMode <CEMode>

Selects the CEMode for test case 8.2.7 according to table 8.2.7.4.2-2: Test parameters for testing PUSCH of TS 36.141.

Parameters:
<CEMode> A | B
*RST: A

Example: `SOURce1:BB:EUTRa:TCW:WS:CEMode A`

Options: R&S SMW-K119

Manual operation: See "CE Mode" on page 550

[:SOURce<hw>]:BB:EUTRa:TCW:WS:REPetitions <Repetitions>

Sets the Tx repetitions of wanted signal.

Parameters:
<Repetitions> R4 | R8 | R32 | R16 | R64 | R2 | R1
*RST: R4

Example: `SOURce1:BB:EUTRa:TCW:WS:REPetitions R32`

Options: R&S SMW-K119

Manual operation: See "Repetitions" on page 551

[:SOURce<hw>]:BB:EUTRa:TCW:WS:NIOT:FRC <NBIOTFRC>

Sets the FRC of NPUSCH wanted signal (A16-1 to A16-5).

Parameters:
<NBIOTFRC> A161 | A162 | A163 | A164 | A165
*RST: A162

Example: `SOURce1:BB:EUTRa:TCW:WS:NIOT:FRC A163`

Options: R&S SMW-K115

Manual operation: See "FRC" on page 648

[:SOURce<hw>]:BB:EUTRa:TCW:WS:PFMT <PreambleFormat>

Selects the NPRACH preamble format for test case 8.5.3 according to tables 8.5.3.5-1 (FDD) or 8.5.3.5-2 (TDD) of TS 36.141.

Parameters:
<PreambleFormat> F0 | F1 | F2 | F0A | F1A | 0 | 1
*RST: F0

Example: `SOURce1:BB:EUTRa:TCW:WS:PFMT F1A`

Options: R&S SMW-K115

Manual operation: See "Preamble Format" on page 651

[:SOURce<hw>]:BB:EUTRa:TCW:WS:SCSPacing <SubcarrierSpac>

Sets the NB-IoT subcarrier spacing of 15 kHz or 3.75 kHz.

Parameters:

<SubcarrierSpac> S15 | S375

*RST: S15

Example: Set the subcarrier spacing of NB-IoT wanted signal to 3.75 kHz.

```
SOURce1:BB:EUTRa:TCW:WS:SCSPacing S375
```

Options: R&S SMW-K115

Manual operation: See "Subcarrier Spacing" on page 648
See "Subcarrier Spacing" on page 649

Annex

A Conflict handling

In TS 36.211, physical signals and physical channels are defined for the EUTRA/LTE system. Therefore the available resources in the time-frequency domain are shared by the different signals and different kinds of allocations (comparable to the different channel types in the 3GPP FDD mode).

A.1 Downlink

R&S SMW supports the following types of downlink signals and channels:

- Reference signals
- Primary synchronization signal (PSS)
- Secondary synchronization signal (SSS)
- Physical broadcast channel (PBCH)
- Physical Downlink Control Channel (PDCCH), including PCFICH and PHICH
- Physical Downlink Shared Channel (PDSCH)

Due to the concept of the R&S SMW, different situations can appear that need clarification. If several signals and/or channels (of the same or different type) partly share resources, a decision has to be made what bits are mapped to the affected subcarriers. The general rule here is that the signal or channel with higher priority is transmitted completely while the affected subcarriers are stamped out of the lower priority signal or channel. Note that this reduces the number of available physical bits of a signal/channel.

The actual size of a certain allocation is displayed in the column physical bits of the resource allocation table.

The following picture shows the priorities of the different signal and channel types.

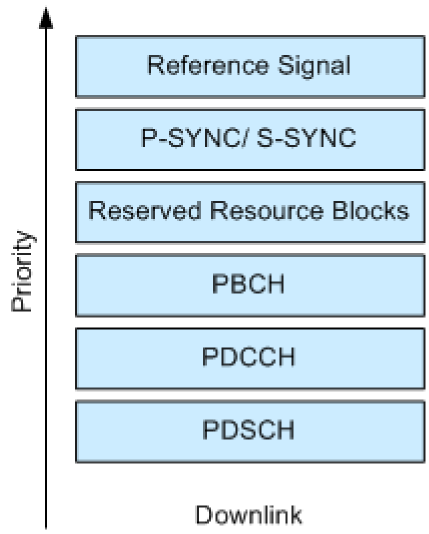


Figure A-1: Priority of different allocations, channels and signals in the downlink

- Overlapping of signals and/or channels with different priorities
  In case signals or channels of different priorities overlap, no conflict is indicated in the resource allocation table, as the signal with the higher priority is transmitted completely.
- Overlapping of allocations with the same priority
  If different allocations of the same priority are overlapping, the one with the lower allocation index (i.e. which comes first) in the resource allocation table is treated with higher priority. In this case, the reduced allocation is marked in the conflict column of the resource allocation table.

There is no way to configure a signal with overlapping reference signal and P-SYNC/S-SYNC.

If PRS and MBSFN are configured to be in the same subframe, MBSFN is skipped and PRS is transmitted solely.

If a PDSCH is configured to overlap partially with the PRS bandwidth in a PRS subframe, the PRS in these resource blocks is skipped then (see Example"Overlapping PDSCH, PRS and MBSFN" on page 113).

A.2 Uplink

In the uplink implementation of the R&S SMW, you can configure different user equipment (UEs) to use the same physical resources. The signals of the different UEs are added, nevertheless a conflict is indicated in the resource allocation table.

Although a conflict is also displayed if the PUSCH and PUCCH allocations of one UE are overlapping, the signals of both allocations are added. However, a conflict can occur between the sounding reference signal of a certain UE and the PUSCH of another UE.

A.3 DCI conflict handling

In the R&S SMW, you can configure multiple scheduling messages with their corresponding PDCCHs per subframe. Using the DCI table in the Chapter 4.3, "DL frame configuration settings", on page 136 dialog, you can set appropriate CCE index and define the position of the DCI/PDCCH inside the multiplexed bitstream.

Because the number of CCEs for each PDCCH vary, the 3GPP specification TS 36.211, chapter 6.8.1 defines some restriction on the aggregation of CCEs. An aggregation of eight CCEs for instance can only start on CCE numbers evenly dividable by eight. The same principle applies to the other aggregation levels. In this implementation, if the restriction is not fulfilled or two CCEs are overlapping, a conflict is displayed for the DCI/PDCCH with the greater number. This DCI/PDCCH is not considered by the multiplexing, i.e. it is not transmitted.

The R&S SMW provides the operations "Append", "Insert", "Delete", "Up", "Down" and "Resolve Conf." for flexibly configuration of valid DCIs and for resolving of conflicts.

Example:

This example is based on a DCI table of a control channel with a total "Number of CCEs = 26".

The "DCI Table" indicates a conflict in the second DCI/PDCCH. The reason for this conflict is that the CCEs allocated for the second DCI/PDCCH are overlapping with the CCEs used by the first one. The second DCI/PDCCH is ignored by the multiplexing.

	User	UE_ID n_RNTI	Cell Index	CIF	(E)PDCCH	DCI Format	Search Space	Content	(E)PDCCH Format	Number (E)CCEs	(E)CCE Index	No.Dummy (E)CCEs	Conflict
0	User1	0	0	-	PDCCH	0	Common	Config...	2	4	0	4	
1	User1	0	0	-	PDCCH	1A	UE-Spec	Config...	0	1	1	-	⚠
2	User2	250	0	-	PDCCH	0	UE-Spec	Config...	1	2	16	8	
3	RA_RNTI	1	0	-	PDCCH	1C	Common	Config...	2	4	8	4	

One of the ways to overcome this problem and to resolve the DCI conflict is to use the Resolve Conflicts function of the software. The built-in algorithm reassigns automatically the CCE values depending on the configured "Search Space"; previously configured CCE values are not maintained. The calculated signal is suitable for receiver tests that demand conflict free CCEs but have no requirements on explicit CCE values. If the conflict cannot be resolved automatically, the values remain unchanged.

If however there is a requirement for CCE indexes with explicit values, you can perform the corrections manually. In this particular example, you can set the CCE index of the third DCI/PDCCH to 4.

	User	UE_ID n_RNTI	Cell Index	CIF	(E)PDCCH	DCI Format	Search Space	Content	(E)PDCCH Format	Number (E)CCEs	(E)CCE Index	No.Dummy (E)CCEs	Conflict
0	User1	0	0	-	PDCCH	0	Common	Config...	2	4	4	0	
1	User1	0	0	-	PDCCH	1A	UE-Spec	Config...	0	1	1	2	
2	User2	250	0	-	PDCCH	0	UE-Spec	Config...	1	2	16	8	
3	RA_RNTI	1	0	-	PDCCH	1C	Common	Config...	2	4	8	4	

The CCEs used by the two subsequent DCIs/PDCCHs are not overlapping and the two DCIs/PDCCHS are configured to be transmitted consecutive, i.e. there is no gap between them ("No. Dummy CCEs" = 0).

The Figure A-2 shows the resulting PDCCH after multiplexing.

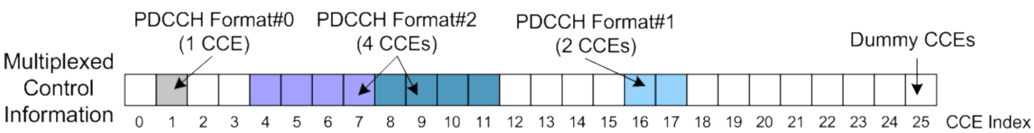


Figure A-2: PDCCH multiplexing (example)

If "Activate Carrier Aggregation > On", the parameter DCI Table determines the component carrier the corresponding User is mapped to. For this reason, there is no DCI conflict, if in the example above the second DCI belongs to a User enabled on an SCell.

	User	UE_ID n_RNTI	Cell Index	CIF	(E)PDCCH	DCI Format	Search Space	Content	(E)PDCCH Format	Number (E)CCEs	(E)CCE Index	No.Dummy (E)CCEs	Conflict
0	User1	0	0	-	PDCCH	0	Common	Config...	2	4	0	4	
1	User1	0	0	-	PDCCH	1A	UE-Spec	Config...	0	1	1	24	
2	User2	250	0	-	PDCCH	0	UE-Spec	Config...	1	2	16	8	
3	RA_RNTI	1	0	-	PDCCH	1C	Common	Config...	2	4	8	4	

B Subframes handling

The following sections explain the subframes handling concept and implementation in the R&S SMW.

B.1 Copy/paste subframe

The required EUTRA/LTE test signal consists of several subframes, possibly with the same or similar settings.

In these cases, you can:

- Copy and paste settings from one subframe to another.
- Configure a subset of subframes manually and use them periodically
  See Chapter B.2, "Number of configurable subframes", on page 1104

Consider, however, that with both methods only subset of settings are inherited.

Both methods maintain the following settings:

- Cyclic prefix length
- Structure of PDCCH and PDSCH allocations
- Structure of PUSCH and PUCCH allocations

The following settings are not considered:

- P-SYNC/S-SYNC
  The P-SYNC/S-SYNC are global setting ("General DL Settings" dialog) and therefore cannot be overwritten by the configuration of one particular frame
- PBCH
  The PBCH is transmitted in subframe#0 only
- PRACH and sounding reference signals
  The SRS and the PRACH are settings dedicated to the individual user equipment (User equipment configuration dialog)

Copying allocations from a subframe without P-SYNC/S-SYNC/PBCH to one with P-SYNC/S-SYNC/PBCH and vice versa can lead to conflict situations. In this case, the internal algorithm applies the rules discussed in Chapter A, "Conflict handling", on page 1099.

However, it can happen that allocations which are identical in terms of scheduled resource blocks have a different number of physical bits available in the different subframes. This situation occurs due to the out stamping of overlapping subcarriers.

B.2 Number of configurable subframes

As described in Chapter B.1, "Copy/paste subframe", on page 1104, you can simplify the configuration of the EUTRA/LTE test signal if you define a small number of subframes manually ("Number of Configurable Subframes") and use them periodically.

Internally, the R&S SMW applies the Copy/paste subframe functionality and the same subset of settings are inherited.

B.3 Four configurable frames in uplink and downlink direction

The R&S SMW supports the configuration of up to four frames in uplink and downlink direction. However, there is a limitation for the maximum number of the real configurable subframes in these four frames depending on the transmission direction and several other parameters.

B.3.1 Uplink direction

The maximum number of configurable subframes changes as function of the parameters in the following way:

- For **disabled** Realtime Feedback
  - In FDD duplexing mode, the maximum number of configurable subframes is 40 subframes, where the maximum number of 40 subframes is available for sequence lengths of at least four frames
  - In a TDD frame, only the uplink subframes are enabled for configuration. The maximum number of the configurable subframes is determined by the selected "UL/DL Configuration" and the possible values are listed in the corresponding column in the cross-reference table below.

The current subframe to be configured is selected by means of the parameter Subframe.

The configurable range ("Number of configurable uplink subframes") can be selected independently for the individual user equipment (UE). Furthermore, for LTE-A UEs, the range can be selected independently for the PUCCH and the PUSCH channel.

Subframes behind the configurable range of the corresponding UE or channel are indicated as read-only.

Table B-1: Value range for the parameter Number of Configurable UL Subframes

"Duplex-ing mode"	"UL/DL Configu-ration"	UL subframes in the first four frames (see Figure 2-5)	Number of UL sub-frames per frame	Number of HARQ processes	Value range for the param-eter "Number of Configura-ble UL Subframes"	
					Disabled realtime feedback	Enabled real-time feed-back
TDD	0	2, 3, 4, 7, 8, 9, 12, 13, 14, 17, 18, 19, 22, 23, 24, 27, 28, 29, 32, 33, 34, 37, 38, 39	6	7	1 to 24	1, 7
	1	2, 3, 7, 8, 12, 13, 17, 18, 22, 23, 27, 28, 32, 33, 37, 38	4	4	1 to 16	1, 2, 4
	2	2, 7, 12, 17, 22, 27, 32, 37	2	2	1 to 8	1, 2
	3	2, 3, 4, 12, 13, 14, 22, 23, 24, 32, 33, 34	3	3	1 to 12	1, 3
	4	2, 3, 12, 13, 22, 23, 32, 33	2	2	1 to 8	1, 2
	5	2, 12, 22, 32	1	1	1 to 4	1
	6	2, 3, 4, 7, 8, 12, 13, 14, 17, 18, 22, 23, 24, 27, 28, 32, 33, 34, 37, 38	5	6	1 to 20	1, 2, 3, 6
FDD	-	0 .. 39	10	8	1 to 40	1, 2, 4 ,8

Example:

If not stated otherwise, the following examples assume disabled realtime feedback.

- For selected FDD duplexing mode and **"Number of Configurable Uplink Subframes = 13"**, "Subframes = 0 to 12" are configurable.
  Subframes from 13 on are read-only.
- For selected TDD duplexing mode and "UL/DL Configuration = 6", the "Number of Configurable Uplink Subframes = 1 to 20".
  (See Table B-1).
  If for instance the "Number of Configurable Uplink Subframes = 10", the following ten subframes are configurable: 2, 3, 4, 7, 8, 12, 13, 14, 17, 18.
  These subframes are the first ten uplink subframes. All other subframes (downlink subframes, special subframes and subframes from 19 on) are read-only.
- For selected TDD duplexing mode, "UL/DL Configuration = 6" and enabled realtime feedback, up to six HARQ processes can be configured. Therefore 1, 2, 3 or 6 configurable uplink subframes are available for the PUSCH channel of UE1.
  If for instance the "Number of Configurable Uplink Subframes = 6", the following six subframes are configurable: 2, 3, 4, 7, 8, 12.
  These subframes are the first six uplink subframes. All other subframes (downlink subframes, special subframes and subframes from 13 on) are read-only.

B.3.2 Downlink direction

In downlink direction, the maximum number of the real configurable subframes depends on the selected General settings mode (TDD or FDD), TDD frame structure settings. In downlink direction, the special subframes are also configurable (in addition to the downlink subframes).

Because the realtime feedback functionality is an uplink feature, the maximal number of the configurable subframes in downlink direction is not additionally limited by the number of HARQ processes.

The subframe to be configured is selected by means of the parameter "Subframe Selection". The maximum value for this parameter is then determined by the number of the last configurable subframe (see also Table B-2).

Table B-2: Value range for the parameter Number of Configurable DL Subframes

Duplexing mode	UL/DL Configuration	DL and special subframes in the first four frames (see Figure 2-5)	Number of DL and special subframes per frame	Value range for the parameter "Number of Configurable DL Subframes"
TDD	0	0, 1, 5, 6, 10, 11, 15, 16, 20, 21, 25, 26, 30, 31, 35, 36	4	1 to 16
	1	0, 1, 4, 5, 6, 9 10, 11, 14, 15, 16, 19 20, 21, 24, 25, 26, 29, 30, 31, 34, 35, 36, 39	6	1 to 24
	2	0, 1, 3, 4, 5, 6, 8, 9 10, 11, 13, 14, 15, 16, 18, 19 20, 21, 23, 24, 25, 26, 28, 29, 30, 31, 33, 34, 35, 36, 38, 39	8	1 to 32
	3	0, 1, 5, 6, 7, 8, 9 10, 11, 15, 16, 17, 18, 19 20, 21, 25, 26, 27, 28, 29, 30, 31, 35, 36, 37, 38, 39	7	1 to 28
	4	0, 1, 4, 5, 6, 7, 8, 9 10, 11, 14, 15, 16, 17, 18, 19 20, 21, 24, 25, 26, 27, 28, 29, 30, 31, 34, 35, 36, 37, 38, 39	8	1 to 32
	5	0, 1, 3, 4, 5, 6, 7, 8, 9 10, 11, 13, 14, 15, 16, 17, 18, 19 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38, 39	9	1 to 36
	6	0, 1, 5, 6, 9 10, 11, 15, 16, 19, 20, 21, 25, 26, 29, 30, 31, 35, 36, 39	5	1 to 20
FDD	-	0 .. 39	10	1 to 40

Glossary: 3GPP specifications, references

Symbols

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TS 36.106: "Evolved Universal Terrestrial Radio Access (E-UTRA); FDD repeater radio transmission and reception"

TS 36.113: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) and repeater ElectroMagnetic Compatibility (EMC)"

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