R&S®SMW-K60/-K117/-K178
Bluetooth® Signal Generation
User Manual

1175680302
Version 26

ROHDE&SCHWARZ
Make ideas real

This document describes the following software options:

- R&S®SMW-K60 Bluetooth EDR (1413.4239.xx)
- R&S®SMW-K117 Bluetooth 5.x (1414.3336.xx)
- R&S®SMW-K178 Bluetooth 5.4 + Channel Sounding (1434.8279.xx)

This manual describes firmware version FW 5.30.175.xx and later of the R&S®SMW200A.

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1175.6803.02 | Version 26 | R&S®SMW-K60/-K117/-K178

Throughout this document, R&S® is indicated as R&S.

Contents

1 Welcome to the Bluetooth options

The Bluetooth options R&S SMW-K60/-K117/-K178 are firmware applications that add functionality to generate signals in accordance with the Bluetooth standard.

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 SMW200A 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 SMW200A service manual.

1.1 Key features

R&S SMW-K60 key features

Option R&S SMW-K60 provides Bluetooth signals for basic rate (BR) and enhanced data rate (EDR) signals. These signals are in line with Bluetooth Core Specification v4.2. Also, the option provides low energy (LE) signals for the LE 1 Msymbol/s physical layer.

R&S SMW-K60 supports the following BR and EDR features:

- Support for three transport modes ACL+EDR, SCO and eSCO+EDR
- Support of all packet types for both the basic rate and the enhanced data rate modes.
- Generation of signals with up to 5238 frames sequence length
- Configuration of the packet contents with a convenient packet editor or all data packets, both with optional data whitening
- Generation of signals in line with the "Dirty Transmitter Test" specification. The test enables you to change the start phase, the frequency drift rate and the frequency drift deviation.
- Power ramp control with possibilities to choose ramp time, rise and fall offset
- Configuration of the clipping, filter and modulation settings

R&S SMW-K60 supports the following LE features:

- Support for two channel types, the "Advertising" and "Data" channel types
- Support of all Bluetooth packet types for LE 1 Msymbol/s physical layer (LE 1M PHY).
- Convenient packet editor for all supported packet types including optional data whitening

- Dirty transmitter test, compliant to the RF test specification with options to change start phase, frequency drift rate and frequency drift deviation
- Support of CRC corruption for every 2nd packet
- Power ramp control with configurable ramp time, rise and fall offsets
- Clipping, filter and modulation settings supported

R&S SMW-K117 key features

Option R&S SMW-K117 is an extension to option R&S SMW-K60. It provides Bluetooth LE signals in line with Bluetooth Core Specification v5.4.

Option R&S SMW-K117 supports the following LE features:

- Support for two channel types "Advertising" and "Data"
- Support of all Bluetooth packet types for uncoded LE 2 Msymbol/s physical layer (LE 2M PHY)
- Support of all Bluetooth packet types for LE coded 1 Msymbol/s physical layer (LE coded PHY)
- Support of CRC corruption for every 2nd packet
- Convenient packet editor for all supported packet types including optional data whitening.
- Dirty transmitter test, compliant to the RF test specification with options to change start phase, frequency drift rate, frequency drift deviation, and modulation index mode.
- Support of Bluetooth Direction Finding using Constant Tone Extension methods Angle of Arrival or Angle of Departure

R&S SMW-K178 key features

Option R&S SMW-K178 is an extension to option R&S SMW-K117. It provides Channel Sounding of Bluetooth LE signals in line with the Bluetooth Channel Sounding specification [2].

Option R&S SMW-K178 supports the following LE Channel Sounding features:

- Support of channel type "Channel Sounding"
- Support of Channel Sounding packet types CS SEQUENCE, Test Packet and CS LL CONTROL PDUs
- Support of LE uncoded PHY "LE 2M 2BT" with PHY 2 Msymbol/s modulation and bandwidth time product BT = 2
- Support CS subevent configuration
- Support CS step configuration including Mode-0, Mode-1, Mode-2 and Mode-3 configurations
- CS steps with user-defined random sequence or sounding sequence

For more information, refer to the Bluetooth Core Specification [1].

1.2 Accessing the Bluetooth dialog

To open the dialog with Bluetooth settings

► In the block diagram of the R&S SMW200A, select "Baseband > Bluetooth".

A dialog box opens that displays 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 5.30.175.xx and later of the R&S®SMW200A.

Compared to the previous version, it provides the new features listed below:

- Option Bluetooth 5.4 + Channel Sounding (R&S SMW-K178) related to the Bluetooth release providing Channel Sounding (CS) for Bluetooth LE devices, see Chapter 2.3, "About Bluetooth LE Channel Sounding", on page 25.
- CS settings of option R&S SMW-K178:
  - Chapter 5.1, "Channel settings", on page 44 including settings to configure the channel type, packet type, packet PHY, CS event and CS role.
  - Chapter 5.4, "CS subevent configuration", on page 91 including settings to configure the CS subevent, channel table, CS security and channel selection.
  - Chapter 5.4.5, "CS step configuration", on page 99 including CS step settings to configure the main mode and the submode for subevent 0.
  - Chapter 5.4.6, "CS step info", on page 108 including CS step information for individual CS steps per subevent
  - Chapter 5.5, "CS control data payload settings", on page 112 including settings to configure the payload of CS_CONTROL_DATA PDUs.
- User-defined Sync Word in the test packet header for LE uncoded PHYs, see "Sync Word" on page 131 and "User Pattern(hex)" on page 131.
- Payload type "Data List" added for a test packet, see "Payload Type" on page 131.
- Command for querying common filter type and EDR-specific filter type, see `[:SOURce<hw>]:BB:BTOoth:FILTer:FILTers?` on page 284.
- Editorial changes

1.4 Documentation overview

This section provides an overview of the R&S SMW200A 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 SMW200A 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 SMW200A is not included.

The contents of the user manuals are available as help in the R&S SMW200A. 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 SMW200A provides interactive examples and demonstrations on operating the instrument in the 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 SMW200A 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 Specifications and product brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S SMW200A. It also lists the firmware applications 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 Calibration certificate

The document is available on https://gloris.rohde-schwarz.com/calcert. You need the device ID of your instrument, which you can find on a label on the rear panel.

1.4.9 Release notes and open source acknowledgment

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

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

www.rohde-schwarz.com/firmware/smw200a

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

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

www.rohde-schwarz.com/application/smw200a

For some application sheets, see also:

www.rohde-schwarz.com/manual/smw200a

1.4.11 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 SMW200A 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 Bluetooth options

The R&S SMW200A provides you with the ability to generate signals in accordance with the core specification 5.4 for Bluetooth wireless technology.

This section lists required options and provides background information on basic terms and principles used in Bluetooth technology.

2.1 Required options

The basic equipment layout for generating Bluetooth signals includes the:

- Standard or wideband baseband generator (R&S SMW-B10/-B9) per signal path
- Baseband main module (R&S SMW-B13/-B13T
- Frequency option (e.g. R&S SMW-B1003)
- Option Bluetooth EDR (R&S SMW-K60)
  One option per signal path
- Option Bluetooth 5.x (R&S SMW-K117), requires R&S SMW-K60
  One option per signal path
- Option Bluetooth 5.4 + Channel Sounding (R&S SMW-K178), requires R&S SMW-K117
  One option per signal path

You can generate signals via playback of waveform files at the signal generator. To create the waveform file with 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, for example, R&S SMW-K255 for playing LTE waveforms.
- If supported, install the real-time option of the digital standard, for example, R&S SMW-K55 for playing LTE waveforms.

For more information, refer to the specifications document.

2.2 About Bluetooth LE

The R&S SMW200A provides you with the ability to generate signals in accordance with the Low Energy (LE) specification for Bluetooth wireless technology.

Bluetooth LE provides data transfer from low-power devices running on the smallest of batteries to a larger device, for example, a PC or a mobile phone. Bluetooth LE establishes a connection, for example, to a wristwatch, a heart rate sensor, or a data transfer from a digital camera. The generated packets do not support audio content.

A time division duplex (TDD) scheme for duplex transmission is defined. The frequency band defined for Bluetooth devices is the unlicensed 2.4 GHz "Industrial, Scientific and Medical" (ISM) frequency band.

Table 2-1: Operating band

Frequency range	RF channels k and center frequencies f
2400.0 MHz to 2483.5 MHz	k = 0 to 39, f = k * 2 MHz + 2402 MHz

Table 2-2: Channel index

RF channel	RF center frequency	Data channel index	Advertising channel index
0	2402 MHz	-	37
1 to 11	2404 MHz to 2424 MHz	0 to 10	-
12	2426 MHz	-	38
13 to 38	2428 MHz to 2478 MHz	11 to 36	-
39	2480 MHz	-	39

Figure 2-1: RF channels

red = primary advertising channels
blue = data channels and secondary advertising channels

The minimum output power is -20 dBm. The maximum output power for LE is 20 dBm. For more information on the limits of the output power level, see [1].

The following sections provide a detailed overview on LE signal characteristics:

2.2.1 Packet formats for LE

Packet formats for LE uncoded PHY

The following packet format defines the LE uncoded physical layers (PHYs) LE 1M and LE 2M. Advertising channel packets and data channel packets use this format.

Figure 2-2: LE uncoded PHY packet format

Each packet consists of four mandatory fields: Preamble, Access Address, Protocol Data Unit (PDU) and Cyclic Redundancy Check (CRC). For Bluetooth direction finding, the optional field Constant Tone Extension (CTE) is at the end of the packet. See also Chapter 2.2.6, "Direction finding", on page 21.

Table 2-3: LE uncoded PHYs and field lengths

PHY	Preamble	Access address	PDU	CRC	CTE
LE 1M	1 octet	4 octets	2 octets to 257 octets	3 octets	16 µs to 160 µs
LE 2M	2 octets	4 octets	2 octets to 257 octets	3 octets	16 µs to 160 µs

When transmitting a packet, a Bluetooth receiver receives the preamble first and CTE last. For packet transmission, the symbol rate stays the same but is different for different PHYs. The table below provides an overview including the required option.

PHY	Symbol rate	Required options
LE 1M	1 Msymbol/s	R&S SMW-K60
LE 2M	2 Msymbol/s	R&S SMW-K117

The transmit time for an LE uncoded PHY packet is between 44 µs and 2120 µs. The period extends by an additional period of 16 µs to 160 µs, if CTE is active.

Packet formats for LE coded PHY

The following packet format defines the PHY LE Coded. Advertising channel packets and data channel packets use this format.

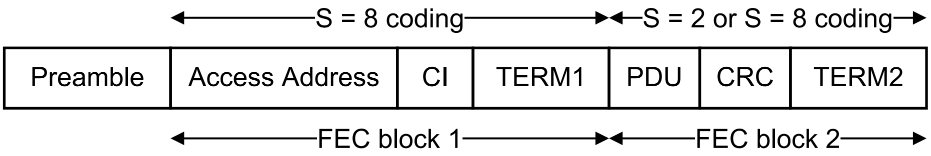


Figure 2-3: LE coded PHY packet format

Each packet consists of the Preamble, a Forward Error Correction (FEC) block 1, and FEC block 2. The preamble is not coded. The FEC block 1 consists of three fields: Access Address, Coding Indicator (CI), and TERM1. These fields use the S=8 coding scheme. The CI field determines the coding scheme for the FEC block 2. The FEC block 2 consists of three fields: PDU, CRC, and TERM2. These fields use either the S=2 or S=8 coding scheme, depending on the value of the CI field.

The entire packet is transmitted with 1 Msymbol/s modulation. The following table captures the size and duration of the data packet fields.

Table 2-4: Packet format for LE coded PHY

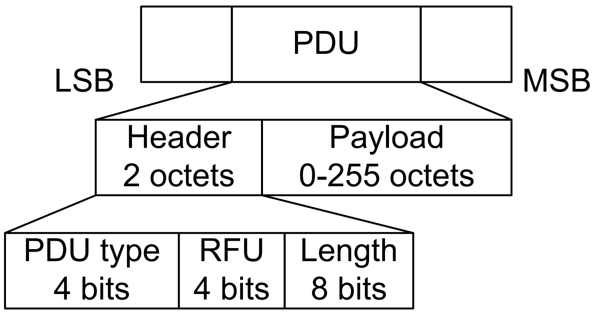
	Pream-ble	Access address	CI	TERM1	PDU	CRC	TERM2
Number of uncoded bits	80	32	2	3	16 - 2056	24	3
Duration in µs for S=8 coding	80	256	16	24	128 - 16448	192	24
Duration in µs for S=2 coding	80	256	16	24	32 - 4112	48	6

Packets take between 462 µs and 17040 µs to transmit.

2.2.2 Packet types for LE

Test packet types

The test packet PDU consists of a PDU header and the payload field. The PDU header indicates the payload content type and the payload length expresses in octets. RFU field means reserved for future use.



LE test packets are described in the "Air Interface Packets" section of the core specification for Bluetooth wireless technology, volume 6, part B.

Advertising channel packet types

The advertising channel PDU has a 16-bit header and a variable-size payload. The header fields of the advertising channel PDU are as shown in "Header" on page 18.

Table 2-5: Advertising packets for R&S SMW-K60

ADV_IND	SCAN_REQ
ADV_DIRECT_IND	SCAN_RSP
ADV_NONCONN_IND	CONNECT_IND
ADV_SCAN_IND	

Table 2-6: Advertising packets for R&S SMW-K117

ADV_EXT_IND	AUX_SCAN_REQ
AUX_ADV_IND	AUX_SCAN_RSP

AUX_CHAIN_IND	AUX_CONNECT_REQ
AUX_SYNC_IND	AUX_CONNECT_RSP

Data channel packet types

The data channel PDU has a 16-bit header, a variable size payload, and can include a message integrity check (MIC) field as shown in "Header" on page 20.

The MIC field is not included in an unencrypted link layer (LL) connection, or in an encrypted LL connection with a data channel PDU with a zero length payload. The MIC field is included in an encrypted LL connection, with a data channel PDU with a non-zero length payload. The MIC calculation is specified in the section 1 of the core specification for Bluetooth wireless technology, volume 6, part E.

Besides the data packet type, the instrument supports the following CONTROL_DATA packet types.

Table 2-7: Control data packets for R&S SMW-K60

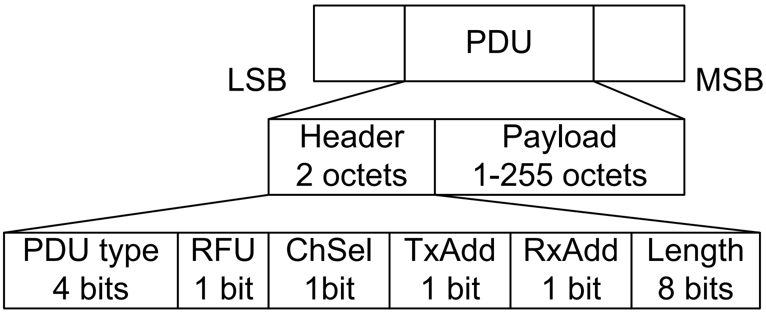
Opcode	CONTROL_DATA	Opcode	CONTROL_DATA
0x00	LL_CONNECTION_UPDATE_IND	0x07	LL_UNKNOWN_RSP
0x01	LL_CHANNEL_MAP_IND	0x08	LL_FEATURE_REQ
0x02	LL_TERMINATE_IND	0x09	LL_FEATURE_RSP
0x03	LL_ENC_REQ	0x0A	LL_PAUSE_ENC_REQ
0x04	LL_ENC_RSP	0x0B	LL_PAUSE_ENC_RSP
0x05	LL_START_ENC_REQ	0x0C	LL_VERSION_IND
0x06	LL_START_ENC_RSP	0x0D	LL_REJECT_IND

Table 2-8: Control data packets for R&S SMW-K117

Opcode	CONTROL_DATA	Opcode	CONTROL_DATA
0x0E	LL_PERIPHERAL_FEAT_REQ	0x14	LL_LENGTH_REQ
0x0F	LL_CONNECTION_PARAM_REQ	0x15	LL_LENGTH__RSP
0x10	LL_CONNECTION_PARAM_RSP	0x16	LL_PHY_REQ
0x11	LL_REJECT_EXT_IND	0x17	LL_PHY_RSP
0x12	LL_PING_REQ	0x18	LL_PHY UPDATE_IND
0x13	LL_PING_RSP	0x19	LL_MIN_USED_CHANNELS_IND

2.2.3 Advertising channel packet structure

Header



- The possible **PDU types**, indicated in the header of advertising channel PDU, are listed in the previous tables, see Table 2-5.

Table 2-9: PDU types and PHYs

PDU type	PDU name	Physical channel	LE 1M	LE 2M	LE Coded
0000_b	ADV_IND	Primary advertising	Yes	No	No
0001_b	ADV_DIRECT_IND	Primary advertising	Yes	No	No
0010_b	ADV_NONCONN_IND	Primary advertising	Yes	No	No
0011_b	SCAN_REQ	Primary advertising	Yes	No	No
0011_b	AUX_SCAN_REQ	Secondary advertising	Yes	Yes	Yes
0100_b	SCAN_RSP	Primary advertising	Yes	No	No
0101_b	CONNECT_IND	Primary advertising	Yes	No	No
0101_b	AUX_CONNECT_REQ	Secondary advertising	Yes	Yes	Yes
0110_b	ADV_SCAN_IND	Primary advertising	Yes	No	No
0111_b	ADV_EXT_IND	Primary advertising	Yes	No	Yes
0111_b	AUX_ADV_IND	Secondary advertising	Yes	Yes	Yes
0111_b	AUX_SCAN_RSP	Secondary advertising	Yes	Yes	Yes
0111_b	AUX_SYNC_IND	Secondary advertising	Yes	Yes	Yes
0111_b	AUX_CHAIN_IND	Secondary advertising	Yes	Yes	Yes
1000_b	AUX_CONNECT_RSP	Secondary advertising	Yes	Yes	Yes
Others	Reserved for future use				

- The **ChSel**, **TxAdd** and **RxAdd** fields contain information specific to the PDU type. If the ChSel, TxAdd or RxAdd fields are not defined as used in a given PDU then they are reserved for future use.
- The **Length** field indicates the payload field length in octets.

Payload

The advertising channel PDU types consist of three groups.

Table 2-10: Advertising channel PDU types

PDU type	PDU name	Option
Advertising PDU (legacy)	ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_SCAN_IND	R&S SMW-K60
Advertising PDU (extended)	ADV_EXT_IND, AUX_ADV_IND, AUX_SYNC_IND, AUX_CHAIN_IND	R&S SMW-K117
Scanning PDU	SCAN_REQ, SCAN_RSP	R&S SMW-K60
Scanning PDU	AUX_SCAN_REQ, AUX_SCAN_RSP	R&S SMW-K117
Initiating PDUs	CONNECT_IND	R&S SMW-K60
Initiating PDUs	AUX_CONNECT_REQ, AUX_CONNECT_RSP	R&S SMW-K117

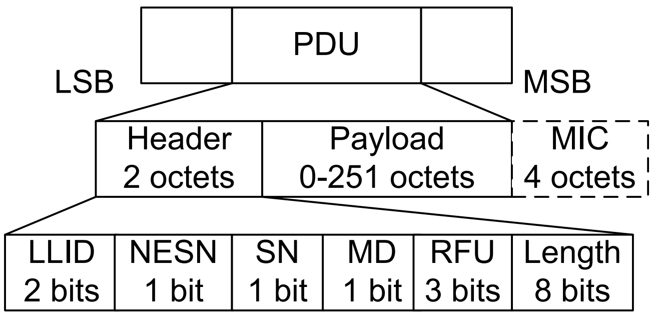
Table 2-11: Advertising channel PDU fields and subfields

PDU name	Field and parameter	Option
ADV_IND, ADV_NON-CONN_IND, ADV_SCAN_IND	AdvA, AdvData	R&S SMW-K60
ADV_DIRECT_IND	AdvA, TargetA (formerly InitA)	R&S SMW-K60
ADV_EXT_IND, AUX_ADV_IND, AUX_SYNC_IND, AUX_CHAN_IND	Extended Header Length, AdvMode, Extended Header, AdvData Extended Header subfields: AdvA, TargetA, ADI, AuxPtr, SyncInfo, Tx Power, ACAD, AdvData	R&S SMW-K117
SCAN_REQ	ScanA, AdvA	R&S SMW-K60
SCAN_RSP	AdvA, ScanRspData	R&S SMW-K60
AUX_SCAN_REQ	ScanA, AdvA Extended Header Length, AdvMode, Extended Header, AdvData Extended Header subfields: see above	R&S SMW-K117
CONNECT_IND	InitA, AdvA, LLData LLData subfields: AA, CRCinit, WinSize, WinOffset, Interval, Latency, Timeout, ChM, Hop, and SCA fields	R&S SMW-K60
AUX_CONNECT_REQ	InitA, AdvA, LLData LLData subfields: see above	R&S SMW-K117
AUX_CONNECT_RSP	Extended Header Length, AdvMode, Extended Header, AdvData Extended Header subfields: see above	R&S SMW-K117

For more information, refer to the section Advertising channel PDU in [1].

2.2.4 Data channel packet structure

Header



The 16-bit header field consists of five fields:

- The **LLID** field of the header specifies the payload format, see "Payload" on page 20.
- The **NESN** bit indicates a nextExpectedSeqNum used by the peer to acknowledge the last PDU sent, or to request resending.
- The **SN** bit indicates a transmitSeqNum to identify packets sent by the link layer.
- The **MD** bit indicates, whether the device has more data to send.
- The **Length** field indicates the length of the payload and MIC if included.

Payload

- An **LL data PDU** is used to send L2CAP data. The LLID field is set to either 01b or 10b.
  – For the LLID field set to 01b, the LL data PDU is a continuation fragment of an L2CAP message, or an empty PDU.
    The LL of the Central sends an empty PDU to the Peripheral to allow the Peripheral to respond with any data channel PDU, including an empty PDU.
  – For the LLID field set to 10b, the LL data PDU is a start of an L2CAP message or a complete L2CAP message with no fragmentation.
- An **LL control PDU** is used to control the LL connection. The payload consists of Opcode and CtrData fields. All LL control PDUs have a fixed length, depending on the Opcode. The Opcode field identifies different types of LL Opcode PDU, see Table 2-7.

For more information, refer to section Data channel PDU in [1].

2.2.5 Modulation scheme

The modulation is Gaussian frequency shift keying (GFSK) with a bandwidth bit period product BT = 0.5. The modulation index is between 0.45 and 0.55. The mandatory modulation scheme is 1 Msymbol/s modulation. It uses a shaped, binary FM to minimize transceiver complexity.

Option R&S SMW-K60 supports LE uncoded 1 Msymbol/s (LE 1M) physical layer (PHY).

Option R&S SMW-K117 supports LE Coded 1 Msymbol/s PHY and an optional modulation scheme LE uncoded 2 Msymbol/s (LE 2M) PHY.

2.2.6 Direction finding

Since Bluetooth version 5.1, a Bluetooth LE device can transmit its direction information to a Bluetooth receiver. The information is transmitted in the direction finding enabled packets in the LE uncoded PHY. In combination with location information sent on profile-level, the Bluetooth LE receiver can calculate its position.

Angle of Arrival (AoA) method

A Bluetooth LE transmitter sends direction finding enabled packets using a single antenna. A receiving Bluetooth LE peer device consists of an antenna array linked to an RF switch which forwards the combined antennae signal to a Bluetooth LE receiver.

The peer device switches its antennae while receiving parts of the packets and capturing I/Q samples. The I/Q samples are used to calculate the phase difference of the radio signal received by different antennae of the array.

For an array of two antennae with distance d, frequency f of the radio signal and speed of light c, the phase difference ψ calculates as follows:

$$\Psi = 2\pi d \cos(\Theta) \cdot \frac{f}{c}$$

The angle of arrival Θ is calculated as follows:

$$\Theta = \frac{\arccos(\Psi \cdot c)}{2\pi d \cdot f}$$

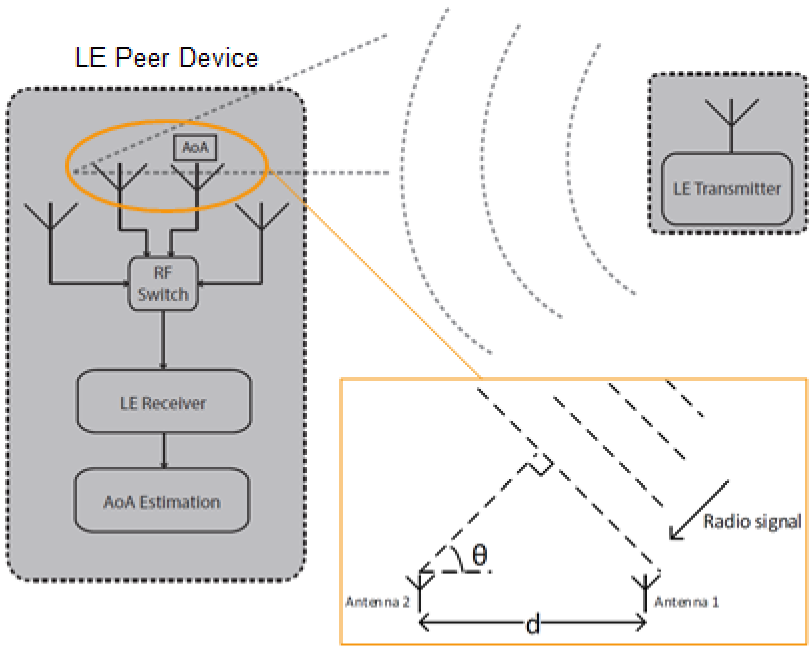


Figure 2-4: Angle of Arrival method

Angle of Departure (AoD) method

A Bluetooth LE transmitter sends direction finding enabled packets using an antenna array. A receiving Bluetooth LE device, consisting of a single antenna, captures I/Q samples and the geometry of the antenna array from profile-level information.

For an array with two antennae with distance d, frequency f of the radio signal and speed of light c, the phase difference ψ calculates as follows:

$$\Psi \;=\; 2\pi d\cos(\Theta)\cdot\frac{f}{c}$$

The angle of arrival Θ is calculated as follows:

$$\Theta \;=\; \frac{\arccos(\Psi\cdot c)}{2\pi d\cdot f}$$

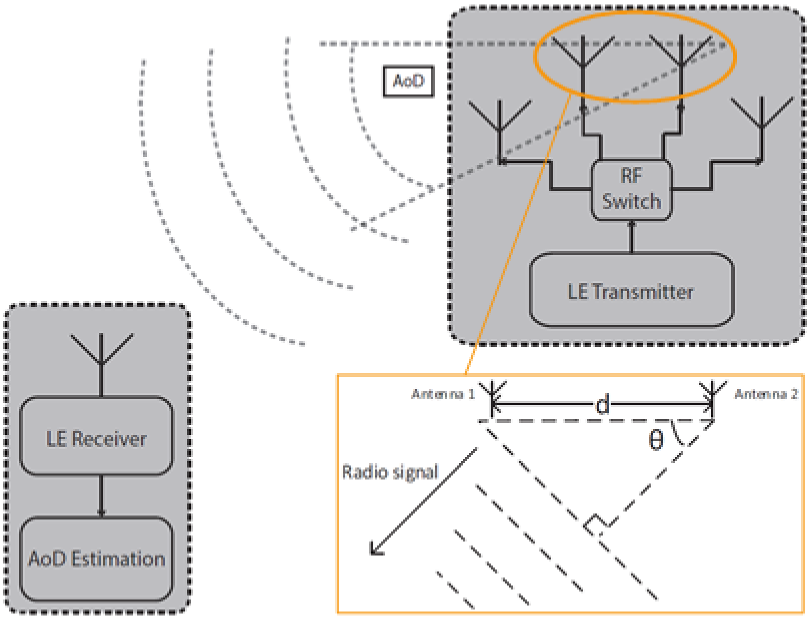


Figure 2-5: Angle of Departure method

The geometry of the antenna array is information that is shared between Bluetooth LE transmitter and receiver on a profile-level. The antenna switching pattern and the method of angle estimation is specified by Constant Tone Extension.

For more information, refer to the section Direction Finding Using Bluetooth Low Energy in [1].

Constant tone extension

To transmit direction finding information in packets in the Bluetooth LE Uncoded PHYs, the link layer packet format is extended by an optional field Constant Tone Extension (CTE) as illustrated in Figure 2-2. The field has a length between 16 µs and 160 µs and consists of a constantly modulated series of unwhitened 1s. This modulation results in a CW tone shifted by 250 kHz (LE 1M) or 500 kHz (LE 2M) from the LE channel center frequency.

The presence, type and length of CTE is specified in the CTEInfo field available for ADV_SYNC_IND and ADV_CHAIN_IND PDUs.

CTEInfo (8 bit)		
CTETime	RFU	CTEType

Figure 2-6: CTEInfo field

The parts of the CTEInfo field are described in the table below. CTEType specifies if the AoA or AoD method is used for direction finding.

CTEInfo field	Length	Value	Description
CTETime	5 bit	2 to 20	CTE length = 8 µs * Value Other values are reserved for future use.
RFU	1 bit	1 to 2	Reserved for future use
CTEType	2 bit	0 1 2 3	AoA Constant tone extension AoD Constant tone extension with 1 µs slots AoD Constant tone extension with 2 µs slots Reserved for future use

If Bluetooth LE devices support AoA/AoD CTE, the antennae within the array follow a switching pattern specified by the Host. After a guard and reference period, timeslots of 1 µs or 2 µs provide periods for antenna switching and I/Q sampling.

The following figure illustrates the CTE structure for the AoA method. On the transmitting side, there is no antenna switching. On the receiving side, antenna switching and I/Q sampling alternate in the timeslots after the guard and reference period.

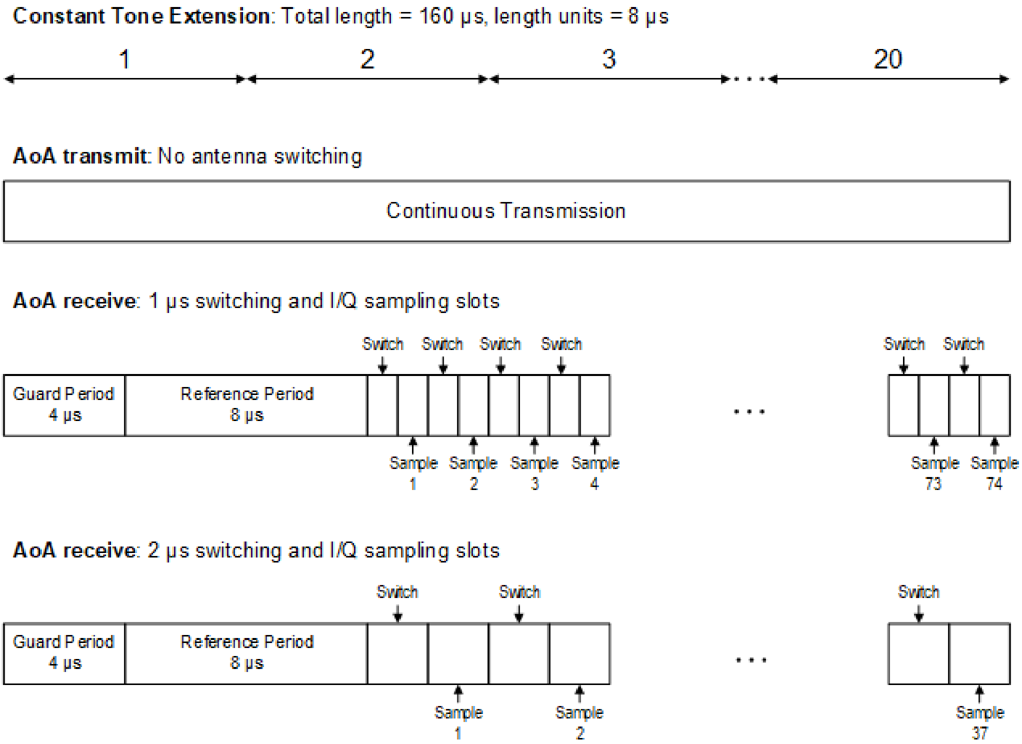


Figure 2-7: CTE structure for AoA method

The following figure illustrates the CTE structure for the AoD method. On the transmitting side, antenna switching and I/Q sampling alternate in the timeslots after the guard and reference period. On the receiving side, I/Q sampling is only in every second timeslot after the guard and reference period.

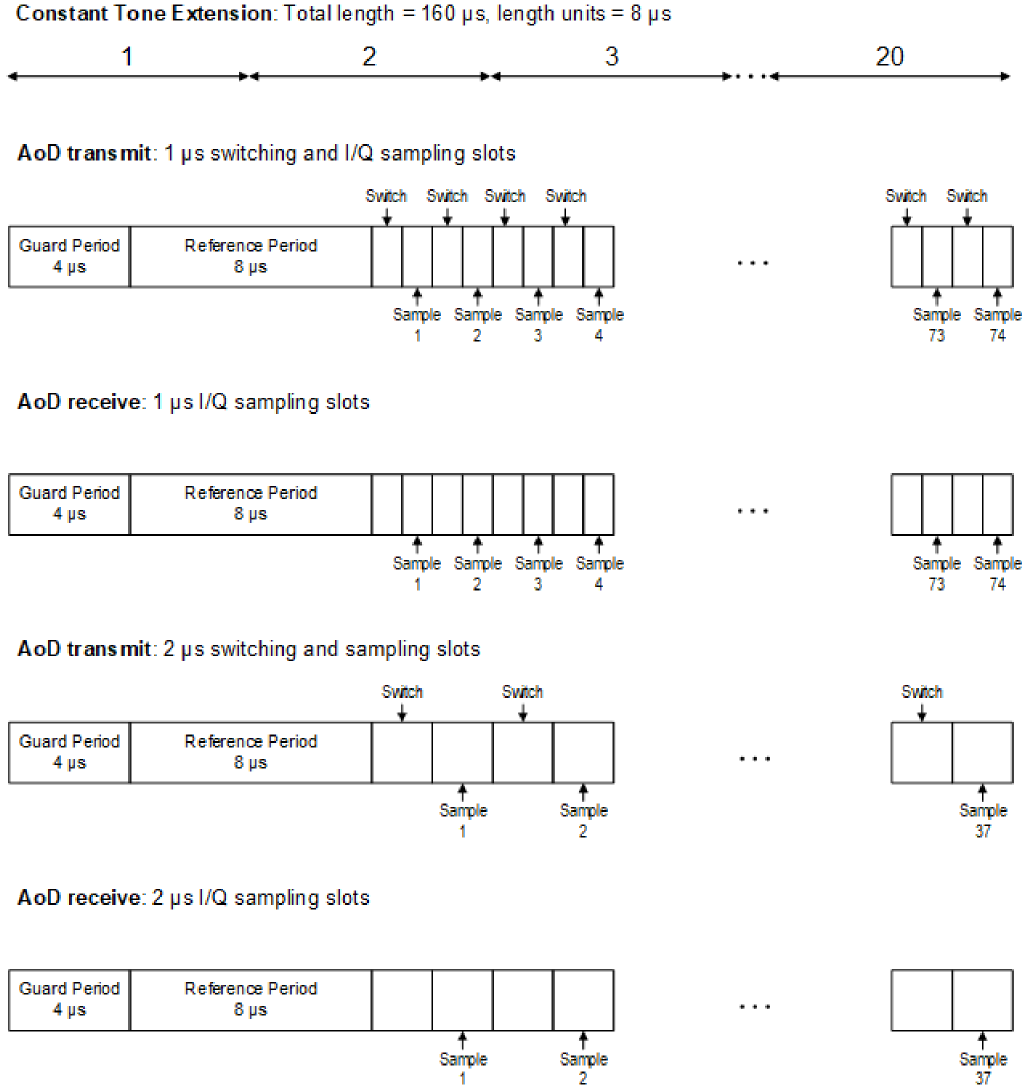


Figure 2-8: CTE structure for AoD method

For more information, refer to section 2.5 Constant Tone Extension and IQ Sampling of core specification for Bluetooth wireless technology, volume 6, part B.

2.3 About Bluetooth LE Channel Sounding

This section provides basic information on Bluetooth LE Channel Sounding technology. For the detailed information, refer to the Bluetooth specifications [2] and [1].

Channel Sounding architecture

Devices can use the LE Channel Sounding (CS) physical link to exchange information for distance estimation calculations. A CS procedure, including the first CS event within that procedure, is started offset from the timing of ACL connection event anchor points.

A CS procedure exists only for a limited duration, and consists of CS events, CS subevents, and CS steps.

CS events may contain one or more subevents. CS subevents contain two or more CS steps. CS steps contain bilateral exchanges between the two CS peers known as the initiator and reflector. The CS initiator transmits first in each step, followed by one or more transmissions from the CS reflector. These transmissions may be a packet-based GFSK-modulated exchange or a tone-based, amplitude shift keying modulated exchange, or both.

Channel Sounding RF channels

Table 2-12: Operating frequency band

Frequency range	RF channels k and center frequencies f
2400.0 MHz to 2483.5 MHz	k = 0 to 78, f = k * 1 MHz + 2402 MHz

Some channels are not allowed for CS communication. The table Table 2-13 provides an overview on allowed channels and not allowed channels including the channel index and the center frequency of the channel.

Table 2-13: CS channel index and allowed channels

Channel index	RF center frequency	Channel allowed
0 and 1	2402 MHz and 2403 MHz	No
2 to 22	2404 MHz to 2424 MHz	Yes
23 to 25	2425 MHz to 2427 MHz	No
26 to 76	2428 MHz to 2478 MHz	Yes
77 and 78	2479 MHz and 2480 MHz	No

Fractional frequency offset actuation error (FAE)

The FAE feature allows a device to adapt its frequency hopping pattern to avoid interference from other wireless devices operating in the same frequency band.

The feature uses a list of channels in the FAE table, which is periodically updated based on the results of Channel Sounding procedures. When a device detects interference on a particular channel, it can switch to a different channel from the FAE table to avoid the interference.

2.4 About Bluetooth BR/EDR

The frequency band defined for Bluetooth devices is the unlicensed 2.4 GHz Industrial, Scientific and Medical (ISM) frequency band.

Table 2-14: Operating band

Regulatory range	RF channels k and center frequencies f
2400.0 MHz to 2483.5 MHz	k = 0 to 78, f = k * 1 MHz + 2402 MHz

Two modulation formats are used for Bluetooth: the mandatory basic rate (BR) and the optional enhanced data rate (EDR). The BR mode uses binary FM modulation and provides a data rate of 1 Mbit/s. The EDR mode uses two types of PSK modulation, the π/4-DQPSK or 8DPSK, and achieves data rates of 2 Mbit/s and 3 Mbit/s, respectively. All modulation schemes have the symbol rate equal to 1 Msymbol/s.

A time division duplex (TDD) scheme for duplex transmission is defined for both modes.

The following sections describe signal characteristics in detail:

2.4.1 Bluetooth packet types for BR/EDR

2.4.1.1 ACL packets

The ACL packets are used for asymmetric links and they contain user data or control data. The table and the figures below give an overview of the ACL packets and their structure.

Table 2-15: ACL packet - basic rate

<table>
<tr><th>Type</th><th>Payload Header (bytes)</th><th>User Payload (bytes)</th><th>FEC</th><th>CRC</th><th>Slot number</th></tr>
<tr><td>DM1</td><td rowspan="2">1</td><td>0-17</td><td>2/3</td><td rowspan="6">Yes, 16-bit</td><td rowspan="2">1</td></tr>
<tr><td>DH1</td><td>0-27</td><td>no</td></tr>
<tr><td>DM3</td><td rowspan="4">2</td><td>0-121</td><td>2/3</td><td rowspan="2">3</td></tr>
<tr><td>DH3</td><td>0-183</td><td>no</td></tr>
<tr><td>DM5</td><td>0-224</td><td>2/3</td><td rowspan="3">5</td></tr>
<tr><td>DH5</td><td>0-339</td><td rowspan="2">no</td></tr>
<tr><td>AUX1</td><td>1</td><td>0-29</td><td>no</td></tr>
</table>

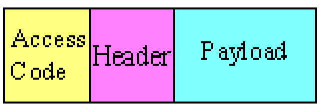


Figure 2-9: Packet structure of ACL packets - basic rate

Table 2-16: ACL packets - enhanced rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot number
2-DH1		0-54			1
2-DH3		0-367			3
2-DH5	2	0-679	no	Yes, 16-bit	5
3-DH1		0-83			1
3-DH3		0-552			3
2-DH5		0-1021			5

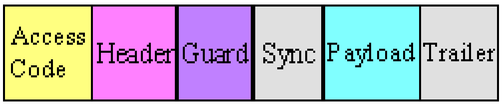


Figure 2-10: Packet structure of ACL packets - enhanced data rate

2.4.1.2 SCO and eSCO packets

The SCO and eSCO packets are used for symmetric links. The SCO packets are used for 64 kb/s speech transmission and for transparent synchronous data. The eSCO packets are also used for 64kb/s speech transmission and transparent data at 64 kb/s but also at other rates.

The tables and the figures below give an overview of the SCO and eSCO packets and their structure.

Table 2-17: SCO packets

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot number
HV1		10	1/3		
HV2	n.a.	20		no	
HV3		30	2/3		n.a.
DV	1 (data only)	10+(0-9)	2/3 (data only)	Yes, 16-bit (data only)	

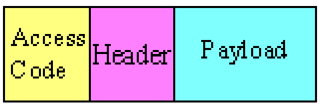


Figure 2-11: Packet structure SCO packets

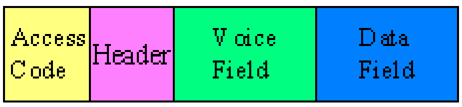


Figure 2-12: Packet structure SCO packets (data only)

Table 2-18: eSCO packets - basic rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot number
EV3		1-30	no		1
EV4	n.a.	1-120	2/3	Yes, 16-bit	3
EV5		1-180	no	(Data only)	3

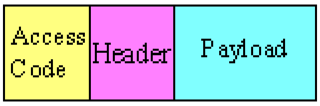


Figure 2-13: Packet structure eSCO packets - basic rate

Table 2-19: eSCO packets - basic rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot number
2-EV3		1-60			1
2-EV5	n.a.	1-360	no	Yes,	3
3-EV3		1-90		16-bit	1
3-EV5		1-540			3

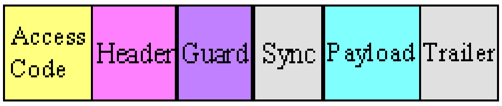


Figure 2-14: Packet structure eSCO packets - enhanced data rate

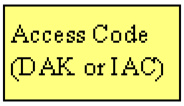
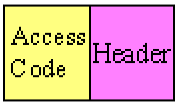
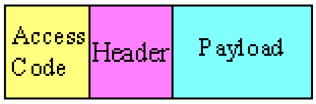
2.4.1.3 Link control packets for ACL, SCO, eSCO transport modes

There are some common kinds of packet types. An overview of these packet types is given in the table below.

Table 2-20: Common link control packets

Transport modes	Type	Payload Header (bytes)	FEC	CRC	Application
SCO, eSCO, ACL	ID				Paging, inquiry, response
SCO, eSCO, ACL	NULL	n.a.	n.a.	n.a.	Carries Link information to the source, e.g. about successfully received signal (ARQN) or the state of the receiving buffer (FLOW)
SCO, eSCO, ACL	POLL				Similar to NULL packet, used by the Central to poll the Peripheral devices, must be confirmed
SCO, ACL	FHS	18	2/3	Yes	Page Central response, inquiry response, in roll switch

Table 2-21: Common link control packets: packet structure

Packet Type ID	Packet Types NULL and PULL	Packet Types FHS
		

2.4.2 Bluetooth transport modes

There are three different transport modes defined in the Bluetooth core specification, each of them with special applications:

- Synchronous connection-oriented (SCO)
  The SCO transport mode is used for a symmetric point-to-point link establishment between a Central and a specific Peripheral in the piconet.
- Extended synchronous connection-oriented (eSCO)
  The eSCO transport mode is used for a symmetric or asymmetric, point-to-point link establishment between the Central and a specific Peripheral.
- Asynchronous connection less (ACL)
  The ACL transport mode is used for a point-to-multipoint link establishment between the Central and all Peripheral participating on the piconet.

There are some common transmitted packets used by all transport modes and some specific packets defined for each transport mode.

2.4.3 Packet structure and fields

Almost all Bluetooth transmitted packets have standard format and consist of the access code, the header and the payload with useful information. The exceptions are the ID packet which consists of the access code only and NULL and POLL packets which carry only the access code and the header.

2.4.3.1 Access code

The access code is used for synchronization, DC offset compensation and identification. The fields of the access code are shown in the figure below and their meaning is explained in the table below.

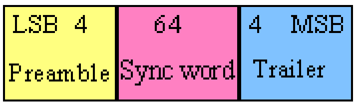


Table 2-22: The access code fields

Field	Description	Packets
Preamble	A fixed zero-one pattern of 4 symbols, used to facilitate DC compensation	All packets
Sync word	A 64-bit code word derived from a 24-bit address, improves timing acquisition	All packets
Trailer	A fixed zero-one pattern of four symbols, extended DC compensation	All packets, except ID

2.4.3.2 Header

The header contains link control information. The fields of the header are shown in the figure and their meaning is explained in the table below.

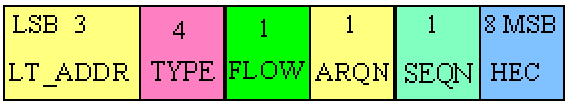


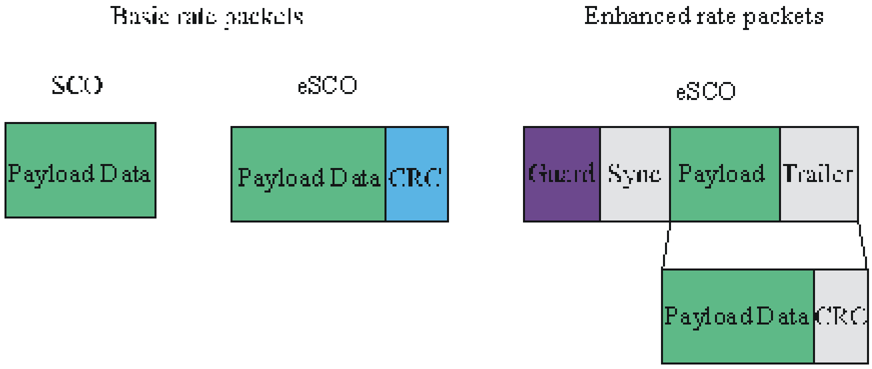
Table 2-23: The header fields

Field	Description	Packets
LT_ADDR	Logical transport address, indicates the destination Peripheral for a packet in a Central-to-Peripheral transmission slot and the source Peripheral for a Peripheral-to-Central transmission slot	
TYPE	Type code, specifies which packet type is used	
FLOW	Flow control, used for flow control of packets over the ACL logical transport. When the RX buffer in the recipient is full, a STOP indication must be returned. When the RX buffer can accept data, a "Go" indication must be returned.	All packets, except ID
ARQN	Automatic repeat request number, acknowledgement indication, used to inform the source of a successful transfer of payload data with CRC can be positive acknowledged ACK or negative acknowledged NAK,	
SEQN	Sequential numbering scheme to order the data packet stream	
HEC	Header-error-check to check the header integrity	

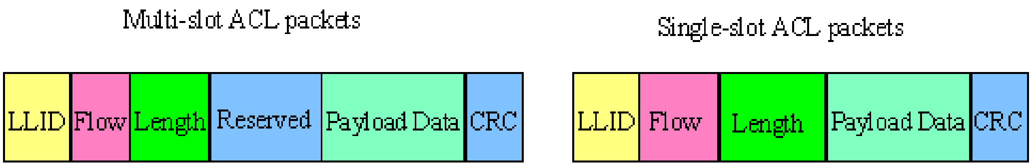
2.4.3.3 Payload format

The payload structure depends on the type of the data field and the data rate. Two fields are defined in the payload: the synchronous data field and the asynchronous data field. The ACL packets only have the asynchronous data field and the SCO and eSCO packets only have the synchronous data field. The exception is DV of SCO transport mode which has both data fields, synchronous and asynchronous.

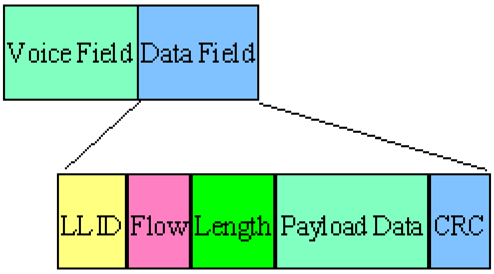
Synchronous data fields



Asynchronous data fields



Synchronous and asynchronous data fields



The meaning of some payload fields is given in the table below.

Table 2-24: The payload fields

Field	Description
CRC	The cyclic redundancy error check
Guard, sync	The guard time and synchronization sequence, used for physical layer change of modulation scheme
LLID	The logical link identifier, specifies the logical link
Flow	Field which controls the flow on the logical channels

The payload format and content of the FHS packet are different from other packets. The fields of the FHS packet are shown in the figure below and their meaning is explained in the table below.

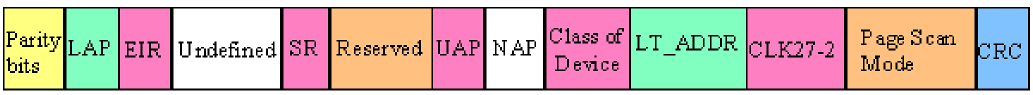


Table 2-25: The payload fields for the FHS packet

Field	Description
Parity bits	Form the first part of the sync word of the access code of the device that sends the FHS packet
LAP	Contains the lower address part of the device that sends the FHS packet
EIR	An extended inquiry response, provides miscellaneous information during the inquiry response procedure
Undefined	Reserved for future use and must be set to zero
SR	The scan repetition field, indicates the interval between two consecutive page scan windows
Reserved	Must be set to 10
UAP	Contains the upper address part of the device that sends the FHS packet
NAP	Contains the non–significant address part of the device that sends the FHS packet
Class of device	Contains the class of device of the device that sends the FHS packet. This field is defined in Bluetooth assigned numbers.
LT_ADDR	Contains the logical transport address
CLK27-2	Contains the value of the native clock of the device that sends the FHS packet, sampled at the beginning of the transmission of the access code of this FHS packet
Page scan mode	Indicates which scan mode is used by default by the sender of the FHS packet

2.4.4 Bluetooth modulation schemes

The modulation used for the basic data rate packets is GFSK (Gaussian Frequency Shift Keying) with a bandwidth bit period product BT = 0.5. The modulation index is between 0.28 and 0.35.

The modulation scheme used for enhanced data rate packets changes within the packet. The access code and packet header have a GFSK modulation scheme and are transmitted with the basic rate 1 Mbps. The subsequent synchronization sequence, payload and trailer sequence have a PSK type of modulation and are transmitted with a data rate of 2 Mbps or optionally 3 Mbps.

The PSK modulation, namely π/4 rotated differential encoded quaternary phase shift keying (π/4–DQPSK) is defined for the 2 Mbps transmission.

The PSK modulation, namely differential encoded 8-ary phase shift keying (8DPSK), is defined for the 3 Mbps transmission.

The modulation types and corresponding packet types are given in the table below.

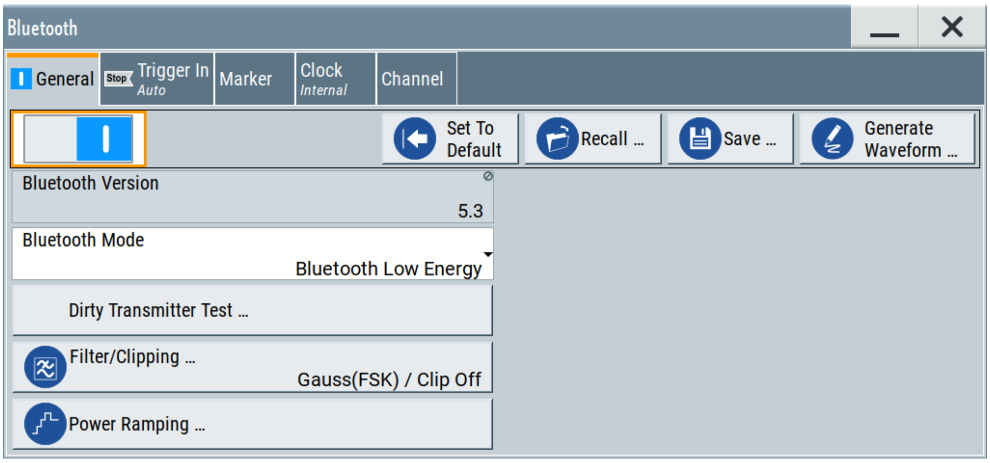
Table 2-26: The modulation types and corresponding packet types

Modulation type	Packet types
GFSK	ID, NULL, POLL, FHS, DM1, DH1, DM3, DH3, DM5, DH5, AUX1, HV1, HV2, HV3, DV, EV3, EV4, EV5
GFSK + π/4-DQPSK	2-DH1, 2-DH3, 2-DH5, 2-EV3, 2-EV5
GFSK + 8DPSK	3-DH1, 3-DH3, 3-DH5, 3-EV3, 3-EV5

3 Bluetooth general settings

Access:

► Select "Baseband" > "Bluetooth".



The tab provides general settings to call default settings and the "Save"/"Recall" settings. Also, it provides Bluetooth version information, Bluetooth mode settings and access to further settings.

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:BTOoth:STATe` on page 166

Set To Default

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

Parameter	Value
State	Not affected by "Set To default"
Bluetooth version	R&S SMW-K60: 4.2 R&S SMW-K117: 5.4 R&S SMW-K178: 5.4 + Channel Sounding
Bluetooth mode	Basic Rate + EDR
Transport mode	ACL(Asynchronous)+EDR
Packet type	DH1
Sequence length	1 Frame
Slot timing	Tx Test Mode
Data whitening	Off
Dirty transmitter test	Off
Filter	Gauss(FSK)
Clipping state	Off
Power ramping function	Cosine
Trigger mode	Auto
Marker mode	Restart
Clock source	Internal

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRESet` on page 165

Save/Recall

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

The settings are saved in a file with predefined extension. You can define the filename and the directory, in that you want to save the file.

See also, chapter "File and Data Management" in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:SETTing:CATalog` on page 165
`[:SOURce<hw>]:BB:BTOoth:SETTing:LOAD` on page 165
`[:SOURce<hw>]:BB:BTOoth:SETTing:STORe` on page 166
`[:SOURce<hw>]:BB:BTOoth:SETTing:DELete` on page 165

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.

Remote command:
[:SOURce<hw>]:BB:BTOoth:WAVeform:CREate on page 167

Bluetooth Version

Displays the version of the standard that the firmware supports.

The displayed version for Bluetooth wireless technology depends on installed options. For example, "Bluetooth Version" > "5.4" requires R&S SMW-K117.

Remote command:
[:SOURce<hw>]:BB:BTOoth:VERSion? on page 167

Bluetooth Mode

Selects the Bluetooth mode.

"Basic Rate + EDR"
: Selects basic rate (BR) or enhanced data rate (EDR) Bluetooth mode. For related settings, see Chapter 6, "Bluetooth BR/EDR configuration and settings", on page 133.

"Bluetooth Low Energy"
: Selects low energy (LE) Bluetooth mode. For related settings, see Chapter 5, "Bluetooth LE configuration and settings", on page 44.

Remote command:
[:SOURce<hw>]:BB:BTOoth:BMODe on page 164

Transport Mode

Requires "Bluetooth Mode" > "Basic Rate + EDR".

Selects the transport mode.

"ACL(Asynchronous)+EDR"
: The transport mode selected is used for a point-to-multipoint link establishment between the Central and all the Peripheral devices participating on the piconet.

"SCO(Synchronous)"
: The transport mode selected is used for a point-to-point link establishment between a Central and a single Peripheral in the piconet.

"eSCO(Extended SCO)+EDR"
: The transport mode selected is used for a symmetric or asymmetric point-to-point link establishment between a Central and a specific Peripheral.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TMODe on page 166

Dirty Transmitter Test

Opens a dialog to configure dirty transmitter tests.

See Chapter 4, "Dirty transmitter test settings", on page 39.

Filter/Clipping

Opens a dialog to configure the baseband filtering, the modulation settings and clipping.

The button also displays configured filters and the clipping state.

See Chapter 7.1, "Filter/clipping settings", on page 143.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:FILTers?` on page 284
`[:SOURce<hw>]:BB:BTOoth:CLIPping:STATe` on page 283

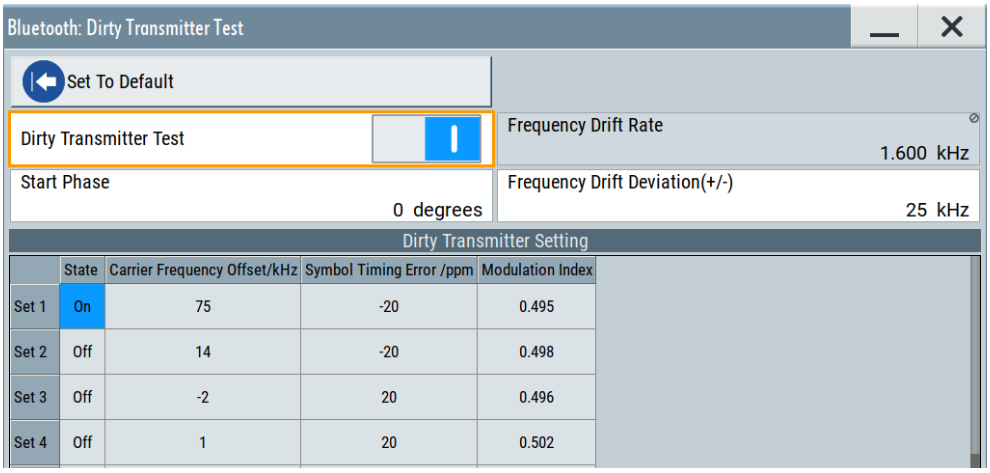
Power Ramping
Opens a dialog to configure the power ramping.

See Chapter 7.2, "Power ramping settings", on page 149.

4 Dirty transmitter test settings

Access:

1. Select "Bluetooth" > "General".
2. Select "Dirty Transmitter Test".



The dialog provides settings to configure dirty transmitter test settings. These settings contain parameters that you can change for the central device signal. It is used to test the connection under 'dirty transmitter' conditions, and to define the influence on the receiver quality (bit error rate tests).

The following tables list dirty transmitter parameters according to the Bluetooth test specification. f_{offset} is the frequency offset, Δt_{error} is the symbol timing error and h is the modulation index.

Table 4-1: Dirty transmitter test parameters for BR

Set	f_{offset}	Δt_{error}/ppm	h
1	75	-20	0.28
2	14	-20	0.30
3	-2	20	0.29
4	1	20	0.32
5	39	20	0.33
6	0	-20	0.34
7	-42	-20	0.29
8	74	-20	0.31
9	-19	-20	0.28
10	-75	20	0.35

Table 4-2: Dirty transmitter test parameters for EDR

Set	f_{offset}	Δt_{error}/ppm
1	0	0
2	65	20
3	-65	-20

Table 4-3: Dirty transmitter test parameters for LE

Set	f_{offset}	Δt_{error}/ppm	$h_{standard}$	h_{stable} *)
1	100	-50	0.45	0.495
2	19	-50	0.48	0.498
3	-3	50	0.46	0.496
4	1	50	0.52	0.502
5	52	50	0.53	0.503
6	0	-50	0.54	0.504
7	-56	-50	0.47	0.497
8	97	-50	0.50	0.500
9	-25	-50	0.45	0.495
10	-100	50	0.55	0.505

*) h_{stable} requires R&S SMW-K117.

Settings:

Set To Default

Calls the default settings for the dirty transmitter test. Default settings are according to the specification for Bluetooth wireless technology. The setting corresponds to the selected Bluetooth mode.

Remote command:

`[:SOURce<hw>]:BB:BTOoth:DTTest:STDefault` on page 170

Dirty Transmitter Test

Enables the dirty transmitter test.

The setting is available for the following packet types:

- **BR**: DH1, DH3, DH5
  For basic rate packets, each enabled set of parameters in the "Dirty Transmitter Setting" is used for a duration of 20 ms. After 20 ms, the following enabled set is used, continuing with the first enabled set after the sequence is completed.
- **EDR**: 2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3, 3-DH5, 2-EV3, 2-EV5, 3-EV3, 3-EV5
  For EDR packets, the parameter sets apply for 20 packets each.
- **LE**: See the tables Table 5-1 and Table 5-2.
  For LE packets, each enabled set of parameters in the "Dirty Transmitter Setting" is used. After transmitting a configured number of packets or steps, the enabled set is used. After the sequence is completed, the transmission continues with the first enabled set.
  You can set up to 50 packets or steps, see "Number Of Packets Per Set/Number Of Steps Per Set" on page 42.

For more information, refer to the Bluetooth Core Specification [1].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:DTTState` on page 168

Start Phase

Enters a start phase.

The start phase of the sine wave used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset is set here.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:SPHase` on page 170

Modulation Index Mode

Requires option R&S SMW-K117 and "Bluetooth Mode" > "Bluetooth Low Energy".

Specifies the mode of the modulation index h that is standard or stable.

"Standard" Standard modulation index $h_{standard}$ with a range from 0.450 to 0.550.

"Stable" Stable modulation index h_{stable} with a range from 0.495 to 0.505.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:MIMode` on page 169

Frequency Drift Rate

Sets the frequency drift rate.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset with the set frequency drift rate.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:FDRate` on page 169

Frequency Drift Deviation(+/-)

Sets the frequency drift deviation.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset. The maximum deviation reached during the drift equals the set frequency drift deviation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:FDDeviation` on page 169

Number Of Packets Per Set/Number Of Steps Per Set
Setting the parameter requires "Bluetooth Mode" > "Bluetooth Low Energy" and one of the following:

"Number Of Packets Per Set"
Requires "Channel Type" > "Advertising" or "Data".
Sets the number of transmitted packets per enabled dirty transmitter set.

"Number Of Steps Per Set"
Requires "Channel Type" > "Advertising" or "Data".

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:NPPSet` on page 170

Dirty Transmitter Setting
Indicates the dirty transmitter parameters according to the Bluetooth test specification.

State ← Dirty Transmitter Setting
Enables the corresponding parameter set.

If deactivated, the parameters are skipped in the sequence, and the next active set is used.

Remote commands `...:LONG:SET<ch>:...` are used for BR and LE packets. The instrument provides a configuration of up to 10 sets (SET1 to SET10).

Remote commands `...:SHORt:SET<ch>:...` are used for EDR packets. The instrument provides a configuration of up to 3 sets (SET1 to SET3).

For basic rate packets, each enabled set applies to 20ms of signal. For EDR packets, each enabled set applies to 20 packets.

For LE, each enabled set applies to 50 test packets.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STATe`
on page 172
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STATe`
on page 173

Carrier Frequency Offset (kHz) ← Dirty Transmitter Setting
Determines a carrier frequency offset.

The center frequency of the modulated RF carrier is offset by the specified value.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:CFOFfset`
on page 171
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:CFOFfset`
on page 173

Symbol Timing Error (ppm) ← Dirty Transmitter Setting

Sets the symbol timing error in ppm.

The symbol timing error modifies the symbol clock frequency by the specified value.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STERror`
on page 173
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STERror`
on page 174

Modulation Index ← Dirty Transmitter Setting

Sets the modulation index.

The modulation index **h** specifies the frequency deviation, defined as:

$$h = \frac{2\Delta f}{f_{symbol}}$$

f_{symbol} is the symbol rate and Δf is the frequency deviation.

The modulation index can vary between 0.28 and 0.35.

For more information, refer to the Bluetooth Core Specification [1].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:MINDex`
on page 171

5 Bluetooth LE configuration and settings

Access:

1. Select "Baseband" > "Bluetooth".
2. Select "Bluetooth Mode" > "Bluetooth Low Energy".

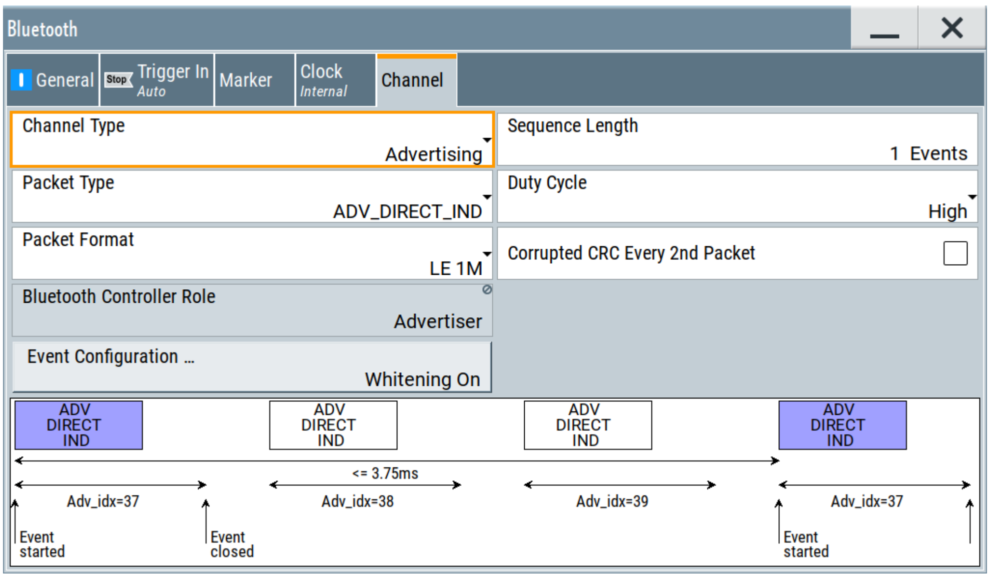
The remote commands required to define these settings are described in Chapter 8, "Remote control commands", on page 161.

Settings:

5.1 Channel settings

Access:

1. Select "Bluetooth" > "General".
2. Select "Bluetooth Mode" > "Bluetooth Low Energy".
3. Select "Channel".



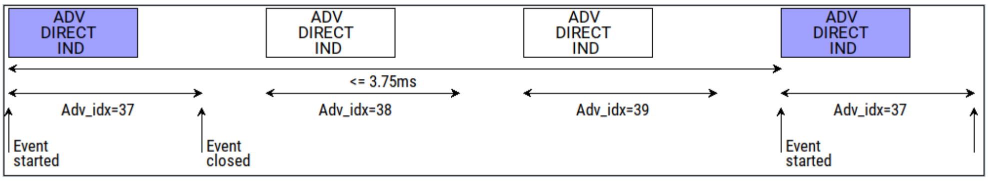
The tab provides settings to configure channel settings and general packet settings.

To display Bluetooth LE event or frame sequences

Depending on the channel type packet type and packet format, the "Channel" tab displays a chart at the bottom that illustrates sequences of the corresponding events or frames. The following steps provide examples to illustrate default sequences for different channel types.

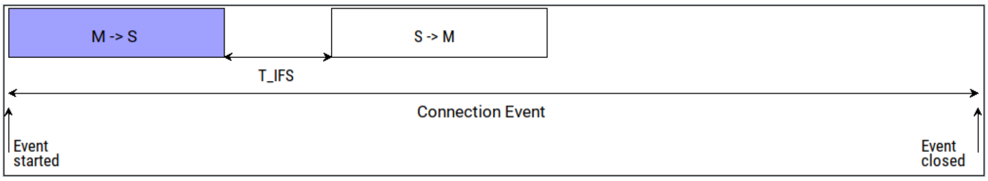
1. To display the sequence for an advertising channel, select the following:
   a) Select "Channel Type" > "Advertising".
   b) Select, for example, "Packet Type" > "ADV_DIRECT_IND".

   The chart displays one sequence of ADV_DIRECT_IND packets including markers for event start and event stop.



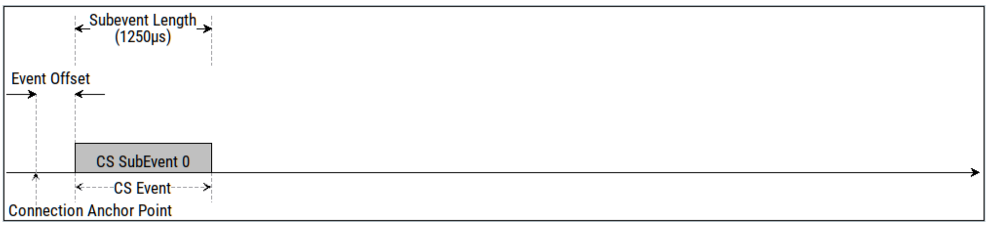
2. To display the sequence for a data channel, select the following:
   a) Select "Channel Type" > "Data".
   b) Select, for example, "Packet Type" > "DATA".

   The chart displays one sequence of data PDUs including markers for event start and event stop.



3. To display the sequence for a Channel Sounding channel, select the following:
   a) Select "Channel Type" > "Channel Sounding".
   b) Select, for example, "Packet Type" > "CS SEQUENCE".

   The chart displays one sequence of CS events including event offset, CS subevents and subevent lengths.



Settings:

Channel Type

Determines the channel type.

"Advertising" Selects channel type advertising.

"Data" Selects the data channel type.
Devices in a connected state transmit the data channel packets in connection events with a start point and an interval.

"Channel Sounding"
Requires R&S SMW-K178.
Selects channel type Channel Sounding.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CTYPe` on page 176

Packet Type

Selects the packet type that is the PDU type.

Available packet types depend on the channel type and installed options, see the following tables:

- For non-control data PDUs, see Table 5-1.
- For LE CONTROL_DATA PDUs, see Table 5-2.
- For LE Channel Sounding CS_CONTROL_DATA PDUs, see Table 5-3.

Table 5-1: Channel types and packet/PDU types

Channel type	Packet/PDU type	Option
Advertising	ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_SCAN_IND, SCAN_REQ, SCAN_RSP, CONNECT_IND	R&S SMW-K60
Advertising	ADV_EXT_IND *), AUX_ADV_IND, AUX_CHAIN_IND, AUX_SYNC_IND, AUX_SCAN_REQ, AUX_SCAN_RSP, AUX_CONNECT_REQ, AUX_CONNECT_RSP	R&S SMW-K117

Channel type	Packet/PDU type	Option
Advertising	TEST PACKET	R&S SMW-K60
Advertising	CONTINUOUS	R&S SMW-K60
Data	DATA	R&S SMW-K60
Data	CONTROL_DATA, see Table 5-2.	See Table 5-2.
Data	TEST PACKET	R&S SMW-K60
Data	CONTINUOUS	R&S SMW-K60
Channel Sounding	TEST PACKET	R&S SMW-K178
Channel Sounding	CS SEQUENCE	R&S SMW-K178
Channel Sounding	CS_CONTROL_DATA, see Table 5-3.	R&S SMW-K178

*) PDU type ADV_EXT_IND is available for LE 1M PHY and LE coded PHY.

CONTROL_DATA packets/PDUs depend on the controller role and installed options.

Table 5-2: CONTROL_DATA PDU and controller role

CONTROL_DATA PDU	Controller role	Option
LL_CONNECTION_UPDATE_IND, LL_CHAN-NEL_MAP_IND, LL_ENC_REQ, LL_FEATURE_REQ, LL_PAUSE_ENC_REQ	Central	R&S SMW-K60
LL_ENC_RSP, LL_UNKNOWN_RSP, LL_FEATURE_RSP, LL_PAUSE_ENC_RSP	Peripheral	R&S SMW-K60
LL_TERMINATE_IND, LL_START_ENC_REQ, LL_START_ENC_RSP, LL_VERSION_IND, LL_REJECT_IND	Central or Peripheral	R&S SMW-K60
LL_PHY UPDATE_IND	Central	R&S SMW-K117
LL_PERIPHERAL_FEAT_REQ, LL_CONNEC-TION_PARAM_RSP, LL_PHY_RSP, LL_MIN_USED_CHAN-NELS_IND	Peripheral	R&S SMW-K117
LL_CONNECTION_PARAM_REQ, LL_REJECT_EXT_IND, LL_PING_REQ, LL_PING_RSP, LL_LENGTH_REQ, LL_LENGTH__RSP, LL_PHY_REQ, LL_CTE_REQ, LL_CTE_RSP, LL_PERIODIC_SYNC_IND, LL_CLOCK_ACCURACY_REQ, LL_CLOCK_ACCU-RACY_RSP	Central or Peripheral	R&S SMW-K117

CS_CONTROL_DATA packets/PDUs are available for initiator and reflector Channel Sounding devices.

Table 5-3: CS_CONTROL_DATA PDU

CS_CONTROL_DATA PDU	Option
LL_CS_SEC_REQ, LL_CS_SEC_RSP, LL_CS_CAPABILITIES_REQ, LL_CS_CAPABILITIES_RSP, LL_CS_CONFIG_REQ, LL_CS_CONFIG_RSP, LL_CS_REQ, LL_CS_RSP, LL_CS_IND, LL_CS_TERMINATE_IND, LL_CS_FAE_REQ, LL_CS_FAE_RSP, LL_CS_CHANNEL_MAP_IND	R&S SMW-K178

How to: "To display Bluetooth LE event or frame sequences" on page 45

For more information, refer to the specifications document.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:UPTYpe` on page 177

Packet Format
Selects the packet format that is the format according to the physical layer (PHY) that supports the packet type or PDU type.

"LE 1M"	LE uncoded PHY with 1 Msymbol/s modulation.
"LE 2M"	Requires R&S SMW-K117. LE uncoded PHY with 2 Msymbol/s modulation and bandwidth time product BT = 0.5.
"LE Coded"	Requires R&S SMW-K117. LE coded PHY with 1 Msymbol/s modulation.
"LE 2M 2BT"	Requires R&S SMW-K178. LE uncoded PHY with 2 Msymbol/s modulation and bandwidth time product BT = 2. The BT value in the GFSK filter settings is fixed to a value "B*T" = "2.00". See also "B*T" on page 144.

See also Table 2-9.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PFORmat` on page 177

Duty Cycle
Requires R&S SMW-K117 and "Packet Type" > "ADV_DIRECT_IND".

Specifies the duty cycle for directed advertising.

"High"	Transmits the "ADV_DIRECT_IND" packet expecting an advertising event interval.
"Low"	Transmits the "ADV_DIRECT_IND" packet expecting an advertising event interval and advertising event delay.

See also "Advertising Event Interval" on page 52.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DCYCle` on page 176

Sequence Length
Selects the number of frames or events depending on the packet type. The signal repeats after this number.

The packet types SCAN_REQ, CONNECT_IND, AUX_SCAN_REQ and AUX_CONNECT_REQ define the sequence length in frames. All other packets use events.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:USLength` on page 179

Bluetooth Controller Role
Requires "Channel Type" > "Advertising"/"Data".

Sets or displays the Bluetooth LE controller role depending on the channel type.

Bluetooth controller role	Channel type	PDU type
Advertiser (read-only)	Advertising	ADV_IND, ADV_DIRECT_IND, ADV_NON-CONN_IND, ADV_SCAN_IND, SCAN_RSP, ADV_EXT_IND, AUX_ADV_IND, AUX_CHAIN_IND, AUX_SYNC_IND, AUX_SCAN_RSP, AUX_CON-NECT_RSP, TEST PACKET
Scanner (read-only)	Advertising	SCAN_REQ, AUX_SCAN_REQ
Initiator (read-only)	Advertising	CONNECT_IND, AUX_CONNECT_IND
Central	Data	DATA, CONTROL_DATA
Peripheral	Data	DATA, CONTOL_DATA

See also "Payload" on page 19 and Table 5-2.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:BCRole` on page 175

Bluetooth Controller State
Requires "Packet Type" > "Data"/"CONTROL_DATA".

Displays the state of the Bluetooth controller.

"Connected" The controller is connected and uses a data channel.

"Disconnected" The controller is disconnected.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:BCText?` on page 164

Corrupted CRC Every 2nd Packet
If enabled, sets the ratio of packets with CRC faults to 50%. 50% of packets are generated with correct CRC. This setting is appropriate for packet error rate (PER) report integrity tests.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CCRC:STATe` on page 176

Payload Type
Requires "Packet Type" > "CONTINUOUS".

Sets the pattern for continuous packets. The transmitted packets do not contain packet header information.

For supported payload types, refer to "Payload Type" on page 131.

Duration
Requires "Packet Type" > "CONTINUOUS".

Sets the duration of the continuous packet transmission.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DURation` on page 180

Modulation Format
Requires "Packet Type" > "CONTINUOUS".

Specifies the physical layer.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:MFORmat` on page 179

Event Configuration/Frame Configuration
Opens the "Event Configuration" dialog, if the sequence length of the packet type is expressed in events or opens the "Frame Configuration" dialog, if it is expressed in frames, see Chapter 5.2, "Advertising event and frame configuration", on page 51.

Also, the button displays the data whitening state, see "Data Whitening" on page 59.

CS Subevent Configuration
Requires "Channel Type" > "Channel Sounding".

Opens the "CS Subevent Configuration" dialog, see Chapter 5.4, "CS subevent configuration", on page 91.

Test Packet Configuration
Requires "Packet Type" > "TEST PACKET".

Opens the "Test Packet Configuration" dialog, see Chapter 5.6, "Test packet configuration", on page 129.

For Channel Sounding test packet settings, see "User Payload Pattern" on page 104 and "Select Data List" on page 104 for mode-1 subevents or mode-3 subevents. All other settings are the same as for a CS subevent, see Chapter 5.4, "CS subevent configuration", on page 91.

Event Intervals/Event_Interval
Requires R&S SMW-K178 and "Channel Type" > "Channel Sounding".

Sets the number of LE connection event intervals.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:EINTerval` on page 191

Connection Interval
Requires R&S SMW-K178 and "Channel Type" > "Channel Sounding".

Sets the time of the LE connection interval. The anchor points of two consecutive CS events define the length of this interval.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CINTerval` on page 191

Event Offset
Requires R&S SMW-K178 and "Channel Type" > "Channel Sounding".

Sets the time between the anchor point of the LE connection event and the beginning of the CS event.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:EOFFset` on page 192

Role
Requires R&S SMW-K178 and "Channel Type" > "Channel Sounding".

Sets the role of the Channel Sounding device.

"Initiator" Channel Sounding device initiates a CS procedure.

"Reflector" Channel Sounding device responds to a CS procedure.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:ROLE` on page 192

5.2 Advertising event and frame configuration

Access:

1. Select "Bluetooth" > "General".
2. Select "Bluetooth Mode" > "Bluetooth Low Energy".
3. In the "Channel" tab, select "Event Configuration" for event-type packets or "Frame Configuration" for frame-type packets.

   The "Event Configuration" or "Frame Configuration" dialog provides settings to configure advertising channel events or frames or data channel events. Also it provides access to the packet configuration.
   At the bottom of the dialog, the graphics show the distribution of the packets, the physical channel mapping and the channel indices. The channel table gives an overview of the used channels and their assignments.

Settings:

5.2.1 Advertising event and frame settings

Access:

1. Select "Channel" > "Channel Type" > "Advertising".

2. Select "Event Configuration" for event-type packets or "Frame Configuration" for frame-type packets.

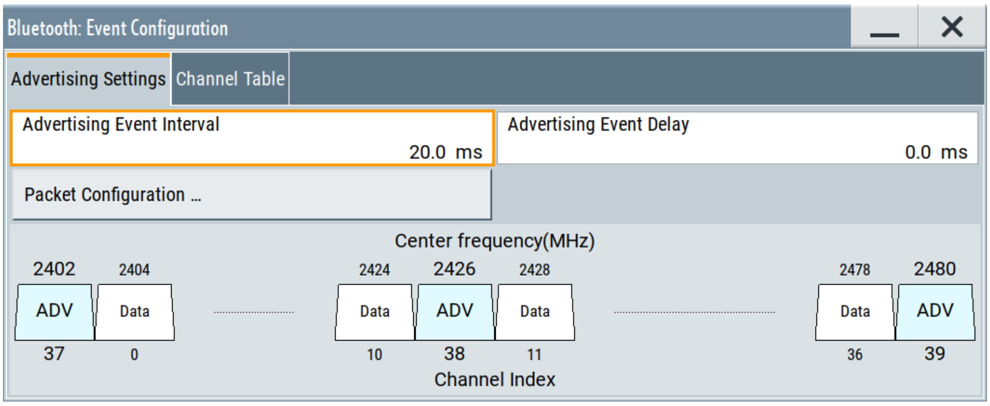


Figure 5-1: Event configuration for an advertising channel (advertiser)

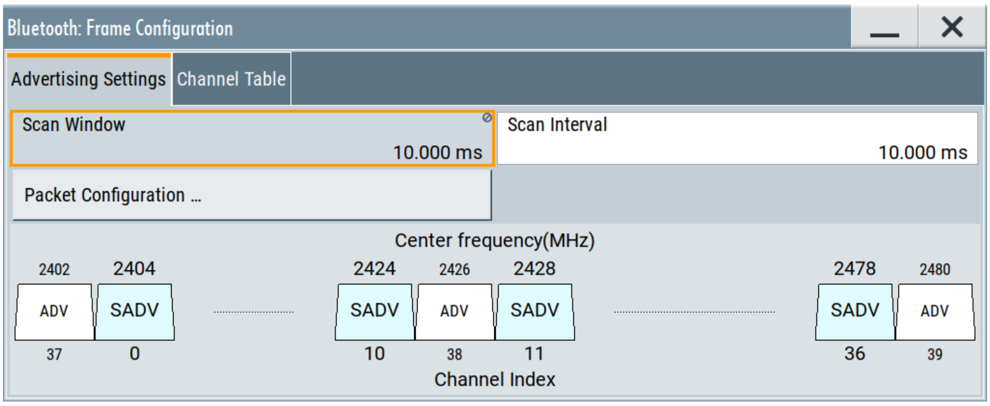


Figure 5-2: Frame configuration for an advertising channel (scanner)

The "Advertising Settings" tab provides general settings to configure advertising channel events or frames or data channel frames. Also it provides access to the packet configuration.

Settings:

Advertising Event Interval

Requires a legacy or an extended advertising PDU, see Table 2-10.

Sets the time interval between two consecutive advertising events, regarding the starting points.

Remote command:
For packet type ADV_DIRECT_IND and duty cycle high:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ADINterval on page 183
For all others:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEINterval on page 183

Advertising Event Delay
Requires a legacy or an extended advertising PDU, see Table 2-10.

Sets a time delay between the start times of two consecutive advertising events. The advertising event interval extends by this value.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEDelay on page 182

Periodic Advertising Interval
Requires option R&S SMW-K117 and packet type AUX_SYNC_IND.

Sets the time interval between the start of two PDUs from the same advertising set.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PAINterval on page 187

Scan Window
Requires a scanning PDU with packet type SCAN_REQ or AUX_SCAN_REQ. The PDU AUX_SCAN_REQ also requires option R&S SMW-K117.

Sets the length of the window during which the scanner is operating in the advertising channel.

Note that the scan window is less or equal to the value of the scan interval.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SWINdow on page 189

Scan Interval
Requires a scanning PDU with packet type SCAN_REQ or AUX_SCAN_REQ. The PDU AUX_SCAN_REQ also requires option R&S SMW-K117.

Sets the time interval between the starting points of two consecutive windows during which the scanner is operating in an advertising channel.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SINTerval on page 188

Advertising Packet Interval
Requires a scanning PDU with packet type SCAN_RSP or AUX_SCAN_RSP. The PDU AUX_SCAN_REQ also requires option R&S SMW-K117.

Sets the time interval between packets starting points of two consecutive packets in the advertising channel.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:APINterval on page 184

Transmit Window Offset
Requires packet type CONNECT_IND, AUX_CONNECT_REQ or AUX_CON-NECT_RSP.

Displays the start point of the transmit window. For related settings, see "Transmit Window Offset" on page 77.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WOFFset` on page 247

Transmit Window Size
Requires packet type CONNECT_IND, AUX_CONNECT_REQ or AUX_CON-NECT_RSP.

Displays the start point of the transmit window for configuring advertising frames. For related settings, see "Transmit Window Size" on page 77.

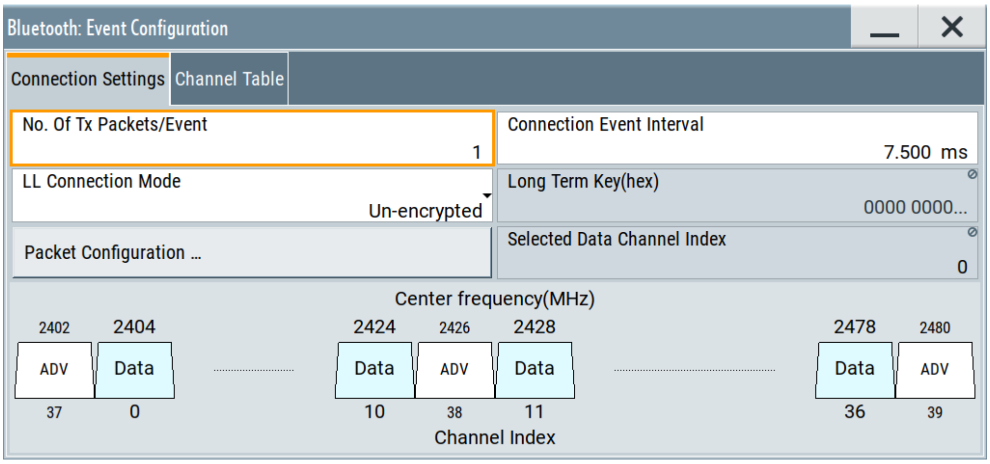
Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WSINfo?` on page 190

Packet Configuration
Opens the dialog to configure packets. See Chapter 5.3, "Advertising and data packet configuration", on page 58.

5.2.2 Connection settings

Access:

1. Select "Channel" > "Channel Type" > "Data".
2. Select "Event Configuration".



The "Connection Settings" tab provides general settings to configure data channel events. Also it provides access to the packet configuration.

Settings:

No. Of Tx Packets/Event

Sets the number of TX packets per event.

Each connection contains at least one data channel packet. The maximum number of packets per event is determined by the duration of the connection event interval.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PNUMber` on page 188

Connection Event Interval

Requires packet type CONNECT_IND, AUX_CONNECT_REQ or DATA.

Set the time interval between the start points of two consecutive connection events. Subsequent transmissions within an event are separated by this parameter to separate connecting event starting points in time.

See also "Connection Event Interval" on page 78.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval` on page 230

LL Connection Mode

Select the link layer connection mode.

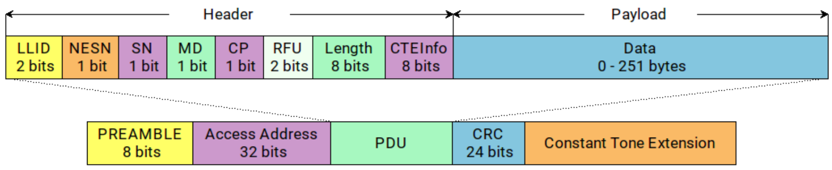
To provide safe transmission of payload data, you can encrypt the data in the packet. If encrypted, the payload data follows a 32-bit message integrity check (MIC field).

The following table shows data packets with limited encrypting or unencrypting. All other data packets allow encrypting and unencrypting the data packet.

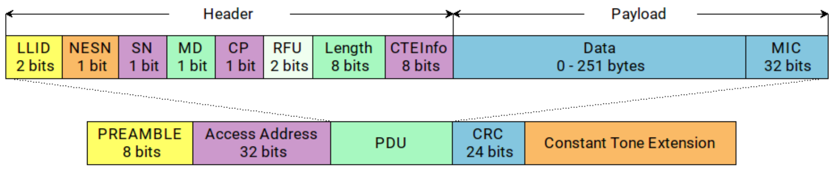
Table 5-4: Limited data packet encryption (R&S SMW-K60)

Packet type	Encrypted	Unencrypted
LL_ENC_REQ	No	Yes
LL_ENC_RSP	No	Yes
LL_START_ENC_REQ	No	Yes
LL_START_ENC_RSP	Yes	No
LL_PAUSE_ENC_REQ	No	Yes
LL_PAUSE_ENC_RSP	Yes	No

"Un-encrypted" Payload data is transmitted without encoding. Example of packet type data:



"Encrypted" The link layer connection runs in encrypted mode. Example of packet type data:



Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LCMode` on page 184

Long Term Key(hex)

For "LL Connection Mode" > "Un-encrypted", indicates the long-term key.

For "LL Connection Mode" > "Encrypted", sets the long-term key.

This key is the time that the controller needs to receive the long-term key from the host. After this time, the controller is ready to enter into the last phase of encryption mode setup.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LTKey` on page 185

Selected Data Channel Index

Displays the number of the first active data channel.

The data channel is selected for each connection event. The Central device and Peripheral device determine the used data channel by selecting from the list of used channels, see "Channel Table" on page 57.

Displays the data channel index currently selected.

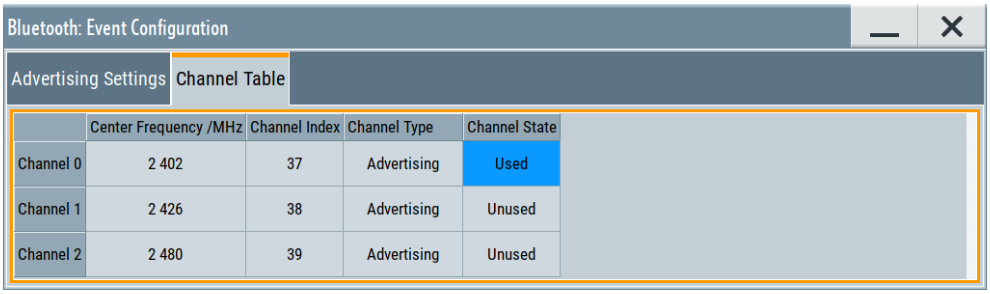
Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SDCI?` on page 188

5.2.3 Channel table settings

Access:

1. Follow the directions in Chapter 5.2, "Advertising event and frame configuration", on page 51.

2. Select "Channel Table"



The channel table displays all possible channels and their characteristics. Also you can select the channel that you want to use for the generated packets.

Settings:

Channel Table

The channel table displays channel characteristics including the channel state.

Each row lists the configuration for a channel as per the data channel index. LSB represents data channel index 0 and the bit in position 36 represents data channel index 36.

If you use the channel ("Used"), the channel bit is 1. If you do not use the channel ("Unused"), the channel bit is 0. The bits in positions 37, 38 and 39 are zero during transmission and a receiver ignores them.

For a graphical representation

"Center Frequency"
Displays the center frequency of a channel.

"Channel Index"
Displays the channel index.

"Channel Type"
Displays the channel type.

"Channel State"
Sets if you use the channel ("Used") or not ("Unused"). You can only use one channel.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ACTable:CHANnel<ch0>:STATe on page 182
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:DCTable:CHANnel<ch0>:STATe on page 182
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DCMTable:CHANnel<ch0>:STATe
on page 182

5.3 Advertising and data packet configuration

Access:

1. Select "Bluetooth" > "General".
2. "Bluetooth Mode" > "Bluetooth LE".
3. In the "Channel" tab, select the channel type, for example, "Channel Type" > "Advertising".
4. Select "Event Configuration" event-type packets or "Frame Configuration" for frame-type packets.

   The "Event Configuration" or "Frame Configuration" dialog opens.
5. Select "Packet Configuration"

   The dialog provides settings to configure the parameters of the selected packet type.

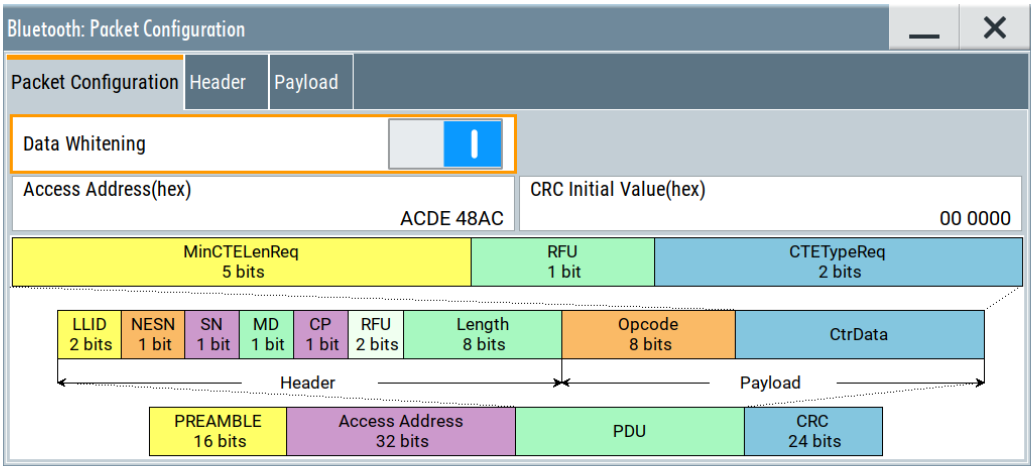
Settings:

5.3.1 Packet configuration settings

Access:

► Select "Packet Configuration".

The "Packet Configuration" tab provides settings to configure the general packet parameters. Also, it displays the main fields and field lengths of the selected packet type.



Settings:

Data Whitening

Enables data whitening.

Evenly distributed white noise is ideal for the transmission and real data can be forced to look similar to white noise with different methods called "Data Whitening". Applied to the PDU and CRC fields of all packet types, whitening is used to avoid long equal sequences in the data bitstream.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DWHitening`
on page 218

Access Address

Sets the access address of the link layer connection.

Bluetooth LE transmissions are based on an interface packet format that consists of a preamble (8 bits) the access address (32 bits), the PDU and CRC (24 bits).

Access address is used to identify communications on a physical channel, and to exclude or ignore packets on different physical channels. The channels are using the same PHY channels in physical proximity.

The structure of the access address depends on the packet type:

- Data channel packets
  The access address is a pseudo-random LL connection address, generated by the initiator of the LL connection. The address has to follow some specific rules, which are described in the Bluetooth LE technology.
- Advertising channel packets
  The address is fixed to 01101011011111011001000101110001 with the leftmost bit sent first and being the LSB.

This parameter is relevant for packet types in event or frame configurations of a data channel or an advertising channel. See also Table 5-1.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress
on page 218

CRC Initial Value(hex)
Requires data channel PDU or an advertising channel PDU. For an advertising channel, also requires packet type CONNECT_IND or AUX_CONNECT_REQ.

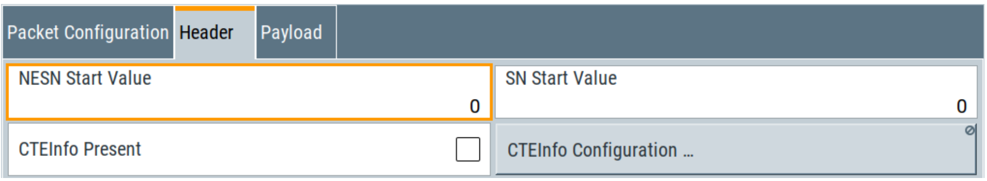
Sets the initialization value for the 24-bit cyclic redundancy check (CRC) calculation. A receiver receives a packet correctly after it passes the CRC.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CIValue
on page 218

5.3.2 Header settings

Access:

1. Select "Packet Configuration".
2. Select "Header".



The tab provides settings to configure the packet header settings.

Settings:

NESN Start Value
Requires a data channel packet that is not a test packet.

Sets the next expected sequence number (NESN). This number is the start value of the next expected packet from the same device in the LL connection. You can set this parameter for the first event. From the second event and later events, the field is empty.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSValue
on page 219

SN Start Value
Requires a data channel packet that is not a test packet.

Sets the sequence number of the packet. You can set this parameter for the first event. From the second event and later events, the field is empty.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SSValue`
on page 219

Channel Selection
Requires option R&S SMW-K117.

Sets the algorithm of channel selection for advertising channel packets, see Table 2-10.

"Algorithm #1"	Channel selection only for connection events.
"Algorithm #2"	Channel selection for connection events and periodic advertising packets.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CSELection`

CTEInfo Present
Requires a data channel packet or a test packet.

Enables the CTEInfo field in the header of Bluetooth LE data packets in the LE uncoded PHY.

See also "Constant tone extension" on page 23.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CPResent`
on page 220

CTEInfo Configuration
Requires "CTEInfo Present" > "On".

Opens the "CTEInfo Configuration" dialog to configure CTE length and the CTE method. See Chapter 5.3.3, "CTEInfo settings", on page 62.

Tx Address Type/Rx Address Type
Requires an advertising channel packet, see Table 2-10.

Selects the address type of a Bluetooth LE device. Depending on the Bluetooth controller role, either the Tx or Rx or both address types are assigned.

The format of the device address differs depending on the selected address type. The address type and corresponding packet types are as follows:

- "Tx" for the packet types ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_SCAN_IND, SCAN_REQ, SCAN_RSP and CONNECT_IND
  Within R&S SMW-K117 also with the packet types ADV_EXT_IND, AUX_ADV_IND, AUX_CHAIN_IND, AUX_SYNC_IND, AUX_SCAN_REQ, AUX_SCAN_RSP and AUX_CONNECT_REQ
- "Rx" for the packet types ADV_DIRECT_IND, SCAN_REQ and CONNECT_IND

"Public" Allocates a unique 48-bit address to each Bluetooth LE device. Public addresses use an organizational unique identifier (OUI) obtained from the IEEE registration authority.

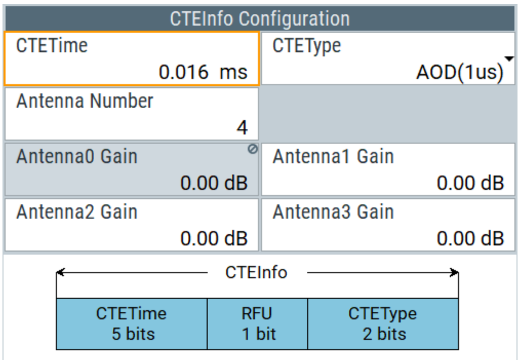
"Random" Allocates a 48-bit random static device address to each Bluetooth LE device. A random address is optional. It can be directly generated by the beacon.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TATYpe on page 242

5.3.3 CTEInfo settings

Access:

1. Select "Packet Configuration".
2. Select "Header".
3. Select "CTEInfo Present" > "On".
4. Select "CTEInfo Configuration".



The dialog provides constant tone extension (CTE) settings for direction finding including the CTE length and the CTE method. The settings are relevant for data event configuration and all data channel packet types including test packets.
See also "Constant tone extension" on page 23.

Settings:

CTETime

Sets the CTETime that is the length of the constant tone extension field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CTIMe
on page 220

CTEType
Sets the type of constant tone extension. The type specifies the CTE AoA/AoD method and for AoD the length of the switching and I/Q sampling slots.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CTYPe
on page 221

Antenna Number
Requires "CTEType" > "AoD(1us)"/"AoD(2us)".

Sets the number of antennas for the angle of departure (AoD) direction finding method. You can select up to four antennas for direction finding.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfig:PCONfig:ANTNumber on page 221

AntennaX Gain
Requires "CTEType" > "AoD(1us)"/"AoD(2us)".

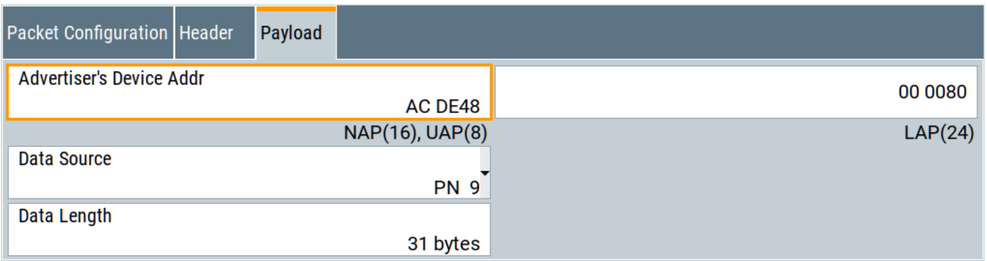
Sets the gain of the antenna "AntennaX", where X is 0 to 3 depending on the number of antennas. You can set the antenna gain information of up for four individual antennas for direction finding.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfig:PCONfig:ANTGain<ch0> on page 221

5.3.4 Legacy advertising PDU payload settings

Access:

1. Select a legacy advertising PDU:
   a) In the "Channel" tab, select "Channel Type" > "Advertising".
   b) Select a legacy advertising PDU, for example "Packet Type" > "ADV_IND".
2. Select "Event Configuration"/"Frame Configuration" > "Packet Configuration".
3. Select "Payload".



The tab provides settings to configure the payload of the legacy advertising PDUs.

For an overview of supported legacy advertising PDUs, see Table 2-10.

Settings:

Advertiser's Device Addr

Sets the 48-bit device address of the advertiser.

This device address identifies the Bluetooth device. Devices use a public device address or a random device address, see "Tx Address Type/Rx Address Type" on page 61. For more information, see [1].

With Bluetooth wireless technology up to the version 4.2, the following address formats are defined:

- "Public Address Type" is the unique 48-bit identity address of each Bluetooth LE device.
  The registration authority IEEE provides the address that consists of the following:
  - LSB: 24 bits = company_assigned
  - MSB: 24 bits = company_id
- "Random Address Type" is an optional 48-bit random static device address.
- "Private Address Type" is a resolvable 48-bit optional address.
  A private address consists of the:
  - LSB: 24 bits = hash
  - MSB: 24 bits = random

Since version 5.0, the device address format is in accordance with BD_ADDR for BR/EDR with the exception that LAP values does not apply. Unless the public device address is also used for a BR/EDR controller.

- **NAP**: Selects the non-significant address part. The length of NAP is 16 bits or 4 hexadecimal figures.
- **UAP**: Selects the upper address part. The length of UAP is 8 bits or two hexadecimal figures.
- **LAP**: Selects the lower address part. The length of LAP is 24 bits or 6 hexadecimal figures.

The NAP+UAP can take any values except the 64 reserved LAP values: #H9E8B00 – #H9E8B3F.

For the address formats of Bluetooth version 5.0 and later, install option R&S SMW-K117.

For advertising channel PDU types, see "Payload" on page 19.

Remote command:
Company_Assigned and Company_Id in the device address of an advertiser:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACID`
on page 225
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACASsigned`
on page 225
NAP+UAP and LAP in the device address of an advertiser:

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ANUap on page 227
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ALAP on page 226

Target's Device Addr
TargetA field of the device address that is a scanner's device address or an initiator's device address.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TNUap on page 227
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TLAP on page 226

Data Source
Selects the data source for data in the corresponding data subfield of the Payload field.

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 set the bit pattern.
- "Data List"/"Select Data List"
  Binary data from a list file, internally or externally generated.
  Select "Select Data List" to open the standard "Select List" dialog. The dialog lists file with file extension *.dm_iqd if existing.
  - Navigate to the list file and tap "Select" to select the file.
  - Use the "New" and "Edit" functions to create a data list internally or to edit an existing one.
  - Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "About data signals" in the R&S SMW200A user manual.
- Section "File and data management" in the R&S SMW200A user manual.
- Section "Data list editor" in the R&S SMW200A user manual.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA on page 231
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DPATtern on page 231
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DSELection on page 232

Data Length
Selects the length of the corresponding data subfield of the Payload field.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DLENgth`
on page 232

5.3.5 Extended advertising PDU payload settings

Option: R&S SMW-K117

Access:

1. Select an extended advertising PDU:
   a) In the "Channel" tab, select "Channel Type" > "Advertising".
   b) Select an extended advertising PDU, for example "Packet Type" > "ADV_EXT_IND".
2. Select "Event Configuration"/"Frame Configuration" > "Packet Configuration".
3. Select "Payload".

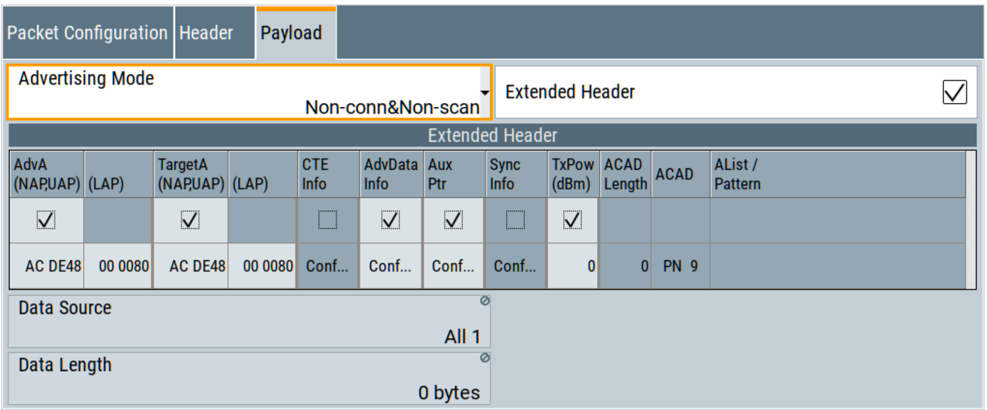
   The tab provides settings to configure the payload of the extended advertising PDUs.

For an overview of supported extended advertising PDUs, see Table 2-10.

5.3.5.1 General settings

Access:

► Select "Payload".



The tab provides general settings to configure the payload of the extended advertising PDUs.

Advertising Mode

Selects the mode of the advertisement in the AdvMode field.

"Non-conn&Non-scan"
Non-connectable and non-scannable

"Conn&Non-scan"
Connectable and non-scannable

"Non-conn&Scan"
Non-connectable and scannable

"Chained data" Fixed value for an AUX_CHAIN_IND PDU.

"Scan response"
Fixed value for an AUX_SCAN_RSP PDU.

"Connection response"
Fixed value for an AUX_CONNECT_RSP PDU.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AMODe` on page 227

Extended Header

Enables the extended header of an extended advertising PDU.

If enabled, displays a table with extended header settings, see Chapter 5.3.5.2, "Extended header settings", on page 67.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHEader:STATe` on page 233

Data Source

See "Data Source" on page 65.

Data Length

See "Data Length" on page 65.

5.3.5.2 Extended header settings

Access:

► Select "Payload" > "Extended Header" > "On".

If enabled, the R&S SMW200A signals the extended header for extended advertising PDUs.

Extended Header											
AdvA (NAP,UAP)	(LAP)	TargetA (NAP,UAP)	(LAP)	CTE Info	AdvData Info	Aux Ptr	Sync Info	TxPow (dBm)	ACAD Length	ACAD	AList / Pattern
☑		☑		☐	☑	☑	☑	☑			
AC DE48	00 0080	AC DE48	00 0080	Conf...	Conf...	Conf...	Conf...	0	26	PN 9	

The "Extended Header" table provides general settings to configure the extended header. It also provides access to further settings of fields within the extended header.

Settings:

AdvA

Enables the flag of the advertiser's device address (AdvA) subfield. If enabled, this subfield is present in the Extened Header field.

For related settings, see "Advertiser's Device Addr" on page 64.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:AADDress:STATe on page 234

TargetA

Requires an advertising channel PDU that contains the TargetA field, see Table 2-11.

Enables the flag of the target's device address (TargetA) subfield. If enabled, this subfield is present in the Extened Header field.

For related settings, see "Advertiser's Device Addr" on page 64.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:TADDress:STATe on page 235

CTEInfo

Requires a data channel packet including a test packet. See also "Constant tone extension" on page 23.

Enables the flag of the CTEInfo subfield. If enabled, this subfield is present in the Extened Header field.

Selecting "Conf" opens the CTEInfo configuration dialog to define the CTE length and the CTE method for direction finding. See Chapter 5.3.3, "CTEInfo settings", on page 62.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:CINFo:STATe on page 235

AdvDataInfo
Enables the flag of the advertising data information (AdvDataInfo) subfield. If enabled, this subfield is present in the Extened Header field.

Select "Conf" to open further AdvDataInfo settings, see Chapter 5.3.5.3, "AdvDataInfo configuration settings", on page 71.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:ADINfo:STATe on page 234

AuxPtr
Enables the flag of the AuxPtr subfield. If enabled, this subfield is present in the Extened Header field.

The presence of the AuxPtr subfield indicates that some or all advertisement data is in a following auxiliary packet. The contents of the AuxPtr subfield describe this auxiliary packet.

Select "Conf" to open further AuxPtr settings, see Chapter 5.3.5.4, "AuxPtr configuration settings", on page 71.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:APTR:STATe on page 234

SyncInfo/SyncInfo Configuration
Requires packet type AUX_ADV_IND or LL_PERIODIC_SYNC_IND.

Enables the flag of the SyncInfo subfield. If enabled, this subfield is present in the Extened Header field. The presence of theSyncInfo field indicates the presence of a periodic advertisement.

Select "Conf" to open further SyncInfo settings, see Chapter 5.3.5.5, "SyncInfo configuration settings", on page 73.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:SINFo:STATe on page 235

TxPow(dBm)
Enables signaling and sets the required transmit power.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:TPOWer:STATe on page 235
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPOWer on page 246

ACAD Length

Specifies the length of an additional controller advertising data (ACAD) field.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ALENgth` on page 227

ACAD

Sets the pattern for additional controller advertising data (ACAD).

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 set the bit pattern.
- "Data List"/"Select Data List"
  Binary data from a list file, internally or externally generated.
  Select "Select Data List" to open the standard "Select List" dialog. The dialog lists file with file extension `*.dm_iqd` if existing.
  – Navigate to the list file and tap "Select" to select the file.
  – Use the "New" and "Edit" functions to create a data list internally or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:

- Section "About data signals" in the R&S SMW200A user manual.
- Section "File and data management" in the R&S SMW200A user manual.
- Section "Data list editor" in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD` on page 224

AList / Pattern

Sets one of the following:

- For "ACAD" > "Data List", selects the data list source file and directory.
- For "ACAD" > "Pattern", sets the pattern.

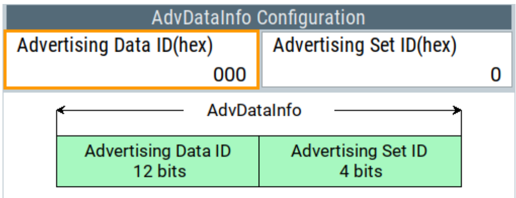
See also "ACAD" on page 70.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD:APATtern` on page 224
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD:ASELection` on page 225

5.3.5.3 AdvDataInfo configuration settings

Access:

1. Select "Payload" > "Extended Header".
2. Select "AdvDataInfo" > "On".
3. Select "AdvDataInfo" > "Conf".
   The "AdvDataInfo Configuration" section opens.



   The section provides AdvDataInfo field settings and displays the structure of the field graphically.

Settings:

Advertising Data ID(hex)
Sets the "Advertising Data ID" in the AdvDataInfo field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ADID
on page 226

Advertising Set ID(hex)
Sets the "Advertising Set ID" in the AdvDataInfo field.

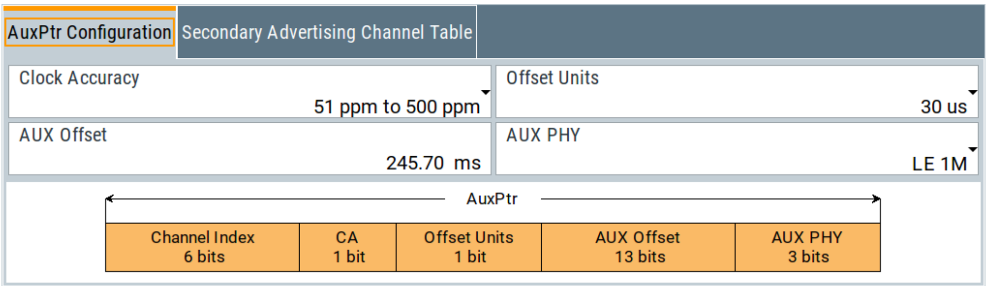
Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ASID
on page 229

5.3.5.4 AuxPtr configuration settings

Access:

1. Select "Payload" > "Extended Header".
2. Select "AuxPtr" > "On".
3. Select "AuxPtr" > "Conf".

The "AuxPtr Configuration" dialog opens.



The "AuxPtr Configuration" tab provides AuxPtr field settings and displays the structure of the field graphically.
The "Secondary Advertising Channel Table" tab lists the configuration of all 37 LE channels and allows you to enable the channel that you want to use for secondary advertising. For related settings, see Chapter 5.2.3, "Channel table settings", on page 56.

Settings:

Clock Accuracy

Sets the clock accuracy of the advertiser used between the packet containing this data and the auxiliary packet.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CACCuracy
on page 229

Offset Units

Sets the units used by the AUX offset, see "AUX Offset" on page 72.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AOUNits
on page 228

AUX Offset

Sets the time from the start of the packet containing the AuxPtr field to the approximate start of the auxiliary packet.

The parameter "Offset Units" affects the length of the AUX offset. Set the value at least to the length of the packet plus 300 µs.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AOFFset
on page 228

AUX PHY

Specifies the physical layer used to transmit the auxiliary packet.

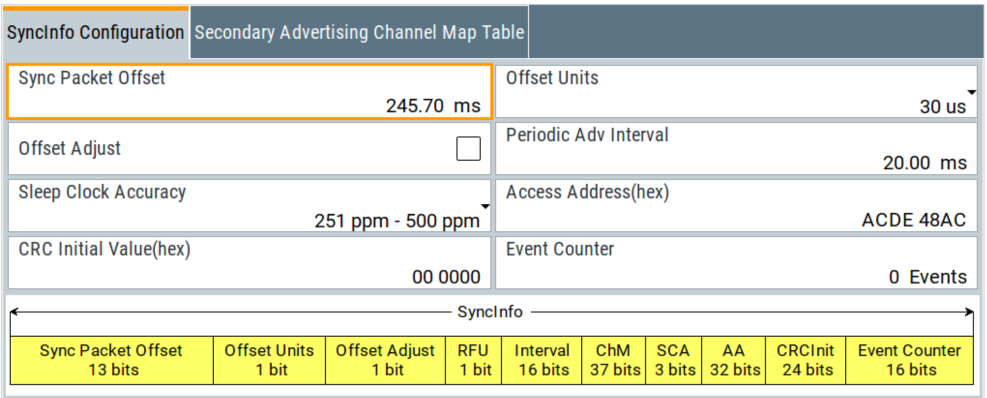
Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:APHY
on page 228

5.3.5.5 SyncInfo configuration settings

Access:

1. Select "Payload" > "Extended Header".
2. Select "SyncInfo" > "On".
3. Select "SyncInfo" > "Conf".

   The "SyncInfo Configuration" dialog opens.



The "SyncInfo Configuration" tab provides SyncInfo field settings and displays the structure of the field graphically.
The "Secondary Advertising Channel Table" tab lists the configuration of all 37 LE channels and allows you to enable the channel that you want to use for secondary advertising. For related settings, see Chapter 5.2.3, "Channel table settings", on page 56.

Sync Packet Offset
Specifies the time from the start of the AUX_ADV_IND packet containing the SyncInfo field to the start of the AUX_SYNC_IND packet.

The sync packet offset consists of multiples of the offset units, see "Offset Units" on page 74.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SPOFfset on page 246

Offset Units

Sets the offset units of the sync packet offset, see "Sync Packet Offset" on page 73.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SOUNits on page 245

Offset Adjust

Adjusts the "Sync Packet Offset" automatically to the next value, which is a multiple of the "Offset Units".

If "Offset Adjust" > "On", the "Sync Packet Offset" is 2.4567 s and "Offset Units" > "300 us".

If "Offset Units" > "30 us", disables the offset adjust.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:OADJust on page 242

Periodic Adv Interval

See "Periodic Advertising Interval" on page 53.

Sleep Clock Accuracy

See "Sleep Clock Accuracy" on page 79.

Access Address

See "Access Address" on page 59.

CRC Initial Value(hex)

See "CRC Initial Value(hex)" on page 60.

Event Counter

Counts the AUX_SYNC_IND packets that the SyncInfo field describes.

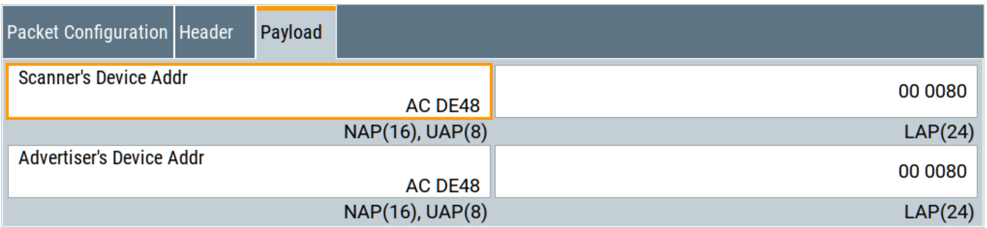
Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ECOunter on page 233

5.3.6 Scanning PDU payload settings

Access:

1. Select a scanning PDU:
   a) In the "Channel" tab, select "Channel Type" > "Advertising".
   b) Select a scanning PDU, for example "Packet Type" > "ADV_SCAN_REQ".

2. Select "Event Configuration"/"Frame Configuration" > "Packet Configuration".
3. Select "Payload".



The tab provides settings to configure the payload of the scanning PDUs.

For an overview of supported scanning PDUs, see Table 2-10.

Settings:

Scanner's Device Addr

Requires a SCAN_REQ PDU or an AUX_SCAN_REQ PDU.

Sets the 48-bit device address of the scanner.

For more information, see "Advertiser's Device Addr" on page 64.

Remote command:
Company_Assigned and Company_Id in the device address of a scanner:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCASsigned`
on page 225
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCID`
on page 225
NAP+UAP and LAP in the device address of a scanner:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SNUap`
on page 227
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SLAP`
on page 226

Advertiser's Device Addr

See "Advertiser's Device Addr" on page 64.

Data Source

Requires a SCAN_RSP PDU or an AUX_SCAN_RSP PDU.

For related settings, see "Data Source" on page 65.

Data Length

Requires a SCAN_RSP PDU or an AUX_SCAN_RSP PDU.

For related settings, see "Data Length" on page 65.

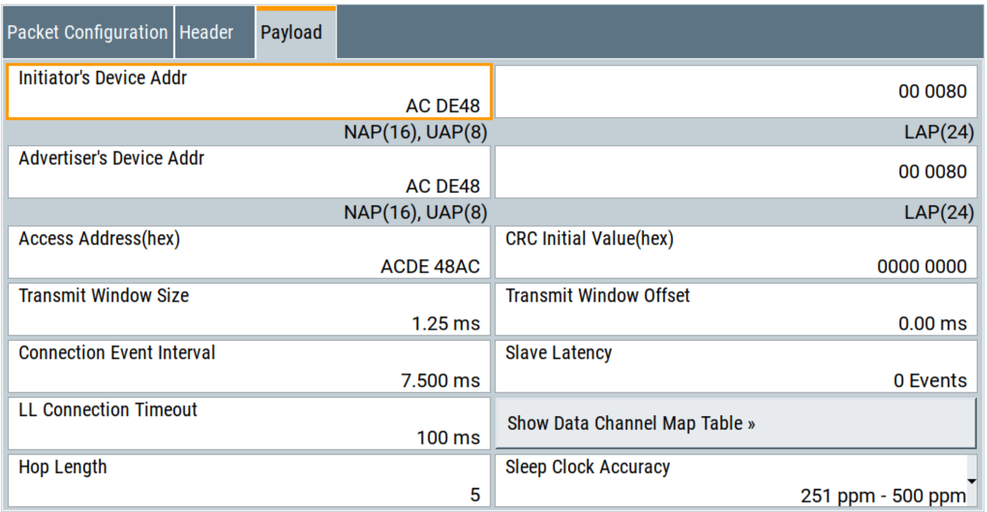
Extended Header
Requires an AUX_SCAN_RSP PDU.

For related settings, see "Extended Header" on page 67 and Chapter 5.3.5.2, "Extended header settings", on page 67.

5.3.7 Initiating PDU payload settings

Access:

1. Select a scanning PDU:
   a) In the "Channel" tab, select "Channel Type" > "Advertising".
   b) Select a scanning PDU, for example "Packet Type" > "CONNECT_IND".
2. Select "Event Configuration"/"Frame Configuration" > "Packet Configuration".
3. Select "Payload".



The tab provides settings to configure the payload of the initiating PDUs.

For an overview of supported initiating PDUs, see Table 2-10.

Settings:

Initiator's Device Addr

Sets the 48-bit device address of the initiator.

For more information, see "Advertiser's Device Addr" on page 64.

Remote command:
Company_Assigned and Company_Id in the device address of an initiator:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICASsigned`
on page 225
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICID`
on page 225
NAP+UAP and LAP in the device address of an initiator:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:INUap`
on page 227
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ILAP`
on page 226

Advertiser's Device Addr

See "Advertiser's Device Addr" on page 64.

Transmit Window Size

Requires packet type CONNECT_IND, AUX_CONNECT_REQ, LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs AUX_CONNECT_REQ, LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

Sets the size of the transmit window for configuring advertising frames. The "Frame Configuration" dialog also displays this setting.

The scan window size is less or equal to the value of the connection interval, see "Connection Event Interval" on page 78.

Remote command:
For advertising channels:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WSIZe`
on page 248
For data channels:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWSize`
on page 241

Transmit Window Offset

Requires packet type CONNECT_IND, AUX_CONNECT_REQ, LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs AUX_CONNECT_REQ, LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

Sets the start point of the transmit window for configuring advertising frames. The "Frame Configuration" dialog also displays this setting.

Remote command:
For advertising channels:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WOFFset
on page 247
For data channels:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWOFfset
on page 241

Connection Event Interval
Requires packet type CONNECT_IND, AUX_CONNECT_REQ, LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_REQ. The PDUs AUX_CONNECT_REQ, LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_REQ also require option R&S SMW-K117.

Set the time interval between the start points of two consecutive connection events. Also, this setting separates subsequent transmissions within an event to separate connecting event starting points in time.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval
on page 240

Peripheral Latency
Requires packet type CONNECT_IND, AUX_CONNECT_REQ, LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_REQ. The PDUs AUX_CONNECT_REQ, LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_REQ also require option R&S SMW-K117.

Sets the number of consecutive connection events that the Peripheral can ignore for asymmetric link layer connections.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SLATency
on page 245
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSLatency
on page 241

LL Connection Timeout
Requires packet type CONNECT_IND, AUX_CONNECT_REQ, LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_REQ. The PDUs AUX_CONNECT_REQ, LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_REQ also require option R&S SMW-K117.

Defines the maximum time between two correctly received Bluetooth LE packets in the LL connection before the connection is considered lost.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:LCTimeout
on page 237
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout
on page 240

Show Data Channel Map Table/Hide Data Channel Map Table
Requires packet type CONNECT_IND or LL_CHANNEL_MAP_IND.

Shows or hides the data channel map table. For related settings, see Chapter 5.2.3, "Channel table settings", on page 56.

Remote command:
n.a.

Hop Length
Requires packet type CONNECT_IND.

Sets the difference from the current channel to the next channel.

The Central and the Peripherals determine the data channel in use for every connection event from the channel map. Hop_length is set for the LL connection and communicated in the CONNECT_IND packets.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:HLENgth`
on page 236

Sleep Clock Accuracy
Requires packet type CONNECT_IND or LL_PERIODIC_SYNC_IND.

Sets the clock accuracy of the Central device with a specified encoding. The Peripheral device uses this parameter to determine the required listening windows in the LL connection. It is a controller design parameter known by the controller.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCACcuracy`
on page 244

Data Source
Requires an AUX_CONNECT_RSP PDU.

For related settings, see "Data Source" on page 65.

Data Length
Requires an AUX_CONNECT_RSP PDU.

For related settings, see "Data Length" on page 65.

Extended Header
Requires an AUX_CONNECT_RSP PDU.

For related settings, see "Extended Header" on page 67 and Chapter 5.3.5.2, "Extended header settings", on page 67.

5.3.8 Data channel PDU payload settings

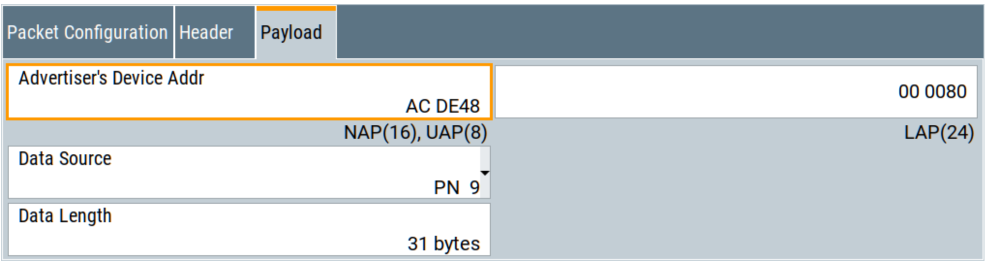
Access:

1. Select "Channel Type" > "Data".

2. Select "Event Configuration" for event-type packets or "Frame Configuration" for frame-type packets.

   The "Event Configuration" or "Frame Configuration" dialog opens.

3. Select "Packet Configuration"



   The dialog provides settings to configure the payload of advertising PDUs.

For an overview of supported advertising PDUs, see Table 2-10.

Settings:

Transmit Window Size
Requires packet type LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

For related settings, see "Transmit Window Size" on page 77.

Transmit Window Offset
Requires packet type LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

For related settings, see "Transmit Window Offset" on page 77.

Connection Event Interval
Requires packet type LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

For related settings, see "Connection Event Interval" on page 78.

Peripheral Latency
Requires packet type LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

For related settings, see "Peripheral Latency" on page 78.

LL Connection Timeout
Requires packet type LL_CONNECTION_UPDATE_IND, LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP. The PDUs LL_CONNECTION_PARAM_REQ and LL_CONNECTION_PARAM_RSP also require option R&S SMW-K117.

For related settings, see "LL Connection Timeout" on page 78.

Connection Instant
Requires packet type LL_CONNECTION_UPDATE_IND, LL_CHANNEL_MAP_IND or LL_PHY_UPDATE_IND. The PDU LL_PHY_UPDATE_IND also requires option R&S SMW-K117.

Sets a connection instant for indicating the connection event at which the new connection parameters are taken in use.

Both the Central and the Peripheral have a 32-bit connection event counter per LL connection. For the first event of the LL connection, the instant is zero and increments by one on every elapsed connection event interval of the LL connection.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant` on page 230

Show Data Channel Map Table/Hide Data Channel Map Table
Requires packet type LL_CHANNEL_MAP_IND.

Shows or hides the data channel map table. For related settings, see Chapter 5.2.3, "Channel table settings", on page 56.

Remote command:
n.a.

Error Code(hex)
Requires packet type LL_TERMINATE_IND, LL_REJECT_IND or LL_REJECT_EXT_IND.

Sets an 8-bit error code. For an LL_TERMINATE_IND packet, informs the remote device about the termination of the connection. For an LL_REJECT_IND packet, indicates a rejected request.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ECODe` on page 232

Random Vector(hex)
Requires the packet type LL_ENC_REQ and a Central Bluetooth controller.

Sets the random vector of the Central device for device identification.

The parameter is an initialization vector provided by the host in the HCI_ULP_Start_Encryption command.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RVECtor` on page 244

Encrypted DIVersifier(hex)
Requires the packet type LL_ENC_REQ and a Central Bluetooth controller.

Sets the encrypted diversifier of the Central device for device identification. The parameter is an initialization vector provided by the host in the HCI_ULP_Start_Encryption command.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EDIVersifier` on page 233

Session Key iD(hex)
Requires the packet type LL_ENC_REQ and a Central Bluetooth controller or LL_ENC_RSP and a Peripheral Bluetooth controller.

Sets the portion of the Central or the portion of the Peripheral of the session key diversifier (SKDm/SKDs).

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MSKD` on page 238

Initialization Vector(hex)
Requires the packet type LL_ENC_REQ and a Central Bluetooth controller or LL_ENC_RSP and a Peripheral Bluetooth controller.

Sets the portion of the Central or the portion of the Peripheral of the initialization vector (IVm/IVs).

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MIVector` on page 237

Unknown Type(hex)
Requires the packet type LL_UNKNOWN_RSP and a Peripheral Bluetooth controller.

Enables indication of an invalid control packet. The "CtrType" field indicates the value of the LL control packet that caused the transmission of this packet.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:UTYPe` on page 247

FeatureSet Length
Requires the packet type LL_FEATURE_REQ, LL_FEATURE_RSP or LL_PERIPHERAL_FEATURE_REQ.

Displays the length of the feature set.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:FSLength` on page 236

FeatureSet Configuration
Requires the packet type LL_FEATURE_REQ, LL_FEATURE_RSP or LL_PERIPHERAL_FEATURE_REQ.

Opens a dialog to enable or disable features within the link layer control PDU. See "FeatureSet configuration table" on page 90.

Version Number(hex)
Requires packet type LL_VERSION_IND.

Sets the version of the Bluetooth controller. It is an 8-bit value in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:VNUMber
on page 247

SubVersion Number(hex)
Requires packet type LL_VERSION_IND.

Sets a unique 16-bit value for each implementation or revision of an implementation of the Bluetooth controller.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SVNumber
on page 246

Company Id(hex)
Requires packet type LL_VERSION_IND.

Sets the 16-bit company identifier of the manufacturer of the Bluetooth controller.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CID
on page 230

Min. Interval
Requires option R&S SMW-K117 and packet types LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP.

Displays the minimum allowed connection interval.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MNINterval
on page 185

Max. Interval
Requires option R&S SMW-K117 and packet types LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP.

Sets the maximum allowed connection interval.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MXINterval
on page 185

Preferred Periodicity
Requires option R&S SMW-K117 and packet types LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP.

Sets the preferred periodicity. This value is typically a multiple of the value of the connection interval.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PPERiodicity on page 187

Ref. Connection Event Count
Requires option R&S SMW-K117 and packet types LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP.

Sets connection event counter relative to the calculation of all valid offset fields Offset0 to Offset5.

See also "Offset Setting Table" on page 85.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RCECount on page 187

Show Offset Setting Table/Hide Offset Setting Table
Requires option R&S SMW-K117 and packet types LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP.

Shows or hides the offset setting table, see "Offset Setting Table" on page 85.

Remote command:
n.a.

Offset Setting Table
Requires option R&S SMW-K117 and packet types LL_CONNECTION_PARAM_REQ or LL_CONNECTION_PARAM_RSP.

Sets the possible positions of the offset points of the LE connection. At these points, you can update connection parameters relative to the reference connection event count, see "Ref. Connection Event Count" on page 85.

"State" Enables the offset point state.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet<ch0>:STATe on page 186

"Offset(ms)" Sets the offset value.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet<ch0>:VALue on page 186

Reject Opcode
Requires option R&S SMW-K117 and packet type LL_REJECT_EXT_IND.

Sets the Opcode of a rejected control data PDU. For Opcode settings, see Table 2-7.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ROPCode on page 243

MaxRxOctets/MaxTxOctets
Requires option R&S SMW-K117 and packet types LL_LENGTH_REQ or LL_LENGTH_RSP.

Sets the maximum allowed payload length of a received packet (RX) or a transmitted packet (TX).

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MROCtets on page 238
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTOCtets on page 238

MaxRxTime/MaxTxTime

Requires option R&S SMW-K117 and packet types LL_LENGTH_REQ or LL_LENGTH_RSP.

Sets the maximum allowed time to receive (RX) a packet or to transmit (TX) a packet.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MRTime on page 239
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTTime on page 239

TX PHYS/RX PHYS

Requires option R&S SMW-K117 and packet types LL_PHY_REQ or LL_PHY_RSP.

Sets preferred physical layers in receive direction (Rx) and transmit direction (Tx). For permitted PHYs, see Table 2-9.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:L1M:STATe on page 243
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:L2M:STATe on page 243
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:LCOD:STATe on page 243
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:L1M:STATe on page 243
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:L2M:STATe on page 244
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:LCOD:STATe on page 244

M_TO_S_PHY/S_TO_M_PHY

Requires option R&S SMW-K117 and packet type LL_PHY_UPDATE_IND.

Sets the physical layers of the Central-to-Peripheral (C_TO_P) direction and Peripheral-to-Central (P_TO_C) direction.

For available PHYs, see Table 2-9.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:L1M:STATe on page 239
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:L2M:STATe on page 239
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:LCOD:STATe on page 239

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:L1M:STATe on page 239
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:L2M:STATe on page 239
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:LCOD:STATe on page 239

PHYs

Requires option R&S SMW-K117 and packet type LL_MIN_USED_CHANNELS_IND.

Sets the physical layers for which the Peripheral device has a minimum used channels requirement. See also "Min Used Channels" on page 87.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L1M:STATe on page 242
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L2M:STATe on page 242
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:LCOD:STATe on page 242

Min Used Channels

Requires option R&S SMW-K117 and packet type LL_MIN_USED_CHANNELS_IND.

Sets the minimum number of channels to be used on the specified "PHYs" on page 87.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MUCHannels on page 239

ID(hex)

Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Sets the ID of the identifier specified by the Host in the CtrData field. The value is in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ID on page 249

SyncInfo Configuration

Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

For related settings, see "SyncInfo/SyncInfo Configuration" on page 69 and Chapter 5.3.5.5, "SyncInfo configuration settings", on page 73.

Connection Event Count

Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Specifies the connEventCount field in the CtrData field.

The count value is specified within the following range:

currEvent - 2^14 < connEventCount < currEvent+ 2^14

CurrEvent is the counter value for the connection event during transmission or retransmission of the PDU.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CECount
on page 248

Last Pa Event Counter
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Sets the lastPaEventCounter field in the CtrData field.

The lastPaEventCounter value is typically equal to the PaEventCounter value in the AUX_SYNC_IND PDU.

The values for lastPaEventCounter and EventCounter are as follows:
- Equal values
- Values with a difference of 1 (modulo 65536)
- Values representing LL_PERIODIC_SYNC_IND and AUX_SYNC_IND timing of less than 5 seconds

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:LPECounter
on page 249

SID(hex)
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Sets the SID field in the CtrData field. The value is in hexadecimal representation.

The SID is typically equal to the Advertising SID subfield of the advertising set pointing to periodic advertising.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SID
on page 251

Address Type
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Sets the address type in the CtrData field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ATYPe
on page 248

Sleep Clock Accuracy
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

For related settings, see "Sleep Clock Accuracy" on page 79.

PHY
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Sets the PHY field in the CtrData field. The value is set in a hexadecimal representation.

The PHY information indicates the PHY type during periodic advertising. The selection is exclusive; enabling one PHY disables the other enabled PHY.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L1M:STATe on page 250
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L2M:STATe on page 250
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:LCOD:STATe on page 250

Advertiser's Device Addr
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

For related settings, see "Advertiser's Device Addr" on page 64.

Sync Connection Event Counter
Requires option R&S SMW-K117 and packet type LL_PERIODIC_SYNC_IND.

Sets the event counter for the sync connection.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCECounter on page 250

MinCTELenReq
Requires option R&S SMW-K117 and packet type LL_CTE_REQ.

Sets the minimum CTE length in the CtrData field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MCLReq on page 249

CTETypeReq
Requires option R&S SMW-K117 and packet type LL_CTE_REQ.

Sets the 2-bit constant tone extension type in the CtrData field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CTReq on page 220
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MCLReq on page 249

5.3.9 FeatureSet configuration settings

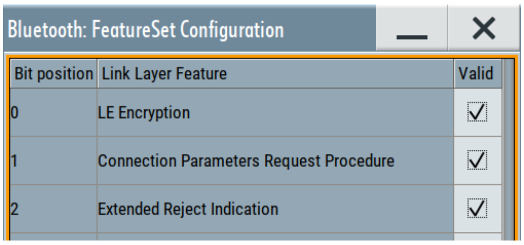
Option: R&S SMW-K117

Access:

1. In the "Channel" tab, select "Channel Type" > "Data".
2. Select a link layer control PDU that contains feature set information. These PDUs are available for central or peripheral controllers.
3. For a central controller, proceed as follows:

a) Select "Bluetooth Controller Role" > "Central".
b) Select "Packet Type" > "LL_FEATURE_REQ" or "LL_PERIPHERAL_FEATURE_REQ".

4. For a peripheral controller, proceed as follows:
   a) Select "Bluetooth Controller Role" > "Peripheral".
   b) Select "Packet Type" > "LL_FEATURE_RSP" or "LL_PERIPHERAL_FEATURE_REQ".
5. Select "Event Configuration" > "Packet Configuration".
6. Select "Payload" > "FeatureSet Configuration".



Opens a dialog to enable or disable features within the link layer control PDU. A table lists all features that are available within the feature set of the PDU.

Settings:

FeatureSet configuration table

Displays available features within the link layer control PDU.

For configurable features, see the table Table 5-5. To enable the feature, select "Valid" > "On" to the right of the feature.

Table 5-5: Link layer features: Bit number and feature

Bit	Link layer feature	Bit	Link layer feature
0	LE encryption	14	Channel selection algorithm #2
1	Connection parameter request procedure	15	LE power class 1
2	Extended reject indication	16	Minimum Number of Used Channels procedure
3	Peripheral-initiated feature exchange	17	Connection CTE request
4	LE ping	18	Connectionless CTE response
5	LE data packet length extension	19	Connectionless CTE transmitter
6	LL privacy	20	Connectionless CTE receiver
7	Extended scanner filter policies	21	Antenna switching during CTE transmission (AoD)
8	LE 2M PHY	22	Antenna switching during CTE reception (AoD)
9	Stable modulation index - transmitter	23	Receiving constant tone extensions
10	Stable modulation index - receiver	24	Periodic advertising Sync transfer - sender
11	LE coded PHY	25	Periodic advertising Sync transfer - recipient

Bit	Link layer feature	Bit	Link layer feature
12	LE extended advertising	26	Sleep clock accuracy updates
13	LE periodic advertising	27	Remote public key validation

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit<ch0>:STATe` on page 236

5.4 CS subevent configuration

Option: R&S SMW-K178

Access:

1. Select "Bluetooth" > "General".
2. Select "Bluetooth Mode" > "Bluetooth Low Energy".
3. Select "Channel".
4. Select "Channel Type" > "Channel Sounding".
5. Select "Cs Subevent Configuration".

   The dialog provides settings to configure Channel Sounding subevents.

For more information, refer to the Bluetooth Channel Sounding specification [2].

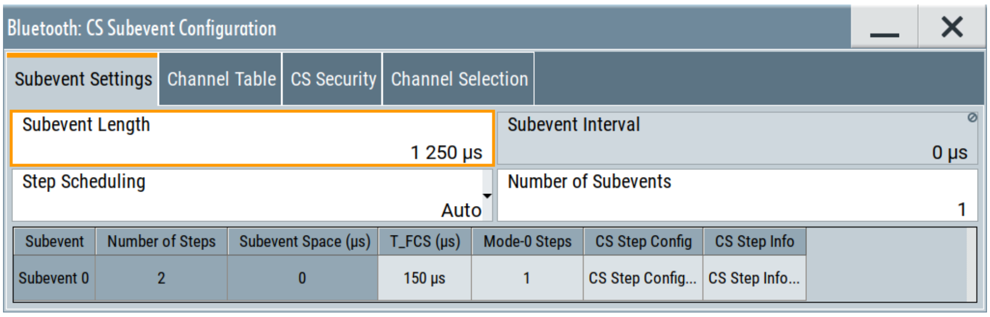
Settings:

5.4.1 Subevent settings

Access:

1. Select "Cs Subevent Configuration".

2. Select "Subevent Settings".



The tab provides settings to configure subevent settings.

Settings:

Subevent Length

Sets the subevent length that is the duration of a CS subevent.

You can set values in multiples of 625 µs. Settable subevent lengths depend on the number of event intervals, the connection interval, the event offset and the subevent interval.

For more information, refer to the Bluetooth Channel Sounding specification [2].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:SLENgth` on page 193

Subevent Interval

Sets the subevent interval. This interval is the time in multiples of 625 µs between the beginning of a CS subevent and the beginning of the next CS subevent within the same CS event.

For "Number of Subevents" = "1", the subevent interval is 0µs. For "Number of Subevents" higher than "1", settable subevent intervals depend on the number of event intervals, the connection interval, the event offset and the subevent length.

For more information, refer to the Bluetooth Channel Sounding specification [2].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:SINTerval` on page 193

Step Scheduling

Sets the CS step scheduling mode.

"Auto"
: Automatic CS step scheduling. The subevent length, the subevent interval and the number of subevents are configurable.
The number of CS steps is 2.

"Manual"
: Manual CS step scheduling. The table Table 5-6 lists fixed CS parameters.

Table 5-6: CS parameters for manual step scheduling

Parameter	Value
"Subevent Length"	1250 µs
"Subevent Interval"	0 µs
"Number of Subevents"	1
"Event Intervals"	2
"Connection Interval"	7.5 ms
"Event Offset"	500 µs

The number of CS steps is configurable.

For more information, refer to the Bluetooth Channel Sounding specification [2].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:SSCHeduling` on page 194

Number of Subevents

Sets number of subevents. Settable values depend on the subevent interval.

For more information, refer to the Bluetooth Channel Sounding specification [2].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:SNUMber` on page 194

Subevent table

Lists properties and settings of all configured subevents in a table. The number of rows equals the number of subevents.

Subevent	Number of Steps	Subevent Space (µs)	T_FCS (µs)	Mode-0 Steps	CS Step Config	CS Step Info
Subevent 0	2	935	150 µs	1	CS Step Config...	CS Step Info...
Subevent 1	2	935	150 µs	1	CS Step Config...	CS Step Info...
Subevent 2	2	935	150 µs	1	CS Step Config...	CS Step Info...

The table allows you to check or configure the following parameters for each subevent individually:

- "Subevent" on page 94
- "Number of Steps" on page 94
- "Subevent Space (µs)" on page 94
- "T_FCS (µs)" on page 94
- "Mode-0 Steps" on page 94
- "CS Step Config" on page 94
- "CS Step Info" on page 94

Subevent
Displays the subevent number "Subevent x" within a subevent interval. "x" ranges from 0 to 31 depending on the number of subevents, see "Number of Subevents" on page 93.

Remote command:
Via suffix `SUBevent<ch>`

Number of Steps
Sets or display the number of CS steps. Setting requires "Step Scheduling" > "Manual". Settable minimum values are 1 or equal to the number of non-zero Mode-0 steps, see "Mode-0 Steps" on page 94.

For more information, refer to the Bluetooth Channel Sounding specification [2].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:NOSTep` on page 194

Subevent Space (µs)
Displays the subevent space in microseconds.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SSPace?` on page 195

T_FCS (µs)
Sets the frequency change period (T_FCS) between consecutive CS steps. The period ranges from 15 µs to 150 µs.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:TFCS` on page 195

Mode-0 Steps
Sets the number of Mode-0 CS steps.

For "Step Scheduling" > "Auto", the range is 1 to 3. For "Step Scheduling" > "Manual", the range is 0 to 3. For non-zero Mode-0 CS steps ("Mode-0 Steps" ≠ "0"), the minimum number of CS steps equals the configured Mode-0 CS steps.

For more information, refer to the Bluetooth Channel Sounding specification [2].

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MZSTeps` on page 195

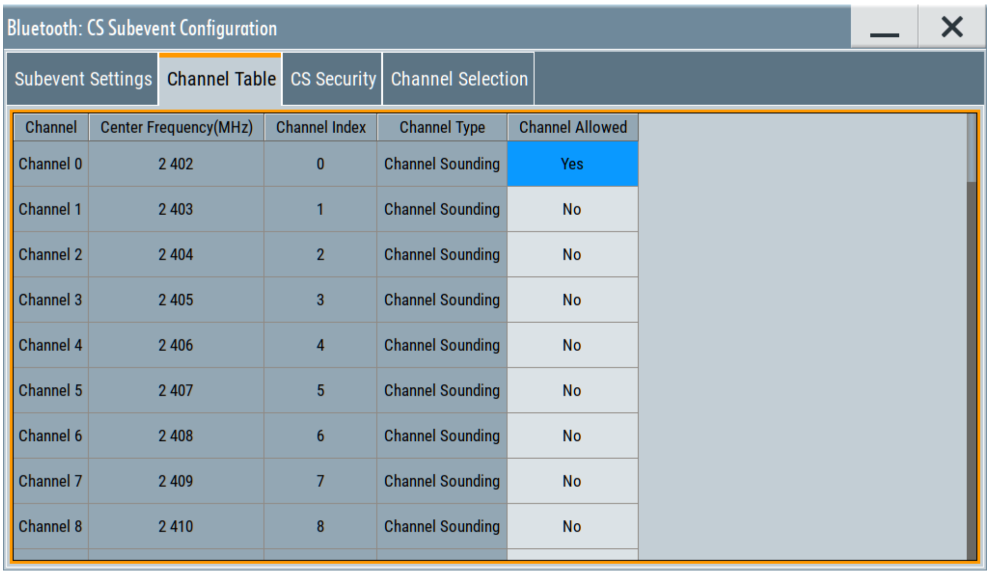
CS Step Config
Opens a dialog to configure CS steps, see Chapter 5.4.5, "CS step configuration", on page 99.

CS Step Info
Opens a dialog that provides information on configured CS steps per subevent in a table, see Chapter 5.4.6, "CS step info", on page 108.

5.4.2 Channel table

Access:

1. Select "CS Subevent Configuration".
2. Select "Channel Table".



The tab lists general settings for all 78 Bluetooth LE channels in a table.

Settings:

Channel

Displays the channel number that consists of "Channel" and the channel index.

For example, for "Channel 0" the channel index is 0 and the center frequency is 2402 MHz. See also Table 2-13.

Remote command:
Via suffix `CHNNL<ch>`

Center Frequency (MHz)

Displays the center frequency of the channel.

See also Table 2-13.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CFRequency?`
on page 205

Channel Index

Displays the channel index of the channel.

See also Table 2-13.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CINDex?
on page 206

Channel Type

Displays the channel type that is Channel Sounding for all channels.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CTYPe?
on page 206

Channel Allowed

Enables transmission of the subevent via the selected channel.

See also Table 2-13.

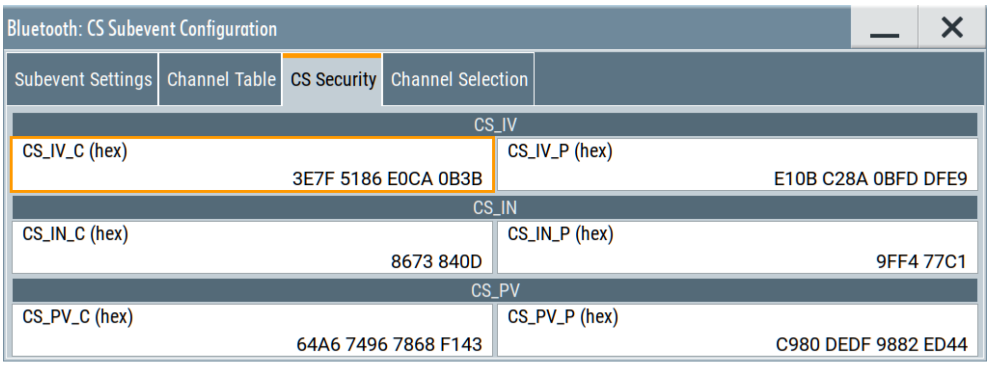
"Yes"	Enables transmission of the subevent for the selected channel.
"No"	Disables transmission of the subevent for the selected channel.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CALLowed
on page 206

5.4.3 CS security settings

Access:

1. Select "CS Subevent Configuration".
2. Select "CS Security".



The tab provides settings to configure CS security settings.

Settings:

CS_IV_C(hex)

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_IV_C parameter. The parameter is 64-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CIVC` on page 207

CS_IV_P(hex)

Requires packet type CS SEQUENCE or LL_CS_SEC_RSP.

Sets the CS_IV_P parameter. The parameter is 64-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CIVP` on page 207

CS_IN_C(hex)

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_IN_C parameter. The parameter is a 32-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CINC` on page 208

CS_IN_P(hex)

Requires packet type CS SEQUENCE or LL_CS_SEC_RSP.

Sets the CS_IN_P parameter. The parameter is a 32-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CINP` on page 208

CS_PV_C(hex)

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_PV_C parameter. The parameter is 64-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CSPVc` on page 209

CS_PV_P(hex)

Requires packet type CS SEQUENCE or LL_CS_SEC_RSP.

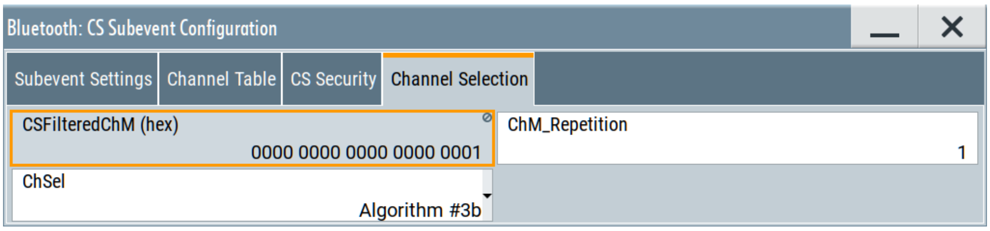
Sets the CS_PV_P parameter. The parameter is 64-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CPVP` on page 209

5.4.4 Channel selection settings

Access:

1. Select "CS Subevent Configuration".
2. Select "Channel Selection".



The tab provides settings to configure channel selection.

Settings:

CSFilteredChM(hex)

Displays the value of the field CSFilteredChM.

This value determines the bit map for the Channel Sounding channel map update procedure. The parameter is 64-bit in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CFCHm?` on page 209

ChM_Repetition

Sets the 3-bit ChM_Repetition field.

The value equals the number of cycles of the ChM field for non-Mode-0 CS steps within a CS procedure.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CMRepetition` on page 210

ChSel

Sets the algorithm to select the channels.

"Algorithm #3b"
Sets for Algorithm #3b channel selection algorithm.

"Algorithm #3c"
Sets for Algorithm #3c channel selection algorithm.

Table 5-7: Algorithm #3c parameters

CSChannelJump	seq1StartCh	seq2StartCh	maxRepsAllowed	saltRate
2	1	76	1	2
3	77	0	1	2
4	78	0	2	2
5	78	0	2	2
6	76	1	3	2
7	74	1	3	2
8	76	0	3	2

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CSEL` on page 210

Ch3cShape
Requires "ChSel" > "Algorithm #3c".

Sets the bits of the Ch3cShape field. The field has a length of 4 bits and sets the shaping method of the rising and falling ramps of the channels.

The resulting shapes are incorporated into a shuffled channel map so that they appear random, preserving equal channel distribution qualities.

"Hat Shape" Channel with a rising ramp and a falling ramp.

"X Shape" Channel with interleaved rising and falling ramps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CTCShape` on page 211

Ch3cJump
Requires "ChSel" > "Algorithm #3c".

Determines the number of skipped channels when rendering the channel shapes. The Ch3cJump field has a length of 1 octet and relates to the channel index values. See also Table 5-7.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CTCJump` on page 210

5.4.5 CS step configuration

Access:

1. Select "CS Subevent Configuration".
2. Select "Subevent Settings" > "Subevent 0" > "CS Step Config...".

The "CS Step Config" tab of the "Structure for Subevent x" dialog opens.

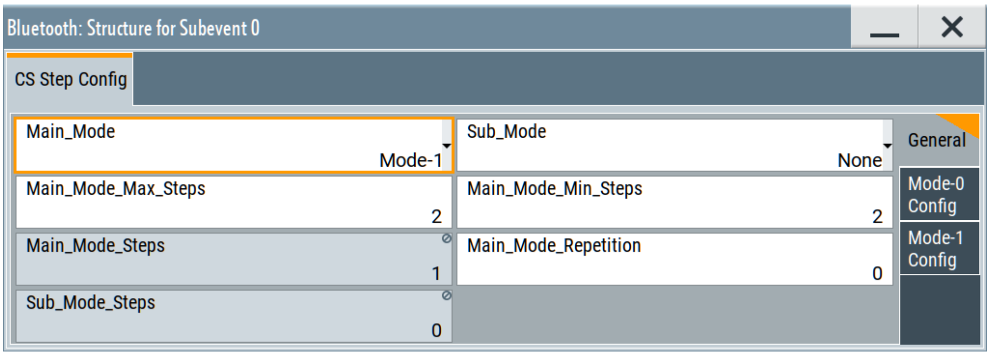
The tab provides CS step settings for the first subevent "Subevent 0". If configured, all following subevents share CS step configuration as subevent 0.

Settings:

5.4.5.1 General settings

Access:

► Select "CS Step Config" > "General".



The tab provides CS step general settings for each subevent.

Settings:

Main_Mode

Sets the main mode of the CS step.

"Mode-1"	Mode-1 mode with no submode available.
"Mode-2"	Mode-2 mode with submodes "Mode-1" and "Mode-3" available.
"Mode-3"	Mode-3 mode with submode "Mode-2" available.

The table Table 5-8 provides an overview on available submodes per main mode.

Table 5-8: CS step main modes and submodes

"Main_Mode"	"Sub_Mode"
"Mode-1"	"None"
"Mode-2"	"None", "Mode-1", "Mode-3"
"Mode-3"	"None", "Mode-2"

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMODe` on page 196

Sub_Mode
Sets the submode of the main mode.

The table Table 5-8 provides an overview on available submodes per main mode.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SMODe` on page 197

Main_Mode_Max_Steps
Sets the maximum number of main mode steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMASteps` on page 197

Main_Mode_Min_Steps
Sets the minimum number of main mode steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMISteps` on page 197

Main_Mode_Steps
Displays the number of main mode CS steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMSTeps?` on page 198

Main_Mode_Repetition
Sets the main mode repetition.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMRepetition` on page 198

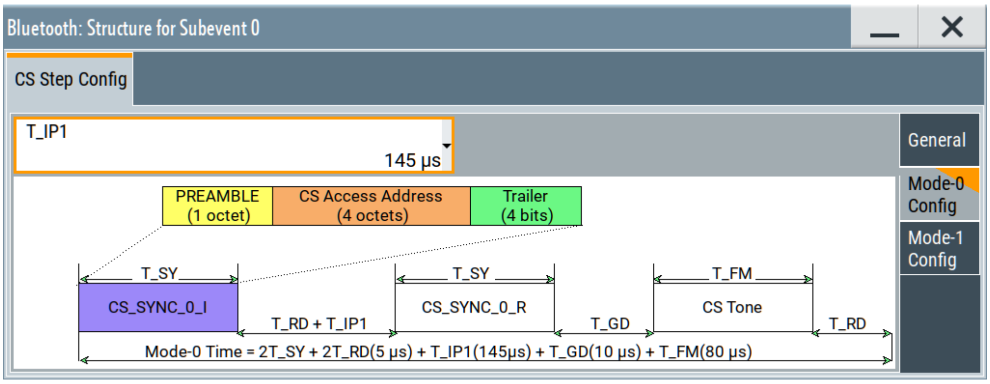
Sub_Mode_Steps
Sets the number of submode CS steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SMSTep?` on page 198

5.4.5.2 Mode-0 config settings

Access:

► Select "CS Step Config" > "Mode-0 Config".



The tab provides Mode-0 CS step settings.

Settings:

T_IP1
Sets the time "T_IP1" for Mode-0 CS steps.

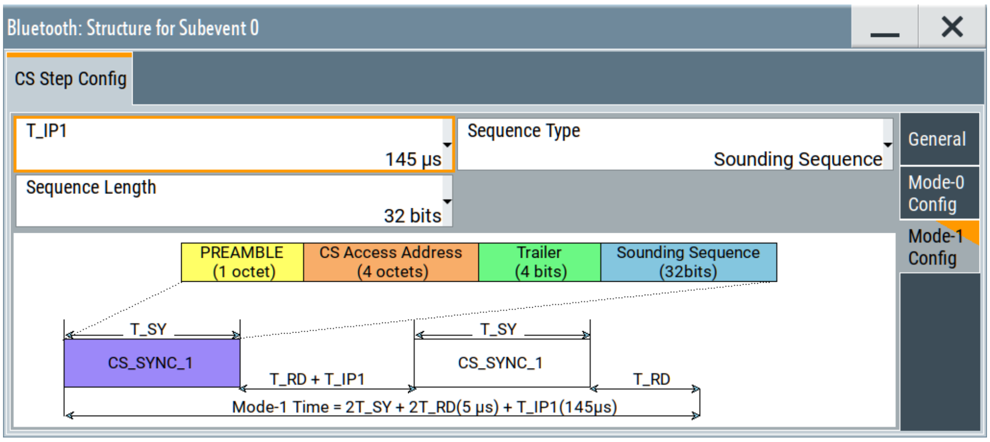
Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MZERo:TIPO` on page 198

5.4.5.3 Mode-1 config settings

Access:

1. Select "CS Step Config" > "General".
2. Select Mode-1 in the CS step main mode or submode:
   - Select "Main_Mode" > "Mode-1".

- Select "Main_Mode" > "Mode-2" and "Sub_Mode" > "Mode-1".



The tab provides Mode-1 CS step settings.

Settings:

T_IP1

Sets the time "T_IP1" for Mode-1.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MONE:TIPO` on page 198

Sequence Length

Sets the sequence length. The length is discrete and depends on the sequence type.

Sequence type	Sequence length
Sounding sequence	32 bits, 96 bits
Random sequence	32 bits, 64 bits, 96 bits and 128 bits

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SEQLength` on page 200

Sequence Type

Sets the sequence type.

"Sounding Sequence"
Sounding sequence

"Random Sequence"
Random sequence

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:STYPe` on page 200

User Payload Pattern
Displaying the parameter "User Payload Pattern" requires the following:
- "Packet Type" > "TEST PACKET".
- "Main_Mode" > "Mode-1" or "Mode-3".
  "Sub_Mode" > "Mode-1" or "Mode-3".
- In the "Mode-1 Config" or "Mode-3 Config", select "Sequence Type" > "Random Sequence".

Sets a predefined pattern or user-defined data list as the data source for the user payload.

"PRBS 9 sequence"/"PRBS 15 sequence"
Pseudo random bit sequences of the length 9 or 15 - transmission of identical packet series.

Predefined pattern
"Repeated 11110000 sequence", "Repeated 10101010 sequence", "Repeated 11111111 sequence", "Repeated 00000000 sequence", "Repeated 00001111 sequence" or "Repeated 01010101 sequence"

"Use CS_SYNC_User_Payload"
Selects binary data from a user-defined data list file, see "Select Data List" on page 104.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPPattern` on page 201

Select Data List
Requires "User Payload Pattern" > "Use CS_SYNC_User_Payload".

See "Data Source" on page 65.

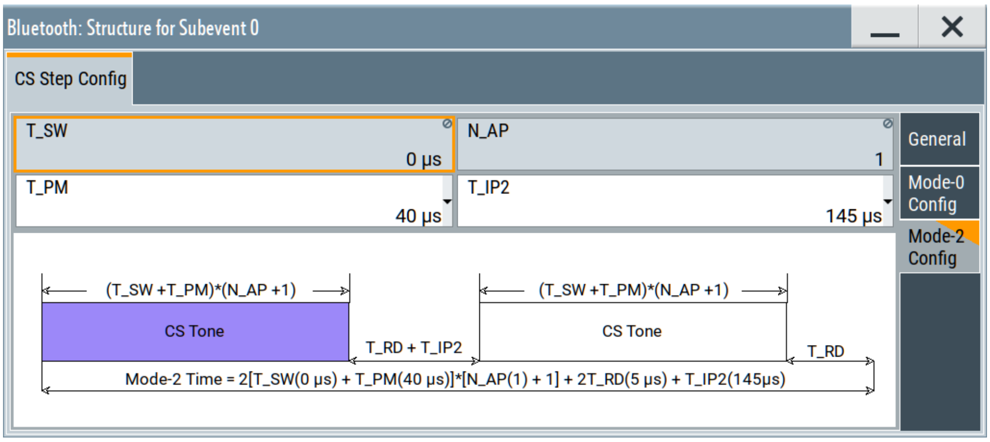
Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPAYload` on page 200

5.4.5.4 Mode-2 config settings

Access:

1. Select "CS Step Config" > "General".
2. Select Mode-2 in the CS step main mode or submode:
   - Select "Main_Mode" > "Mode-2".

- Select "Main_Mode" > "Mode-3" and "Sub_Mode" > "Mode-2".



The tab provides Mode-2 CS step settings.

Settings:

T_SW

Sets the time "T_SW" for Mode-2.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:TSW?` on page 199

N_AP

Sets the number of antenna path in the N_AP field.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:NAP?` on page 199

T_PM

Sets the time "T_PM" for Mode-2.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:TPM` on page 199

T_IP2

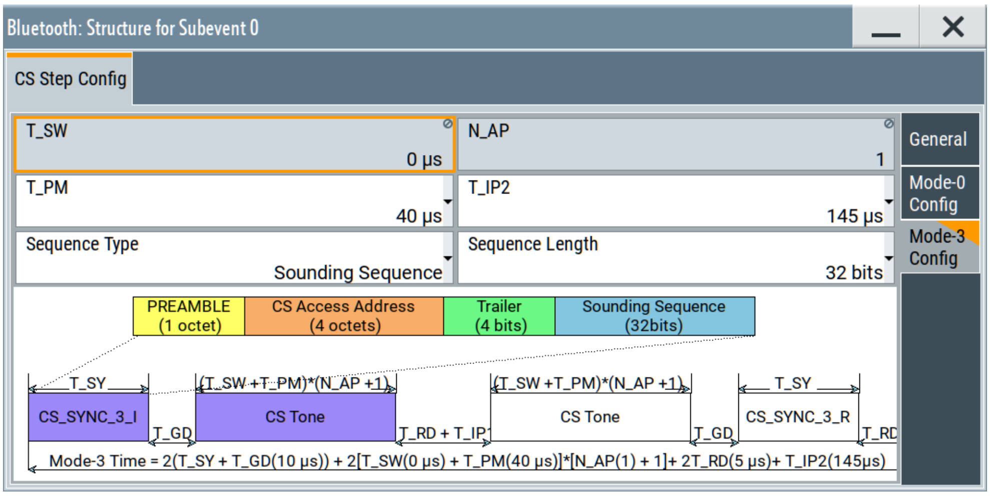
Sets the time "T_IP2" for Mode-2 CS steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:TIPT` on page 200

5.4.5.5 Mode-3 config settings

Access:

1. Select "CS Step Config" > "General".
2. Select Mode-3 in the CS step main mode or submode:
   - Select "Main_Mode" > "Mode-3".
   - Select "Main_Mode" > "Mode-2" and "Sub_Mode" > "Mode-3".



The tab provides Mode-3 CS step settings.

Settings:

T_SW

Sets the time "T_SW" for Mode-3.

Remote command:

`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:TSW?` on page 199

N_AP

Sets the "N_AP".

Remote command:

`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:NAP?` on page 199

T_PM

Sets the time "T_PM" for Mode-3.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:TPM on page 199

T_IP2

Sets the time "T_IP2" for Mode-3.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:TIPT on page 200

Sequence Length

Sets the sequence length. The length is discrete and depends on the sequence type.

Sequence type	Sequence length
Sounding sequence	32 bits, 96 bits
Random sequence	32 bits, 64 bits, 96 bits and 128 bits

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SEQLength on page 200

Sequence Type

Sets the sequence type.

"Sounding Sequence"
Sounding sequence

"Random Sequence"
Random sequence

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:STYPe on page 200

User Payload Pattern

Displaying the parameter "User Payload Pattern" requires the following:

- "Packet Type" > "TEST PACKET".
- "Main_Mode" > "Mode-1" or "Mode-3".
  "Sub_Mode" > "Mode-1" or "Mode-3".
- In the "Mode-1 Config" or "Mode-3 Config", select "Sequence Type" > "Random Sequence".

Sets a predefined pattern or user-defined data list as the data source for the user payload.

"PRBS 9 sequence"/"PRBS 15 sequence"
Pseudo random bit sequences of the length 9 or 15 - transmission of identical packet series.

Predefined pattern
"Repeated 11110000 sequence", "Repeated 10101010 sequence", "Repeated 11111111 sequence", "Repeated 00000000 sequence", "Repeated 00001111 sequence" or "Repeated 01010101 sequence"

"Use CS_SYNC_User_Payload"
Selects binary data from a user-defined data list file, see "Select Data List" on page 104.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPPattern` on page 201

Select Data List
Requires "User Payload Pattern" > "Use CS_SYNC_User_Payload".

See "Data Source" on page 65.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPAYload` on page 200

5.4.6 CS step info

Access:

1. Select "CS Subevent Configuration".
2. Select "Subevent settings" > "CS Step Config".

   The "CS Step Config" dialog opens.

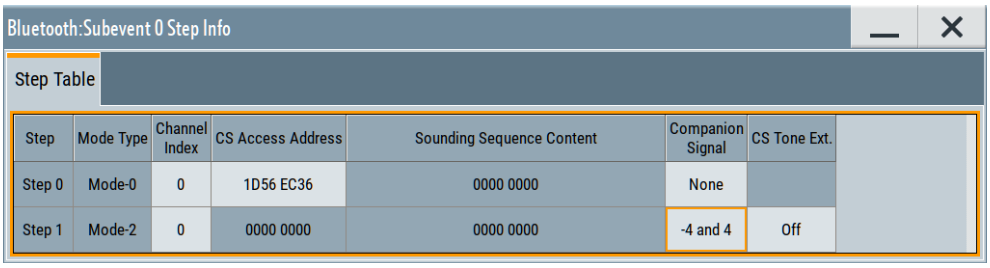
   The dialog provides CS step settings for each subevent.

Settings:

5.4.6.1 Step table

Access:

► Select "CS Step Info" > "Step Table".



Step	Mode Type	Channel Index	CS Access Address	Sounding Sequence Content	Companion Signal	CS Tone Ext.
Step 0	Mode-0	0	1D56 EC36	0000 0000	None	
Step 1	Mode-2	0	0000 0000	0000 0000	-4 and 4	Off

The tab provides the step table that lists the properties and settings for individual CS steps per subevent. The number of rows equals the number of CS steps per subevent. The table allows you to check or configure the following settings for each CS step.

Settings:

Step

Displays the number of the CS step "Step x". "x" depends on the number of main mode steps, see "Main_Mode_Steps" on page 101.

Remote command:
Via suffix `STEP<st0>`

Mode Type

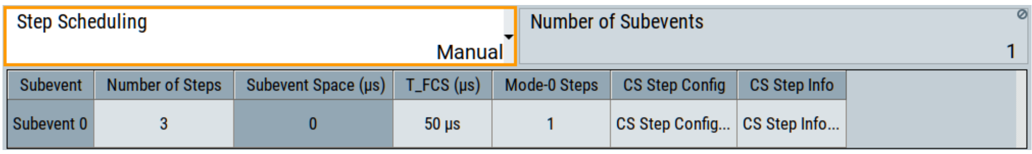
Displays the mode type for individual CS steps.

The displayed mode type depends on the number of Mode-0 CS steps and the configured main mode in the CS step configuration. See "Mode-0 Steps" on page 94 and "Main_Mode" on page 100.

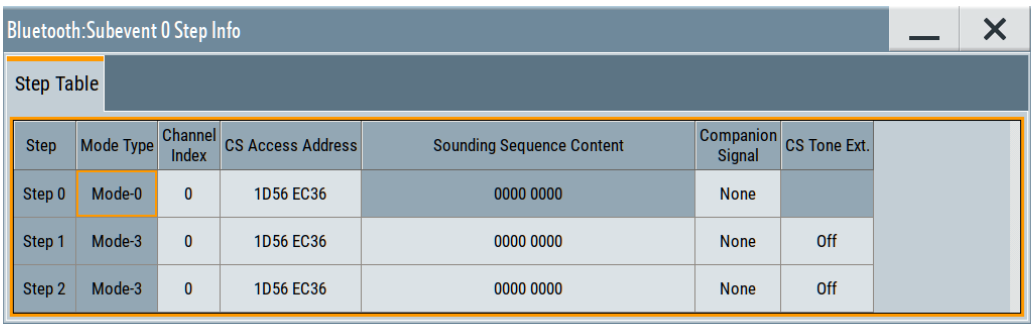
Example:

This example assumes manual step scheduling for one subevent with three CS steps and one mode-0 step. The CS step main mode is mode-3. Set as follows:

"Step Scheduling" > "Manual", "Number of Subevents" = "1", "Number of Steps" = "3", "Mode-0 Steps" = "1" and "Main_Mode" > "Mode-3".



Select "CS Step Info..." to open the CS step table. The table displays the information for three CS steps. The first step "Step 0" has the "Mode Type" > "Mode-0". The second step "Step 1" and the third step "Step 2" have the "Mode Type" > "Mode-3"



Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:MTYPe?`
on page 202

Channel Index
Sets or displays the channel index for individual CS steps.

Setting the index requires "Step Scheduling" > "Manual"

See also Table 2-13.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CINDex`
on page 203

CS Access Address
Sets or displays the 32-bit CS access address for individual CS steps.

Setting the address requires "Step Scheduling" > "Manual"

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CAADdress`
on page 203

Sounding Sequence Content/Random Sequence Content
Displays the 128-bit content of a sounding sequence or a random sequence. The content depends on the subevent mode.

For CS test packets, you can set the content for a sounding sequence and random sequence, see "Sequence Type" on page 103.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:SCONtent`
on page 203

Companion Signal
Sets the companion signal and the data source.

"Companion Signal"

Enables or disables the companion signal. This signal consists of one or two signals that deviate symmetrically from the carrier frequency of the wanted signal.
The carrier frequency is the center frequency of the channel that relates to the channel index, see "Channel Index" on page 110.

You can select between the following values:

- "None":
  Disables the companion signal.
- "-2"/"2"/"-2 and 2":
  Requires "Packet Format" > "LE 1M".
  Enables the companion signal with a deviation of -2 MHz or 2 MHz from the carrier frequency of the wanted signal. "-2 and 2" enables two companion signals that deviate symmetrically from the carrier by 2 MHz.
- "-4"/"4"/"-4 and 4":
  Requires "Packet Format" > "LE 2M" or "LE 2M 2BT".
  Enables the companion signal with a deviation of -4 MHz or 4 MHz from the carrier frequency of the wanted signal. "-4 and 4" enables two companion signals that deviate symmetrically from the carrier by 4 MHz.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CSIGnal` on page 204

"Data Source" Requires "Companion Signal" ≠ "None".
Selects the 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 set the bit pattern.
- "Data List"/"Select Data List"
  Binary data from a list file, internally or externally generated.
  Select "Select Data List" to open the standard "Select List" dialog.
  The dialog lists file with file extension `*.dm_iqd` if existing.
  – Navigate to the list file and tap "Select" to select the file.
  – Use the "New" and "Edit" functions to create a data list internally or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "About data signals" in the R&S SMW200A user manual.
- Section "File and data management" in the R&S SMW200A user manual.
- Section "Data list editor" in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:DATA` on page 204
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:PATTern` on page 205
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:DLISt` on page 204

CS Tone Ext.
Displaying the CS tone extension requires the following:
- "Step Scheduling" > "Manual".
- "Number of Steps" higher than "Mode-0 Steps"
  For example, "Number of Steps" = "2", "Mode-0 Steps" = "1".
- "Main_Mode" > "Mode-2" or "Mode-3"

Enables CS tone extension for mode-2 and mode-3 CS steps.

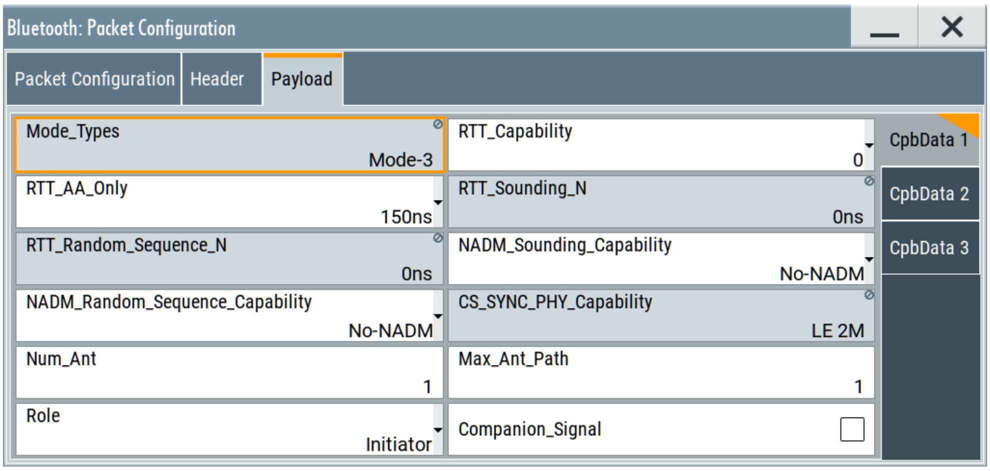
Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CTEXtension` on page 205

5.5 CS control data payload settings

Option: R&S SMW-K178

Access:

1. Select "Packet Configuration".
2. Select "Payload".



The tab provides settings to configure the packet/PDU payload.

5.5.1 CS security payload settings

For packet type LL_CS_SEC_REQ and LL_CS_SEC_RSP, the "Payload" tab provides CS security settings. The table below lists available CS security settings per LL Control PDU.

LL Control PDU	CS security settings
LL_CS_SEC_REQ	"CS_IV_C(hex)", "CS_IN_C(hex)", "CS_PV_C(hex)"
LL_CS_SEC_RSP	"CS_IV_P(hex)", "CS_IN_P(hex)", "CS_PV_P(hex)"

For related settings, see Chapter 5.4.3, "CS security settings", on page 96.

5.5.2 CS capabilities payload settings

For packet type LL_CS_CAPABILITIES_REQ and LL_CS_CAPABILITIES_RSP, the "Payload" tab provides the following settings.

Settings:

5.5.2.1 CpbData 1 settings

Mode_Types
Displays the LL Control packet mode type that is Mode-3.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MTYPe?` on page 260

RTT_Capability
Sets the bits in the RTT_Capability field.

These bits determine the time values for the RTT_AA_Only_N field, the RTT_Sounding_N field and the RTT_Random_Sequence_N field. See the table Table 5-9 for an overview.

Table 5-9: RTT_Capability bit numbers and RTT fields

"RTT_Capability"	"RTT_AA_Only"	"RTT_Sounding_N"	"RTT_Random_Sequence_N"
0	150ns, 10ns, 0ns	0ns	0ns
1	0ns	150ns, 10ns, 0ns	0ns
2	0ns	0ns	150ns, 10ns, 0ns

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RCAPability` on page 264

RTT_AA_Only
Displays or sets the time values of the RTT_AA_Only_N field.

Setting the value depends on the bits of the RTT_Capability field. See the table Table 5-9 for an overview.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RAONly` on page 263

RTT_Sounding_N
Displays or sets the time values of the RTT_Sounding_N field.

Setting the value depends on the bits of the RTT_Capability field. See the table Table 5-9 for an overview.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RSOunding` on page 266

RTT_Random_Sequence_N
Displays or sets the time values of the RTT_Random_Sequence_N field.

Setting the value depends on the bits of the RTT_Capability field. See the table Table 5-9 for an overview.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RRSequence` on page 266

NADM_Sounding_Capability
Sets the NADM sounding sequence capability.

"No-NADM"	NADM disabled
"NADM"	NADM enabled

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NSCapability` on page 261

NADM_Random_Sequence_Capability
Sets the NADM random sequence capability.

"No-NADM"	NADM disabled
"NADM"	NADM enabled

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NRSCapability` on page 261

CS_SYNC_PHY_Capability
Displays the value of the CS_SYNC_PHY_Capability field that is the LE 2M PHY.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSPCapability?` on page 268

Num_Ant
Sets the bits of the Num_Ant field. This field indicates the number of antenna elements of the Channel Sounding device.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NANT` on page 260

Max_Ant_Path
Sets the maximum Num_Ant paths.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MAPath` on page 258

Role

See "Role" on page 50.

Companion_Signal

Enables the companion signal.

See also "Companion Signal" on page 110.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSIGnal` on page 257

5.5.2.2 CpbData 2 settings

No_FAE

Sets the No_FAE bit. This bit indicates if the transmitting LE device supports a fractional frequency offset actuation error (FAE) or not.

"On" No_FAE bit is 1. The transmitting LE device only supports an FAE of zero.

"Off" No_FAE bit is 0. The transmitting LE device supports FAE values as listed in an FAE table.
See also "Channel FAE Table" on page 129.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NFAE` on page 261

Channel Selection Algorithm #3c

Enables the channel selection algorithm #3c.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSAThreec` on page 257

Sounding_PCT_Estimate

Sets the Sounding_PCT_Estimate bit. This bit indicates if the device supports phase correction term (PCT) estimates from a sounding sequence or not.

"On" The Sounding_PCT_Estimate bit is 1. The device supports PCT estimates from a sounding sequence.

"Off" The Sounding_PCT_Estimate bit is 0. The device does not support PCT estimates from a sounding sequence.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SPEStimate` on page 268

RFU

Sets the bits that are reserved for future use (RFU).

The number of RFU bits can vary depending on the CS_Control_Data PDU.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RFU` on page 264

Num_Configs

Sets the Num_Configs field that relates to the number of independent CS configurations.

This number equals the CS configurations supported by the link layer transmitting this PDU for this specific ACL connection.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NCONfig` on page 260

Max_Procedures_Supported

Sets the bits in the Max_Procedures_Supported field.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MPSupported` on page 259

T_SW

Sets the T_SW field values that relate to the duration of the antenna switch period.

The local controller uses this period when switching antennas during active transmissions.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TSW` on page 266

5.5.2.3 CpbData 3 settings

Show T_IP1 Capability Table/Hide T_IP1 Capability Table

Shows or hides the "T_IP1_Capability Table".

The table provides settings to enable T_IP1 capability for bit positions that relate to eight T_IP1 times. See also "T_IP1" on page 102.

T_IP1_Capability Table

The table provides settings to enable the T_IP1 capability including the T_IP1 time per bit position. You can enable T_IP1 capabilities for bit position 0 to bit position 7.

"Bit Position" Displays the bit position.

"T_IP1" Displays the T_IP1 time of the bit position.

"T_IP1 Capability"
Enables the T_IP1 capability per bit position.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TIPO:CAPability` on page 254

Show T_IP2 Capability Table/Hide T_IP2 Capability Table
Shows or hides the "T_IP2_Capability Table".

The table provides settings to enable T_IP2 capability for bit positions that relate to eight T_IP2 times. See also "T_IP2" on page 105.

T_IP2_Capability Table
The table provides settings to enable the T_IP2 capability including the T_IP2 time per bit position. You can enable T_IP2 capabilities for bit position 0 to bit position 7.

"Bit Position" Displays the bit position.

"T_IP2" Displays the T_IP2 time of the bit position.

"T_IP2 Capability"
Enables the T_IP2 capability per bit position.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TIPT:CAPability` on page 255

Show T_FCS Capability Table/Hide T_FCS Capability Table
Shows or hides the "T_FCS_Capability Table".

The table provides settings to enable T_FCS capability for bit positions that relate to 10 T_FCS times. See also "T_FCS (µs)" on page 94.

T_FCS_Capability Table
The table provides settings to enable the T_FCS capability including the T_FCS time per bit position. You can enable T_FCS capabilities for bit position 0 to bit position 9.

"Bit Position" Displays the bit position.

"T_FCS" Displays the T_FCS time of the bit position.

"T_FCS Capability"
Enables the T_FCS capability per bit position.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TFCapability` on page 254

Show T_PM Capability Table/Hide T_PM Capability Table
Shows or hides the "T_PM_Capability Table".

The table provides settings to enable T_PM capability for bit positions that relate to three T_PM times. See also "T_PM" on page 105.

T_PM_Capability Table
The table provides settings to enable the T_PM capability including the T_PM time per bit position. You can enable T_PM capabilities for bit position 0 to bit position 2.

"Bit Position" Displays the bit position.

"T_PM" Displays the T_PM time of the bit position.

"T_PM Capability"
Enables the T_PM capability per bit position.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TPCapability` on page 255

5.5.3 CS configuration payload settings

For packet type LL_CS_CONFIG_REQ and LL_CS_CONFIG_RSP, the "Payload" tab provides the following settings.

Settings:

5.5.3.1 Cfg Data 1 settings

Config_ID
Sets the 6-bit Config_ID field that is the CS configuration ID. Settable ID values are 2 bits in decimal representation. All other values are for future use.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CID` on page 256

State
Enables the CS configuration ID, see "Config_ID" on page 119.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CCID:STATe` on page 256

ChM_Repetition
Sets the 3-bit ChM_Repetition field.

The value equals the number of cycles of the ChM field for non-Mode-0 CS steps within a CS procedure.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CMRepetition` on page 210

Main_Mode
Sets the main mode of the CS control PDU.

"Mode-1"	Mode-1 mode with no submode available.
"Mode-2"	Mode-2 mode with submodes "Mode-1" and "Mode-3" available.
"Mode-3"	Mode-3 mode with submode "Mode-2" available.

For an overview on available submodes per main mode, see Table 5-8.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMODe` on page 258

Sub_Mode
Sets the submode of the main mode.

For an overview on available submodes per main mode, see Table 5-8.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SMODe` on page 268

Main_Mode_Min_Steps
Sets the minimum number of main mode steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMISteps` on page 258

Main_Mode_Max_Steps
Sets the maximum number of main mode steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMASteps` on page 258

Main_Mode_Repetition
Sets the main mode repetition.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMRepetition` on page 259

Mode_0_Steps
Sets the number of Mode-0 steps.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MZSTeps` on page 260

PHY
Displays the PHY field value that is also the packet format.

This value indicates the TX PHY of the remote device, to which the Pwr_Delta field in this PDU applies.

See also "Packet Format" on page 48.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PHY?` on page 263

RTT_Type
Selects the RTT type determined by the 4-bit RTT_Type field. This field indicates the round trip time (RTT) variant within the CS procedure. The table Table 5-10 provides an overview.

Table 5-10: RTT_Type and RTT variant

RTT_Type value	RTT variant	<RttType>
0x00	RTT CS Access Address only timing	RAAOT
0x01	RTT with 32-bit sounding sequence	R32SS
0x02	RTT with 96-bit sounding sequence	R96SS
0x03	RTT with 32-bit random sequence	R32RS
0x04	RTT with 64-bit random sequence	R64RS
0x05	RTT with 96-bit random sequence	R96RS
0x06	RTT with 128-bit random sequence	R128RS
All other	Reserved for future use.	RAAOT

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RTYPe` on page 264

Role
Selects the CS role, see "Role" on page 50.

5.5.3.2 Cfg Data 2 settings

Companion_Signal
Enables the companion signal.

See also "Companion Signal" on page 110.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSIGnal` on page 257

RFU
Sets the bits that are reserved for future use (RFU).

The number of RFU bits can vary depending on the CS_Control_Data PDU.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RFU` on page 264

ChSel
See "ChSel" on page 98.

T_IP1
See "T_IP1" on page 102.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TIONe` on page 265

T_IP2
See "T_IP2" on page 105.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TITWo` on page 265

T_FCS
See "T_FCS (µs)" on page 94.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TFCS` on page 265

T_PM
See "T_PM" on page 105.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TPM` on page 265

5.5.3.3 Cfg Data 3 settings

Show Channel Table/Hide Channel Table
Shows or hides the channel table. For related settings, see Chapter 5.2.3, "Channel table settings", on page 56.

Remote command:
n.a.

5.5.4 CS payload settings

For packet type LL_CS_REQ and LL_CS_RSP, the "Payload" tab provides the following settings.

Settings:

Config_ID

Sets the 6-bit Config_ID field that is the CS configuration ID. Settable ID values are 2 bits in decimal representation. All other values are for future use.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CID` on page 256

RFU

Sets the bits that are reserved for future use (RFU).

The number of RFU bits can vary depending on the CS_Control_Data PDU.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RFU` on page 264

connEventCount

Sets the 16-bit connEventCount field bits in a hexadecimal representation.

The connEventCount field sets a connection event counter value that meets the following requirement:

currEvent – 2^{14} < connEventCount < currEvent + 2^{14} (mod 65536)

The currEvent parameter is the counter value for the connection event for PDUs that transmit or retransmit this field. The currEventCount value is greater than the currEvent value of the event that transmits the LL_CS_REQ PDU first.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CECount` on page 256

Offset_Min

Sets the time value of the Offset_Min field. The value has a length of 3 octets or 9 bits.

The field corresponds to the proposed minimum time (µs) from the ACL anchor point of a certain connection event to the start of the first CS subevent. The connEventCount field references this connection event.

The Offset_Min time value is greater than or equal to 500 µs and less than 4 s.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:OMIN` on page 262

Offset_Max
Sets the time value of the Offset_Max field. The value has a length of 3 octets or 9 bits.

The field corresponds to the proposed maximum time between the ACL anchor point and the offset of the first CS step of the first CS subevent. The anchor point marks a certain connection event.

The Offset_Max time value is in microseconds. The value is greater than or equal to the Offset_Min value and is less than the LE connection interval.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:OMAX` on page 262

Max_Procedure_Len
Sets the time value of the Max_Procedure_Len field. The value has a length of 2 octets or 6 bits.

The Max_Procedure_Len field is the proposed maximum extent of the entire CS procedure in units of 625 µs. This value is equivalent to the time extent from the beginning of the transmission of the first CS step to the end of the transmission of the final CS step.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MPLength` on page 259

Event_Interval
Sets the 16-bit Event_Interval field, see "Event Intervals/Event_Interval" on page 50.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:EINTerval` on page 191

Subevent_Per_Event
For packet type LL_CS_REQ, displays the number of subevents per event.

For packet type LL_CS_RSP, sets the number of subevents per event.

The Subevents_Per_Event field indicates the number of CS subevents in each CS event.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SNUMber` on page 267

Subevent_Interval
Sets or displays the subevent interval. Setting requires "Subevent_Per_Event" ≠ "1". For "Subevent_Per_Event" = "1", the subevent interval is 0 µs.

The subevent interval is the time gap, in units of 625 µs, between the start of two consecutive CS subevents. These subevents start from the same LE anchor point.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SINTerval` on page 267

Subevent_Len
Sets the subevent length in the Subevent_Len field. The value has a length of 3 octets or 9 bits.

The Subevent_Len field implies the maximum duration of each CS subevent in microseconds. It is greater than or equal to 1250 µs and less than 4 s.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SLENgth on page 267

Procedure_Interval
Sets the procedure interval in the Procedure_Interval field. The value has a length of 2 octets or 6 bits.

The Procedure_Interval field implies the time in units of connection intervals between the start of consecutive CS procedures.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PINTerval on page 263

Procedure_Count
Sets the bits in the Procedure_Count field. The value has a length of 2 octets.

The Procedure_Count field implies the number of consecutive CS procedures to invoke. A value of 0 indicates that CS procedures continue to be invoked until they terminate.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PCOunt on page 262

ACI
Sets the antenna configuration index (ACI) field. The value has a length of 1 octet or 0 to 7 in decimal representation.

The ACI field indicates the preferred ACI to use in the CS procedure.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:ACI on page 256

PHY
See "PHY" on page 120.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PHY? on page 263

Preferred_Peer_Ant
Sets the bits in the Preferred_Peer_Ant field. The value has a length of 1 octet or 3 bits.

The Preferred_Peer_Ant field is a bit-mapped field and indicates the preferred peer-ordered antenna elements. The peer uses these elements for the antenna configuration as in the ACI field.

The table Table 5-11 lists all possible values and their meaning.

Table 5-11: Preferred_Peer_Ant field values

Bit number	Description	<PrePeerAnt>
0	Use the first ordered antenna element	ANT0
1	Use the second ordered antenna element	ANT1
2	Use the third ordered antenna element	ANT2
3	Use the fourth ordered antenna element	ANT3
All other bits	Reserved for future use	-

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PPANtenna on page 263

Pwr_Delta
Sets the bits in the Pwr_Delta field. The value has a length of 1 octet or 3 bits.

The Pwr_Delta field indicates the difference between the transmit power level of the remote device for the CS tones and RTT packets and the transmit power level for the PHY is in the PHY field.

The value in the Pwr_Delta field is a signed integer in dB. A positive value indicates a higher transmit power level for the CS tones and RTT packets. A negative value indicates a lower transmit power level for the CS tones and RTT packets, compared to the transmit power level for the PHY indicated by the PHY field. A Pwr_Delta value of 0x00 indicates that the two transmit power levels are the same.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PDELta on page 262

5.5.5 CS IND payload settings

For packet type LL_CS_IND, the "Payload" tab provides the following settings.

Settings:

Config_ID
Sets the 6-bit Config_ID field that is the CS configuration ID. Settable ID values are 2 bits in decimal representation. All other values are for future use.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CID on page 256

RFU
Sets the bits that are reserved for future use (RFU).

The number of RFU bits can vary depending on the CS_Control_Data PDU.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RFU on page 264

connEventCount
See "connEventCount" on page 123.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CECount on page 256

Offset
Sets the time value of the Offset field. The value has a length of 3 octets or 9 bits.

The field corresponds to the proposed minimum time (µs) from the ACL anchor point of a certain connection event to the start of the first CS subevent. The connEventCount field references this connection event.

The Offset time value is greater than or equal to 500 µs and less than 4 s.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:EOFFset on page 257

Event_Interval
Sets the 16-bit Event_Interval field, see "Event Intervals/Event_Interval" on page 50.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:EINTerval on page 191

Subevents_Per_Event
See "Subevent_Per_Event" on page 124.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SNUMber on page 267

Subevent_Interval
See "Subevent_Interval" on page 124.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SINTerval on page 267

Subevent_Len
See "Subevent_Len" on page 125.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SLENgth on page 267

ACI
See "ACI" on page 125.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:ACI on page 256

PHY
Displays the LE physical layer that is the LE uncoded PHY LE1M.

See also "Packet Format" on page 48.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PFORmat on page 177

Pwr_Delta
See "Pwr_Delta" on page 126.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PDELta on page 262

5.5.6 CS terminate payload settings

For packet type LL_CS_TERMINATE_IND, the "Payload" tab provides the following settings.

Settings:

Config_ID
Sets the 6-bit Config_ID field that is the CS configuration ID. Settable ID values are 2 bits in decimal representation. All other values are for future use.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CID on page 256

RFU
Sets the bits that are reserved for future use (RFU).

The number of RFU bits can vary depending on the CS_Control_Data PDU.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RFU on page 264

Error Code(hex)
Sets an 8-bit error code. For an LL_CS_TERMINATE_IND packet, informs the remote device about the termination of the connection.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CS:CDATa:ECODe on page 257

5.5.7 CS FAE payload settings

For packet type LL_CS_FAE_RSP, the "Payload" tab provides the following settings.

Settings:

Show Channel FAE Table/Hide Channel FAE Table
Shows or hides the fractional frequency offset actuation error (FAE) channel table.

See "Channel FAE Table" on page 129.

Channel FAE Table
The FAE channel table provides settings to set the fractional frequency offset actuation error (FAE) per channel.

"Channel Index"
See "Channel Index" on page 96.

"Channel FAE" Sets the FAE of the channel.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:CHANnel<ch0>]:CFAE` on page 255

5.5.8 CS channel map payload settings

For packet type LL_CS_CHANNEL_MAP_IND, the "Payload" tab provides the following settings.

Settings:

Show Channel Mapping Table/Hide Channel Mapping Table
Shows or hides the channel-mapping table to set channel characteristics.

See Chapter 5.4.2, "Channel table", on page 95.

Connection Instant
See "Connection Instant" on page 82.

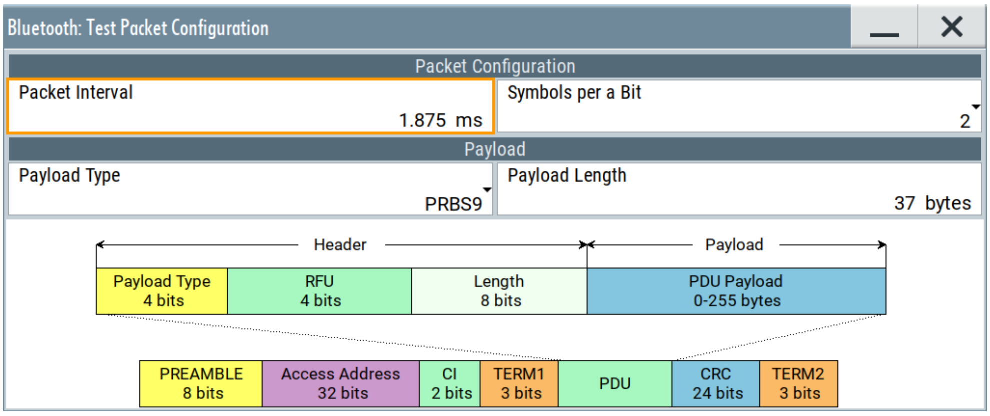
Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant`
on page 230

5.6 Test packet configuration

Access:

1. Select "Bluetooth" > "General".
2. "Bluetooth Mode" > "Bluetooth Low Energy".

3. Select "Channel" > "Packet Type" > "TEST PACKET".
4. Select "Test Packet Configuration".



The dialog provides settings to configure test packets. The graphic below the settings shows the test packet structure and fields.

Settings:

Packet Configuration

The "Packet Configuration" section provides settings to configure the packet interval and the number of symbols per bit "S".

Packet Interval

Sets the time interval between two consecutive test packets, regarding the starting points.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:TPINterval`
on page 271

Symbols per a Bit

Requires option R&S SMW-K117 and "Packet Format" > "LE Coded".

Sets the number of symbols per bit "S" for forward error correction (FEC) coding for LE coded packets. See also Table 2-4.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SPBit
on page 269

Header

The "Header" section provides settings to configure the header of the test packet.

CTEInfo Present

Requires a data channel packet or a test packet.

Enables the CTEInfo field in the header of Bluetooth LE data packets in the LE uncoded PHY.

See also "Constant tone extension" on page 23.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CPResent
on page 220

CTEInfo Configuration

Requires "CTEInfo Present" > "On".

Opens the "CTEInfo Configuration" dialog to configure CTE length and the CTE method. See Chapter 5.3.3, "CTEInfo settings", on page 62.

Sync Word

Requires an LE uncoded PHY, see "Packet Format" on page 48.

Sets the 32-bit Sync Word in the packet header field.

"0x94826E8E" Fixed value in hexadecimal representation.

"User Pattern" Allows a user-defined value, see "User Pattern(hex)" on page 131.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SYNCword
on page 270

User Pattern(hex)

Requires "Sync Word" > "User Pattern".

Sets a user-defined value of the 32-bit Sync Word. This value is an 8-digit hexadecimal input.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:USERpatt
on page 270

Payload

The "Payload" section provides settings to configure the payload of the test packet.

Payload Type

Selects the data source used for the payload test packets.

"PRBS 9"/"PRBS 15"
Pseudo random bit sequences of the length 9 or 15 - transmission of identical packet series.

Predefined pattern
11110000, 10101010, 11111111, 00000000, 00001111 or 01010101

"Data List" See "Data Source" on page 65.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPSource`
on page 271

Payload Length
Sets the payload length of the test packet.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPLength`
on page 271

6 Bluetooth BR/EDR configuration and settings

Access:

1. Select "Baseband" > "Bluetooth".
2. Select "Bluetooth Mode" > "Basic Rate + EDR".

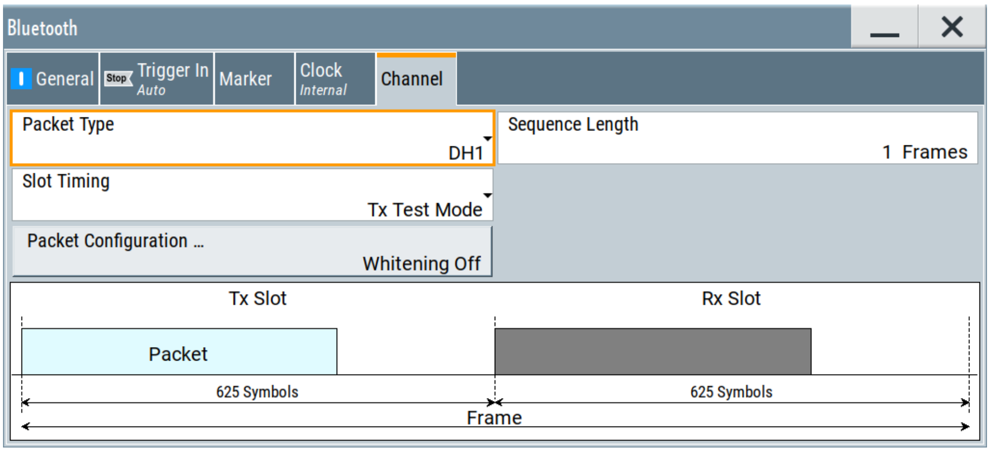
The remote commands required to define these settings are described in Chapter 8, "Remote control commands", on page 161.

Settings:

6.1 Channel settings

Access:

1. Select "Bluetooth" > "General".
2. Select "Bluetooth Mode" > "Basic Rate + EDR".
3. Select "Bluetooth" > "Channel".



The tab provides settings to configure Bluetooth BR/EDR channel settings. These settings include the packet type, the sequence length and the slot timing. The graphic at the bottom of the tab shows the frame structure of the selected packet type.
Also, the tab provides further access to the BR/EDR packet configuration, see Chapter 6.2, "Packet configuration", on page 135.

For Bluetooth LE channel settings, see Chapter 5.1, "Channel settings", on page 44.

Settings:

Packet Type

Selects the packet type.

The available packets depend on the selected Transport Mode.

All packet types as defined in the Bluetooth specification are supported. For an overview, see Chapter 2.4.1, "Bluetooth packet types for BR/EDR", on page 27.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PTYPe` on page 272

Sequence Length

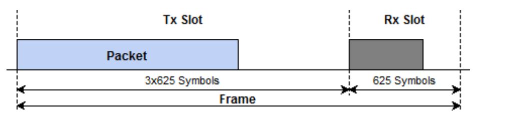
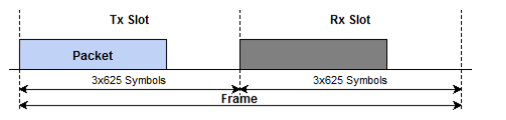
Selects the sequence length in frames of the generated signal. The signal repeats after the specified number of frames.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:SLENgth` on page 272

Slot Timing

Selects the timing mode for the RX slot.

The graphic below shows the frame structure of the selected Packet Type and slot timing.

<table>
<tr><td>
</td><td>
</td></tr>
<tr><td>TX test mode</td><td>Loopback test mode</td></tr>
</table>

A transmitted packet has a duration of N × 625 µs where "N" is an odd integer larger than 0. N depends on the type of the transmitted packet. In "Tx Test" mode, N = 1 for RX slots.

"Tx Test Mode"
: The transmitted RX package takes 625 symbols, regardless of the selected packet type.

"Loopback Test Mode"
: Extends the RX slot time according to the selected packet type. For example, the RX slot of Packet Type > DH3 takes 3 x 625 symbols.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:STIMing` on page 273

Packet Configuration
Access the "Packet Configuration" dialog, see Chapter 6.2, "Packet configuration", on page 135.

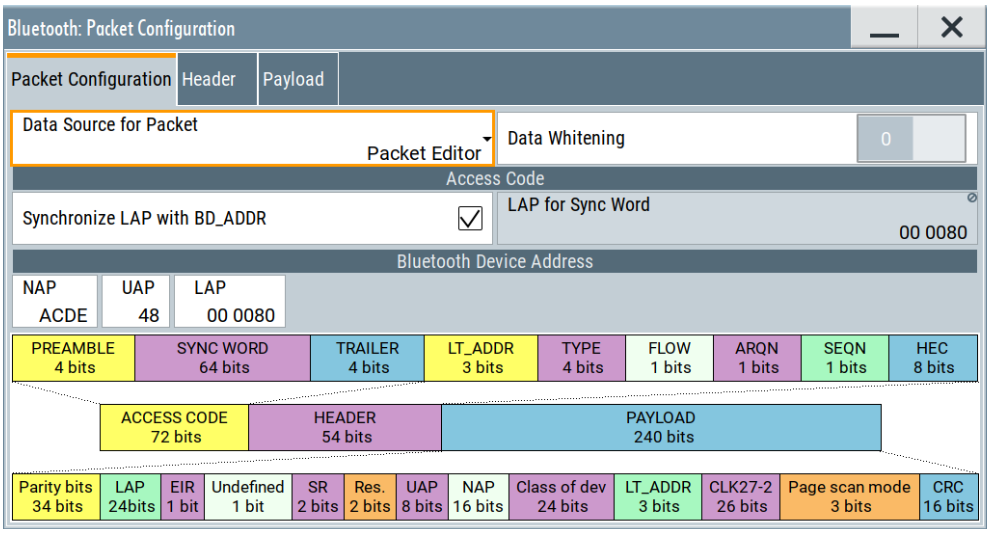
The current data source for the packet and the data whitening state are displayed next to the button.

Remote command:
n.a.

6.2 Packet configuration

Access:

1. Select "Bluetooth" > "General".
2. Select "Bluetooth Mode" > "Basic Rate + EDR".
3. Select "Bluetooth" > "Channel" > "Packet Configuration".



The dialog contains the parameters for configuring the packet type.
Available settings vary according to the selected Packet Type and data source.

Settings:

Packet Configuration

In this section, specify general Bluetooth BR/EDR packet properties.

Data Source for Packet ← Packet Configuration

The data sent for each packet can be comfortably edited with the packet editor, or filled with a predefined "ALL" data sequence.

"Packet Editor" Enables the editing mode to configure the packet fields individually.

"All Data" Fills the generated packets with the selected data source. This mode is useful if you need to load predefined data contents from a data list file or the data contents of the packet are not of interest.

Remote command:

`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DSFPacket` on page 278

Data Whitening ← Packet Configuration

Activates the data whitening.

Evenly distributed white noise is ideal for the transmission, and real data can be forced to look similar to white noise with different methods called "Data Whitening".

Remote command:

`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DWHitening` on page 278

Synchronize LAP with BD_ADDR ← Packet Configuration

Requires "Packet Type" > "FHS".

Activates synchronization of the LAP for Sync Word and the Bluetooth Device Address > LAP.

Remote command:

`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SLAP` on page 281

LAP for Sync Word ← Packet Configuration

Requires "Packet Type" > "FHS".

Sets the 24-bit lower address part (LAP) in the 64-bit sync word separately, if "Synchronize LAP with BD_ADDR > OFF".

The LAP is obtained automatically from the Bluetooth device address "BD_ADDR > LAP", if "Synchronize LAP with BD_ADDR > ON".

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:LFSWord on page 279

Bluetooth Device Address (BD_ADDR) ← Packet Configuration
Enters the Bluetooth device address. Each Bluetooth device has allocated a unique 48-bit Bluetooth device address (BD_ADDR).

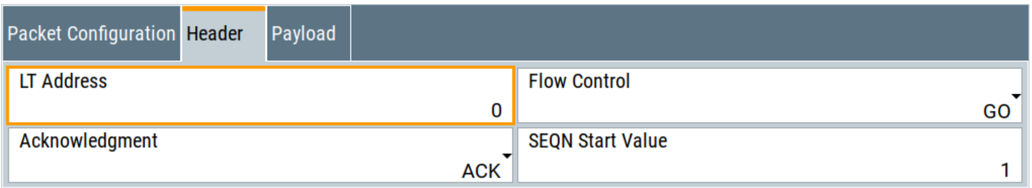
The BD_ADDR can take any values except the 64 reserved LAP values: 0x9E8B00 – 0x9E8B3F.

"NAP"	Selects non-significant address part. The length of NAP is 16 bits or 4 hexadecimal figures.
"UAP"	Selects the upper address part. The length of UAP is 8 bits or two hexadecimal figures.
"LAP"	Selects the lower address part. The length of LAP is 24 bits or 6 hexadecimal figures.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDANap on page 274
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDAUap on page 275
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDALap on page 274

Header
Access:

Select "Bluetooth > General > Bluetooth Mode > Basic Rate + EDR > Packet Configuration > Header".



Provides header settings.

Logical Transport Address ← Header
Available for all packet types except ID packet.

Enters the logical transport address for the header.

Each Peripheral that is active in a piconet is assigned a primary logical transport address (LT_ADDR). The all-zero LT_ADDR is reserved for broadcast messages.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:LTADdress on page 279

Flow Control ← Header
Available for all packet types except ID packet.

Sets the FLOW bit in the header. This bit indicates the start or stop of transmission of packets over the ACL logical transport.

"Go" Allows the other devices to transmit new data.

"Stop" Stops the other devices from transmitting data temporarily.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:HFControl on page 279

Acknowledgment ← Header
Available for all packet types except ID packet.

Sets the ARQN bit of the packet header.

"NAK" Request to retransmit the previous payload.

"ACK" Previous payload has been received successfully.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:ACKNowledgement on page 274

SEQN Start Value ← Header
Available for all packet types except ID packet.

Sets the start value of the header SEQN bit.

The SEQN bit is present in the header to filter out retransmissions in the destination. The signal generator is altering this bit automatically on consecutive frames, if a sequence length of at least two frames is set.

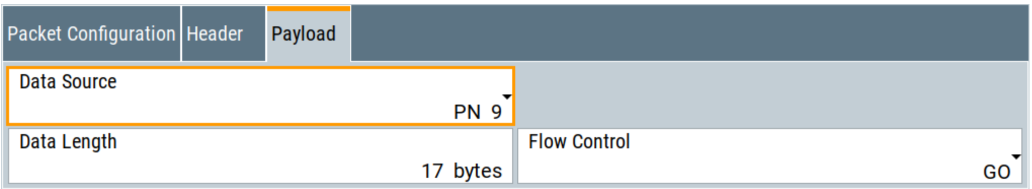
"0" The SEQN bit starts with 0.

"1" The SEQN bit starts with 1.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SNSValue on page 281

Payload
Access:

Select "Bluetooth > General > Bluetooth Mode > Basic Rate + EDR > Packet Configuration > Payload".



Provides payload settings.

Data Source ← Payload
(Available for all packet types except ID, POLL, NULL and FHS packets)

Selects the data source used for the payload.

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 set the bit pattern.
- "Data List"/"Select Data List"
  Binary data from a list file, internally or externally generated.
  Select "Select Data List" to open the standard "Select List" dialog. The dialog lists file with file extension `*.dm_iqd` if existing.
  – Navigate to the list file and tap "Select" to select the file.
  – Use the "New" and "Edit" functions to create a data list internally or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "About data signals" in the R&S SMW200A user manual.
- Section "File and data management" in the R&S SMW200A user manual.
- Section "Data list editor" in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA` on page 276
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DPATtern` on page 276
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DSELection` on page 276

Data Length ← Payload
(Available for all packet types except ID, POLL, NULL and FHS packets)

Enters the payload data length in bytes.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DLENgth` on page 277

EIR packet follows ← Payload
Available for FHS packets.

Indicates that an extended inquiry response packet can follow.

"Yes"	Indicates that an EIR packet follows.
"No"	Indicates that EIR does not follow.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:EIRPacketfollows`
on page 278

Flow Control ← Payload
(Available for all packets types except ID, POLL, NULL, FHS, HV1, HV2, HV3, EV3, EV4, EV5, 2-EV3, 2-EV5, 3-EV3, 3-EV5 packets.)

Sets the FLOW bit in the payload (flow control per logical link)

"Go"	Indicates start of transmission of ACL packets after a new connection has been established.
"Stop"	Indicates stop of transmission of ACL packets before an additional amount of payload data is sent.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PFControl on page 280

Scan Repetition Mode ← Payload
Available for FHS packets.

The 2-bit scan repetition field indicates the interval between two consecutive page scan windows, determines the behavior of the paging device.

"R0"	The scan interval is equal to the scan window T_W_page_scan (continuous scan) and maximal 1.28s.
"R1"	The scan interval is maximal 1.28s.
"R2"	The scan interval is maximal 2.56s.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SRMode on page 281

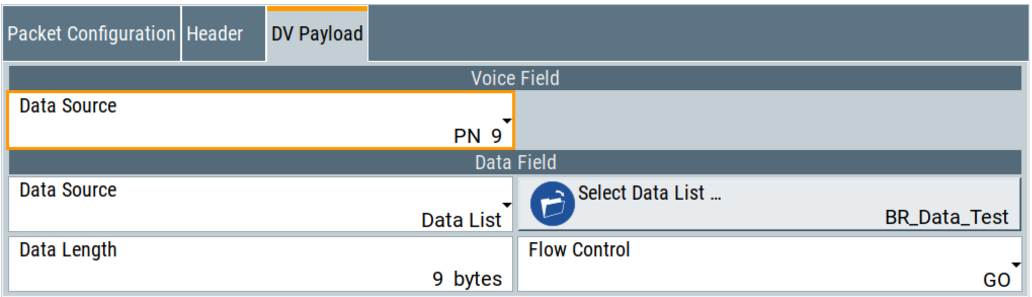
Class of Device ← Payload
Available for FHS packets.

A parameter received during the device discovery procedure, indicates the type of device and which types of service that are supported.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:CODevice on page 275

DV Payload
Access:

Select "Bluetooth > Transport Mode = SCO > Channel > Packet Type = DV > Packet Configuration > Data Source for Packet = Packet Editor > DV Payload".



Provides DV payload settings.

Data Source (Voice Field) ← DV Payload
(Available for DV packets)

Selects the data source for the voice field.

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 set the bit pattern.

- "Data List"/"Select Data List"
  Binary data from a list file, internally or externally generated.
  Select "Select Data List" to open the standard "Select List" dialog. The dialog lists file with file extension `*.dm_iqd` if existing.
  - Navigate to the list file and tap "Select" to select the file.
  - Use the "New" and "Edit" functions to create a data list internally or to edit an existing one.
  - Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:

- Section "About data signals" in the R&S SMW200A user manual.
- Section "File and data management" in the R&S SMW200A user manual.
- Section "Data list editor" in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:VDATa` on page 282
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDPAttern` on page 277
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDSElection` on page 277

Data Source ← DV Payload
(Available for all packet types except ID, POLL, NULL and FHS packets)

Selects the data source used for the payload.

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 set the bit pattern.
- "Data List"/"Select Data List"
  Binary data from a list file, internally or externally generated.
  Select "Select Data List" to open the standard "Select List" dialog. The dialog lists file with file extension `*.dm_iqd` if existing.
  - Navigate to the list file and tap "Select" to select the file.
  - Use the "New" and "Edit" functions to create a data list internally or to edit an existing one.
  - Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:

- Section "About data signals" in the R&S SMW200A user manual.
- Section "File and data management" in the R&S SMW200A user manual.
- Section "Data list editor" in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA` on page 276
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DPATtern` on page 276
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DSELection` on page 276

Data Length ← DV Payload

(Available for all packet types except ID, POLL, NULL and FHS packets)

Enters the payload data length in bytes.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DLENgth on page 277

Flow Control ← DV Payload

(Available for all packets types except ID, POLL, NULL, FHS, HV1, HV2, HV3, EV3, EV4, EV5, 2-EV3, 2-EV5, 3-EV3, 3-EV5 packets.)

Sets the FLOW bit in the payload (flow control per logical link)

"Go" Indicates start of transmission of ACL packets after a new connection has been established.

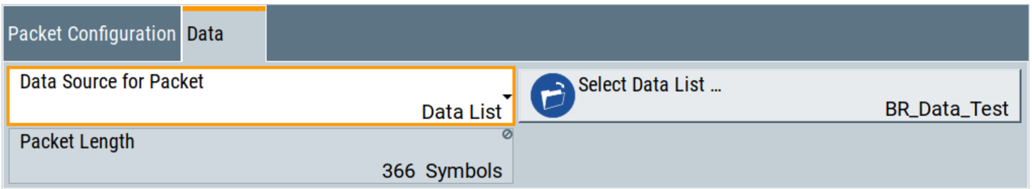
"Stop" Indicates stop of transmission of ACL packets before an additional amount of payload data is sent.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PFControl on page 280

Data

Access:

Select "Packet Configuration > Data Source for Packet = All Data > Data".



Provides data settings.

Packet Length ← Data

(Available in "All Data" mode and for all packet types except ID packet.)

Enters the packet length in symbols.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PLENgth on page 280

7 Signal control and signal characteristics

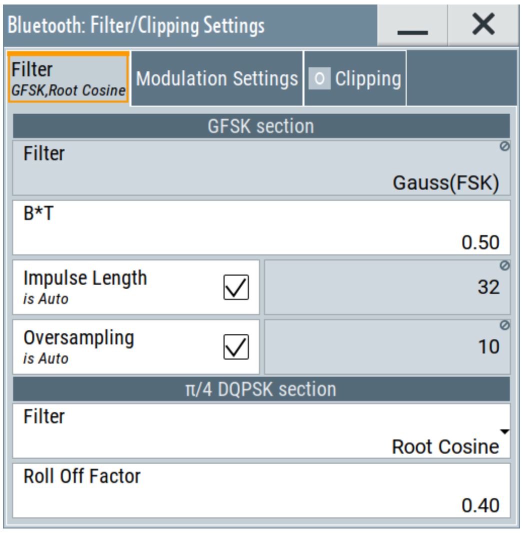
This section lists settings provided for configuring the baseband filter and configuring power ramping of bluetooth bursts. Also settings are listed for defining the signal generation start and for generating signals necessary for synchronization with other instruments.

It covers the following topics:

7.1 Filter/clipping settings

Access:

1. Select "Baseband" > "Bluetooth".
2. Select "General" > "Filter"/"Clipping".



The dialog provides settings to configure the baseband filter, the modulation settings and to enable clipping.

Settings:

7.1.1 Common filter settings

Access:

1. Select "General" > "Filter"/"Clipping".
2. Select "Filter" > "GFSK section".

The section provides settings to configure the common baseband GFSK filter.

Settings:

Filter
Displays the filter type that is GFSK. This type is common to the Bluetooth baseband signal.

Remote command:
n.a.

B*T
Sets the rolloff factor or bandwidth time product ("B*T") for the filter type that supports this parameter.

For supporting predefined filters, this parameter can have a different default value for each of the predefined filters.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:APCO25` on page 286
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:COSine` on page 287
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:FGAuss` on page 287

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:GAUSs on page 287
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:LPASs on page 288
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:PGAuss on page 288
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:RCOSine on page 288
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:SPHase on page 289

Impulse Length

Displays the number of filter tabs.

If enabled, the most sensible parameter values are selected. The value depends on the coherence check.

Disable it to set the values manually.

Remote command:
[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth:AUTO[:STATe] on page 285
[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth on page 285

Oversampling

Sets the upsampling factor.

If enabled, the most sensible parameter values are selected. The value depends on the coherence check.

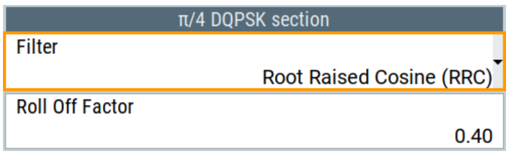
Disable it to change the value manually.

Remote command:
[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling:AUTO[:STATe] on page 285
[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling on page 285

7.1.2 DPSK filter settings

Access:

1. Select a Bluetooth EDR packet that supports a π/4 DQPSK filter or 8DPSK filter: See Table 7-1.
2. Select "General" > "Filter"/"Clipping".
3. Select "Filter" > "π/4 DQPSK section" or "8DPSK section".



The section provides settings to configure the π/4 DQPSK filter or 8DPSK filter.

Table 7-1: DPSK filter for Bluetooth EDR packets

Transport mode	Packet type	DPSK filter type
ACL+EDR	2-DH1, 2-DH3, 2-DH5 3-DH1, 3-DH3, 3-DH5	π/4 DQPSK 8DPSK
eSCO+EDR	2-EV3, 2-EV5 3-EV3, 3-EV5	π/4 DQPSK 8DPSK

Settings:

Filter

Selects the filter type for DQPSK sections or 8DPSK sections in EDR packets.

Remote command:
[:SOURce<hw>]:BB:BTOoth:FILTer:TYPE on page 284

Roll Off Factor/B*T

Sets the rolloff factor or bandwidth time product ("B*T") for the filter type that supports this parameter.

For supporting predefined filters, this parameter can have a different default value for each of the predefined filters.

Remote command:
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:APCO25 on page 286
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:COSine on page 287
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:FGAuss on page 287
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:GAUSs on page 287
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:LPASs on page 288
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:PGAuss on page 288
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:RCOSine on page 288
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:SPHase on page 289

Cut Off Frequency Factor

Requires a lowpass filter.

Sets the value for the cutoff frequency factor. The cutoff frequency of the filter can be adjusted to reach spectrum mask requirements.

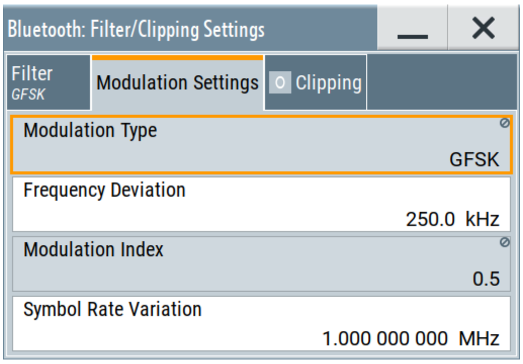
Remote command:
[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:LPASs on page 288

7.1.3 Modulation settings

Access:

1. Select "General" > "Filter"/"Clipping".

2. Select "Modulation Settings".



The tab provides settings to configure modulation settings.

Settings:

Modulation Type

Displays the modulation format used for the current packet selection.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:MTYPe` on page 286

Frequency Deviation

Enter the frequency deviation of the frequency modulated part.

The frequency deviation can be varied in a range from 100.0 kHz to 200.0 kHz according to the Bluetooth specification.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:MSETtings:FDEViation` on page 286

Modulation Index

Displays the modulation index resulting from the entered frequency deviation value.

Modulation index is calculated from the given frequency deviation and symbol rate values.

The modulation index **h** is defined as:

$$h = \frac{2\Delta f}{f_{symbol}}$$

Where f_{symbol} is the "symbol rate" and Δf is the "frequency deviation".

According to the Bluetooth specification, the modulation index is allowed to vary between 0.28 and 0.35.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:MINDex` on page 286

Symbol Rate Variation

Enter the symbol rate.

Remote command:

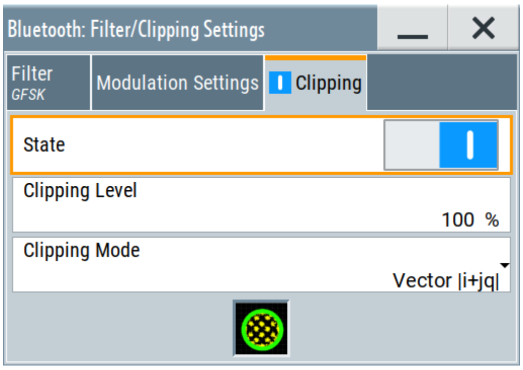
[:SOURce<hw>]:BB:BTOoth:SRATe:VARiation on page 289

7.1.4 Clipping settings

Access:

1. Select "General" > "Filter"/"Clipping".

2. Select "Clipping".



The tab provides settings to configure clipping.

Settings:

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:BTOoth:CLIPping:STATe on page 283

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:BTOoth:CLIPping:LEVel on page 283

Clipping Mode

Selects the clipping method. The dialog displays a graphical illustration on how this two methods work.

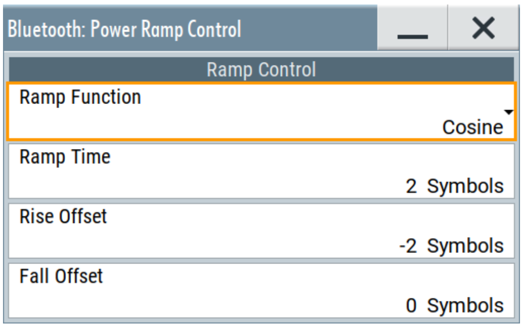
- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the angle changes.

Remote command:
[:SOURce<hw>]:BB:BTOoth:CLIPping:MODE on page 283

7.2 Power ramping settings

Access:

► Select "Bluetooth" > "General" > "Power Ramping".



The dialog provides settings to configure power ramping.

To monitor power ramping for LE Channel Sounding

1. Select "Bluetooth" > "General" > "Bluetooth Mode" > "Bluetooth Low Energy".
2. Select "Bluetooth" > "Channel" > "Channel Type" > "Channel Sounding".
3. Select "Bluetooth" > "General" > "Power Ramping".

   LE Channel Sounding uses fixed power ramping parameter as in the table below.

Parameter	Value
"Ramp Function"	"Cosine"
"Ramp Time"	"5 Symbols"
"Rise Offset"	"0 Symbols"
"Fall Offset"	"0 Symbols"

Settings:

Ramp Function

Selects the form of the transmitted power, i.e. the shape of the rising and falling edges during power ramp control.

"Linear" The transmitted power rises and falls with linear fashion.

"Cosine" The transmitted power rises and falls with a cosine-shaped edge. This setting causes a more favorable spectrum than the "Linear" setting.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:RFUNction` on page 290

Ramp Time

Sets the ramp time, which extends the burst by a corresponding number of 0 padding symbols at the beginning and the end of a burst. During this period of time, power ramping is based on the specified ramp function.

Do not switch the transmitted power abruptly at the end or the start of a burst, since the switching operation generates excessively strong non-harmonics. The switching operation is therefore stretched over several symbol clocks.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:RTIMe` on page 291

Rise Offset

Sets the offset of the rising edge of a burst. The offset is specified by the selected number of symbols.

Negative values shift the rising edge to earlier positions, which results in a corresponding number of added 0 padding symbols before the burst.

Positive values shift the rising edge to later positions, which results in a corresponding number of skipped symbols at the beginning of the burst.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:ROFFset` on page 290

Fall Offset

Sets the offset of the falling edge of a burst. The offset is specified by the selected number of symbols.

Negative values shift the falling edge to earlier positions, which results in a corresponding number of skipped symbols at the end of the burst.

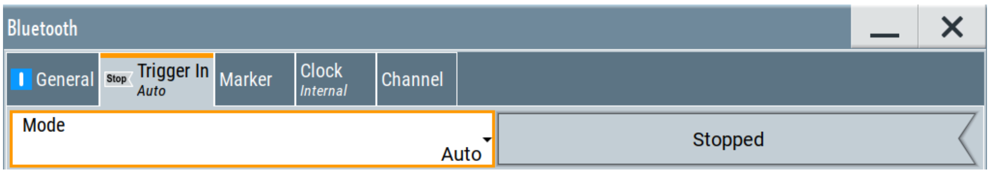
Positive values shift the falling edge to later positions, which results in a corresponding number of added 0 padding symbols following the burst.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:FOFFset` on page 290

7.3 Trigger settings

Access:

► Select "Baseband" > "Bluetooth" > "Trigger In".



This tab provides settings to select and configure the trigger, like trigger source, trigger mode and trigger delays, and to arm or trigger an internal trigger manually. The header of the tab displays the status of the trigger signal and trigger mode. As in the tabs "Marker" and "Clock", this tab provides also access to the settings of the related connectors.

Routing and activating a trigger signal

1. Define the effect of a trigger event and the trigger signal source.
   a) Select "Trigger In" > "Mode".
   b) Select "Trigger In" > "Source".
2. For external trigger signals, define the connector for signal input. See Chapter 7.6, "Local and global connectors settings", on page 160.
   You can map trigger signals to one or more USER x or T/M connectors.

   Local and global connectors settings allow you to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMW200A starts baseband signal generation after the configured trigger event.

About baseband trigger signals

This section focuses on the available settings.

For detailed information on baseband trigger signals, see section About trigger signals" in the R&S SMW200A user manual.

Settings:

Trigger Settings Common to All Basebands

To enable simultaneous signal generation in all basebands, the R&S SMW200A 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.

Mode

Selects the trigger mode. The mode determines the effect of a trigger event on the signal generation.

For more information, see chapter "About trigger signals" in the R&S SMW200A 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:BTOoth[:TRIGger]:SEQuence` on page 293

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:BTOoth:TRIGger:SLUNit on page 296

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:BTOoth:TRIGger:SLENgth on page 295

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:BTOoth:TRIGger:RMODe on page 294

Time Based Trigger
Requires trigger "Mode" > "Armed Auto"/"Single".

Activates time-based triggering with a fixed time reference.

The R&S SMW200A 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 SMW200A user manual.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:TIME[:STATe] on page 295

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 SMW200A. 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 SMW200A user manual.

"Date" Sets the date of the time-based trigger in format YYYY-MM-DD.
Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:TIME:DATE on page 294

"Time" Sets the time of the time-based trigger in format hh:mm:ss.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:TIME:TIME on page 294

Arm
Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:ARM:EXECute on page 296

Execute Trigger
For internal trigger source, executes trigger manually.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:EXECute on page 296

Source
The following sources of the trigger signal are available:
- "Internal"
  The trigger event is internal. Tap "Execute Trigger" to trigger signal generation manually.
- "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"
  Requires "Multi Instrument Trigger" > "Secondary" for primary-secondary instrument mode.
  Triggers signal generation at the secondary instrument by the active edge of the baseband synchronization signal of the primary instrument.

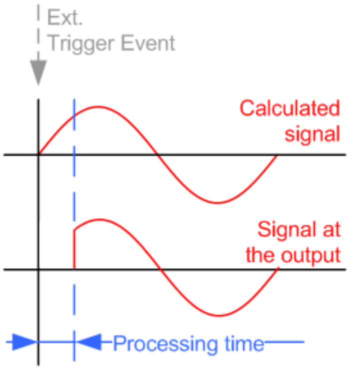
"External Local Clock/Trigger" require R&S SMW-B10.

How to: "Routing and activating a trigger signal" on page 151

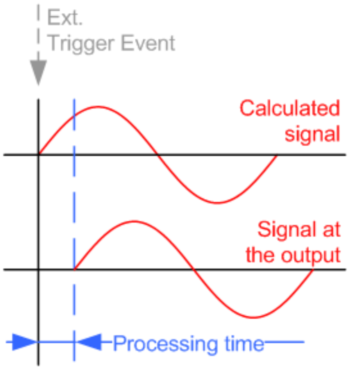
Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:SOURce on page 293

Sync. Output to Ext. 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:BTOoth:TRIGger[:EXTernal]:SYNChronize:OUTPut`
on page 296

External Inhibit/Trigger Inhibit
Applies for an 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 on signals, modulation formats and filters" in the user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:INHibit` on page 297
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OBASeband:INHibit` on page 297

External Delay/Trigger Delay
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

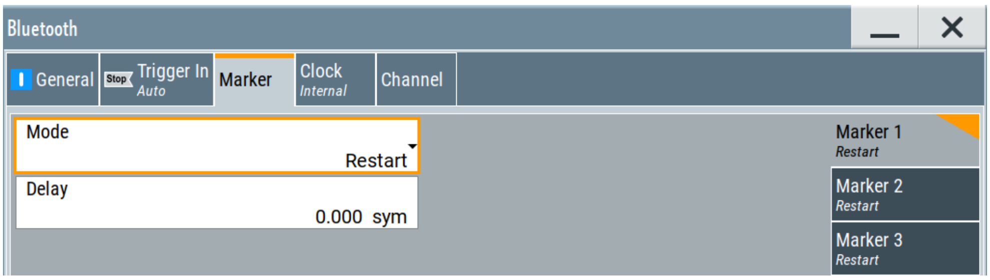
For more information, see chapter "Basics on ..." in the R&S SMW200A user manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:DELay` on page 297
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OBASeband:DELay` on page 296

7.4 Marker settings

Access:

► Select "Baseband" > "Bluetooth" > "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 7.6, "Local and global connectors settings", on page 160.
   You can map marker signals to one or more USER x or T/M connectors.
3. Enable baseband signal generation. In the block diagram, set "Baseband" > "On".

The R&S SMW200A adds the marker signal to the baseband signal. Also, R&S SMW200A outputs this signal at the configured USER x connector.

About marker output signals

This section focuses on the available settings.

For detailed information on baseband trigger signals, see section About trigger signals" in the R&S SMW200A user manual.

Settings:

Mode

Sets the marker mode that defines the shape and periodicity of the marker signals.

You can configure marker modes for up to 3 markers. The marker configuration changes with the selected marker mode.

How to: "Routing and activating a marker signal" on page 156

"Restart" A marker signal is generated at the start of each signal sequence.

"Event/Frame Start"
A marker signal is generated at the start of each event/frame. The term event corresponds to a Bluetooth LE event, the term frame corresponds to a Bluetooth BR/EDR frame.

"Event/Frame Active Part"/"Event/Frame Inactive Part"
The marker masks the active/inactive part of the event/frame. At the start of each burst, the marker signal changes to high/low. It changes back to low/high after the end of each burst.
Shift the marker signal at the start/end of each burst with the parameters "Rising/Falling Edge Shift".
Also, for Bluetooth LE data packets higher than one, configure the "Packet Index". The index corresponds to the transmitted Tx event during the connection interval.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:FESHift` on page 299
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:RESHift` on page 302
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PINDex` on page 301

"Pulse" A regular marker signal is generated. The pulse frequency is defined by entering a divider. The frequency is derived by dividing the sample rate by the divider. The input box for the divider opens when "Pulse" is selected, and the resulting pulse frequency is displayed below it.

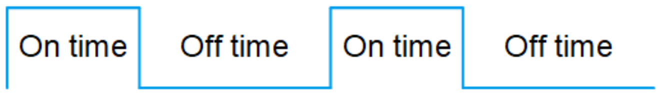
Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PULSe:DIVider on page 301
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PULSe:FREQuency? on page 301

"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when pattern is selected.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PATTern on page 300

"On/Off Ratio"

A regular marker signal that is defined by an On/Off ratio is generated. A period lasts one On and Off cycle.
If "Marker Mode > On/Off Ratio", specify the "On Time" and "Off Time", which are expressed as number of samples.



Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:ONTime on page 300
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:OFFTime on page 300

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:MODE on page 299

Delay

Delays the marker signal at the marker output relative to the signal generation start.

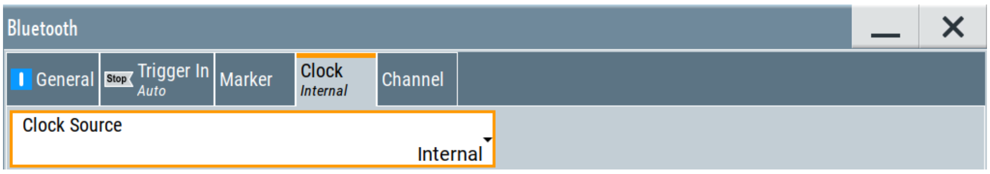
Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:DELay on page 299

7.5 Clock settings

Access:

► Select "Baseband" > "Bluetooth" > "Clock".



This tab provides settings to select and configure the clock signal, like the clock source and clock mode.

Defining the clock

1. Select "Clock" > "Source" to define the source of the clock signal.
2. For external clock signals, define the connector for the signal input. See Chapter 7.6, "Local and global connectors settings", on page 160.
   You can map clock signals to one or more USER x or T/M connectors.

   Local and global connectors settings allow you to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMW200A starts baseband signal generation with a symbol rate that equals the clock rate.

About clock signals

This section focuses on the available settings.

For detailed information on baseband trigger signals, see section About trigger signals" in the R&S SMW200A user manual.

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.

How to: "Defining the clock" on page 159

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CLOCk:SOURce` on page 303

Clock Mode
Option: R&S SMW-B10

Sets the type of externally supplied clock.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CLOCk:MODE` on page 302

Measured External Clock
Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:
`CLOCk:INPut:FREQuency?`

7.6 Local and global connectors settings

Opens 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 of baseband signal configuration dialogs that you can open via the "Baseband" block in the block diagram. These tabs are available, for example, for "ARB" baseband signals.

See also chapter "Local and global connectors settings" in the user manual.

8 Remote control commands

The following commands are required to perform signal generation with the Bluetooth options in a remote environment. We assume that the R&S SMW200A has already been set up for remote operation in a network as described in the R&S SMW200A documentation. A knowledge about the remote control operation and the SCPI command syntax is 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 SMW200A 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 with separate baseband sources `ENTity3|4` require option R&S SMW-K76.
`SOURce<hw>`	[1] to 4	Available baseband signals Only `SOURce1` is possible if the keyword `ENTity` is used.
`OUTPut<ch>`	1 to 3	Available marker signals

Using SCPI command aliases for advanced mode with multiple entities

You can address multiple entity 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 SMW200A user manual.

Programming examples

This section provides simple programming examples. The purpose of the examples is to present all commands for a given task. In real applications, you typically use an appropriate subset of these commands.

For verification and testing purposes, a software tool executed these programming examples. To keep the example as simple as possible, the examples report clean SCPI syntax elements. Non-executable command lines, for example comments, start with two characters `//`.

Before executing a SCPI sequence, most remote control programs reset or preset 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 chapters describe the commands specific to the Bluetooth options R&S SMW-K60, R&S SMW-K117 and R&S SMW-K178.

8.1 General commands

Example: To configure time units for timing and delay commands

The default time unit of timing and delay commands is millisecond. You can set time unit to millisecond or to second.

```
:SOURce1:BB:BTOoth:UNIT:TIME?
// Response: "MS"
// Change time unit to seconds.
:SOURce1:BB:BTOoth:UNIT:TIME S
```

Example: To save and recall settings

```
MMEM:CDIR "/var/user/"
:SOURce1:BB:BTOoth:PRESet
:SOURce1:BB:BTOoth:SETTing:STORe "/var/user/Bluetooth_EDR"
:SOURce1:BB:BTOoth:SETTing:CATalog?
// Response: Bluetooth_EDR,Bluetooth_SCO,BTO_test
:SOURce1:BB:BTOoth:SETTing:DELete "BTO_test"
:SOURce1:BB:BTOoth:SETTing:LOAD "BTO_dl"
:SOURce1:BB:BTOoth:SETTing:CATalog?
// Response: "Bluetooth_EDR,Bluetooth_SCO"
```

Example: To configure general Bluetooth BR/EDR settings

```
// ******************************************************************
// Set time unit to ms.
// ******************************************************************
:SOURce1:BB:BTOoth:UNIT:TIME MS
// ******************************************************************
// Set frequency and level.
// Set BR/EDR PHY and transport modes.
// Query the version of the digital standard.
// Generate and save a waveform file in the current directory.
// ******************************************************************
SOURce1:FREQuency:CW 2402000000
SOURce1:POWer:POWer -50
:SOURce1:BB:BTOoth:BMODe BAS
:SOURce1:BB:BTOoth:TMODe ACL
// :SOURce1:BB:BTOoth:TMODe SCO
// :SOURce1:BB:BTOoth:TMODe ESCO
:SOURce1:BB:BTOoth:VERSion?
// Supported Bluetooth version, for example, "4.2".
:SOURce1:BB:BTOoth:STATe ON
:SOURce1:BB:BTOoth:WAVeform:CREate "Bluetooth_EDR"
```

Example: To configure general Bluetooth LE settings

```
// ******************************************************************
// Set time unit to ms.
// ******************************************************************
:SOURce1:BB:BTOoth:UNIT:TIME MS
// ******************************************************************
// Set frequency and level.
// Set LE PHY and query the version of the digital standard.
// Generate and save a waveform file in the current directory.
// ******************************************************************
SOURce1:FREQuency:CW 2402000000
SOURce1:POWer:POWer -10
:SOURce1:BB:BTOoth:BMODe BLEN
:SOURce1:BB:BTOoth:VERSion?
// Supported Bluetooth version, for example, "5.4".
:SOURce1:BB:BTOoth:STATe ON
:SOURce1:BB:BTOoth:WAVeform:CREate "Bluetooth_LE"
```

[:SOURce<hw>]:BB:BTOoth:BCText?

Queries the state and controller role.

Return values:

<BcText> string

Connected
(only data channel type)

Advertiser
(only advertising channel type)
ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_SCAN_IND
Within R&S SMW-K117 also ADV_EXT_IND, AUX_ADV_IND, AUX_SYNC_IND, AUX_CHAIN_IND

Scanner
(only advertising channel type)
SCAN_REQ, SCAN_RSP
Within R&S SMW-K117 also AUX_SCAN_REQ, AUX_SCAN_RSP

Initiator
(only advertising channel type)
CONNECT_IND
Within R&S SMW-K117 also AUX_CONNECT_REQ, AUX_CONNECT_RSP

Example: See Example"To configure general Bluetooth BR/EDR settings" on page 163.

Usage: Query only

Manual operation: See "Bluetooth Controller State" on page 49

[:SOURce<hw>]:BB:BTOoth:BMODe <BMode>

Sets the Bluetooth mode.

Parameters:

<BMode> BASic | BLENergy

BASic
Sets basic rate (BR) or enhanced data rate (EDR) Bluetooth mode.

BLENergy
Sets low energy (LE) Bluetooth mode.

*RST: BASic

Example: See Example"To configure general Bluetooth BR/EDR settings" on page 163.

Manual operation: See "Bluetooth Mode" on page 37

[:SOURce<hw>]:BB:BTOoth: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:BTOoth:STATe`.

Example: See Example"To save and recall settings" on page 162.

Usage: Event

Manual operation: See "Set To Default" on page 35

[:SOURce<hw>]:BB:BTOoth:SETTing:CATalog <Catalog>

Queries the files with settings in the default directory. Listed are files with the file extension `*.bto`.

Parameters:

<Catalog> string

Returns a string of file names separated by commas.

Example: See Example"To save and recall settings" on page 162.

Manual operation: See "Save/Recall" on page 36

[:SOURce<hw>]:BB:BTOoth:SETTing:DELete <Filename>

Deletes the selected file from the default or specified directory. Deleted are files with the file extension `*.bto`.

Parameters:

<Filename> string

file name or complete file path; file extension can be omitted

Example: See Example"To save and recall settings" on page 162.

Manual operation: See "Save/Recall" on page 36

[:SOURce<hw>]:BB:BTOoth:SETTing:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.bto`.

Parameters:

<Filename> string

file name or complete file path; file extension can be omitted

Example: See Example"To save and recall settings" on page 162.

Manual operation: See "Save/Recall" on page 36

[:SOURce<hw>]:BB:BTOoth:SETTing:STORe <Filename>

Saves the current settings into the selected file; the file extension (`*.bto`) is assigned automatically.

Setting parameters:

<Filename> string

file name or complete file path

Example: See Example"To save and recall settings" on page 162.

Usage: Setting only

Manual operation: See "Save/Recall" on page 36

[:SOURce<hw>]:BB:BTOoth: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: See Example"To configure general Bluetooth BR/EDR settings" on page 163.

Manual operation: See "State" on page 35

[:SOURce<hw>]:BB:BTOoth:TMODe <TMode>

Selects the transport mode.

Parameters:

<TMode> ACL | SCO | ESCO

ACL
Asynchronous connection-less (ACL) mode used for a point-to-point multipoint link between a Central and all Peripherals.

SCO
Synchronous connection-oriented (SCO) mode used for a point-to-point link between a Central and a specific Peripheral.

ESCO
Enhanced SCO mode used for a symmetric or asymmetric point-to-point link between a Central and a specific Peripheral.

*RST: ACL

Example: See Example"To configure general Bluetooth BR/EDR settings" on page 163.

Manual operation: See "Transport Mode" on page 37

[:SOURce<hw>]:BB:BTOoth:UNIT:TIME <Time>

Sets the time unit for remote control commands.

Parameters:

<Time> S | MS

*RST: MS

Example: See Example"To configure time units for timing and delay commands" on page 162.

[:SOURce<hw>]:BB:BTOoth:VERSion?

Queries the version of the specification for Bluetooth wireless technology underlying the definitions.

Return values:

<Version> string

Example: See Example"To configure general Bluetooth BR/EDR settings" on page 163.

Usage: Query only

Options: Version 5.x requires R&S SMW-K117.
Version 5.5 requires R&S SMW-K178.

Manual operation: See "Bluetooth Version" on page 37

[:SOURce<hw>]:BB:BTOoth:WAVeform:CREate <Filename>

Saves the current settings as an ARB signal in a waveform file (`*.wv`).

Setting parameters:

<Filename> string

Example: See Example"To configure general Bluetooth BR/EDR settings" on page 163.

Usage: Setting only

Manual operation: See "Generate Waveform" on page 36

8.2 Dirty transmitter configuration

Example: To configure a dirty transmitter

```
// ******************************************************************
// Set modulation index mode to stable.
// ******************************************************************
SOURce1:BB:BTOoth:DTTest:MIMode STAB
```

```
// ******************************************************************
// Reset dirty transmitter. Set frequency drift rate, start phase,
// frequency drift deviation and number of packets
// per dirty transmitter set (LE only). Enable dirty transmitter.
// ******************************************************************
SOURce1:BB:BTOoth:DTTest:STDefault
SOURce1:BB:BTOoth:DTTest:FDRate 1.25
SOURce1:BB:BTOoth:DTTest:SPHase 0
SOURce1:BB:BTOoth:DTTest:FDDeviation 50
SOURce1:BB:BTOoth:DTTest:NPPSet NP50

// ******************************************************************
// Enable all long sets for LE or BR dirty transmitter.
// ******************************************************************
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET1:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET2:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET3:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET4:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET5:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET6:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET7:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET8:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET9:STATe 1
SOURce1:BB:BTOoth:DTTest:TABLe:LONG:SET10:STATe 1

// ******************************************************************
// Enable dirty transmitter.
// ******************************************************************
SOURce1:BB:BTOoth:DTTest:DTTState 1
```


[:SOURce<hw>]:BB:BTOoth:DTTest:DTTState <DttState>

Activates the "Dirty Transmitter Test".

For EDR packets, the parameter sets apply for 20 packets each.

Parameters:

<DttState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Dirty Transmitter Test" on page 41

[:SOURce<hw>]:BB:BTOoth:DTTest:FDDeviation <FdDeviation>

Sets a frequency drift rate.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset. The maximum deviation reached during the drift equals the set frequency drift deviation.

Parameters:

<FdDeviation> integer

Range: -100 to 100
*RST: 25

Example: See Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Frequency Drift Deviation(+/-)" on page 41

[:SOURce<hw>]:BB:BTOoth:DTTest:FDRate <FdRate>

Sets a frequency drift rate.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset with the set frequency drift rate.

Parameters:

<FdRate> 0.3 KHz | 0.5 KHz | 1.6 KHz | 10 KHz

Range: depends on packet type to depends on packet type
Increment: 0.001
*RST: depends on packet type

Example: See Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Frequency Drift Rate" on page 41

[:SOURce<hw>]:BB:BTOoth:DTTest:MIMode <MIMode>

Determines standard or stable mode for the modulation index of dirty transmitter according to the Bluetooth core specification.

Parameters:

<MIMode> STANdard | STABle

*RST: STANdard

Example: See Example"To configure a dirty transmitter" on page 167.

Options: R&S SMW-K117

Manual operation: See "Modulation Index Mode" on page 41

[:SOURce<hw>]:BB:BTOoth:DTTest:NPPSet <NumPack>

Specifies the number of packets per dirty transmitter set.

Specifies the number of packets or CS steps per dirty transmitter set.

Bluetooth mode	Channel type	Number of packets
BR + EDR	-	50, 2, 1 packets
LE	Advertising, data	50, 2, 1 packets
LE	Channel sounding	50, 20, 18, 16, 14, 12, 10, 8, 6, 4, 2, 1 CS steps

Parameters:

<NumPack> NP50 | NP2 | NP1 | NP4 | NP6 | NP8 | NP10 | NP12 | NP14 | NP16 | NP18 | NP20

*RST: NP50

Example: See Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Number Of Packets Per Set/Number Of Steps Per Set" on page 42

[:SOURce<hw>]:BB:BTOoth:DTTest:SPHase <SPhase>

The command enters a start phase.

The start phase applies to the sine wave that is used to drift the modulated Bluetooth signal. The drift is around the center frequency plus the carrier frequency offset.

Parameters:

<SPhase> integer

Range: 0 to 359
Increment: 1
*RST: 0
Default unit: degree

Example: `SOURce1:BB:BTO:DTT:SPH 0`
enters a start phase.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Start Phase" on page 41

[:SOURce<hw>]:BB:BTOoth:DTTest:STDefault

The command calls the default settings for the Dirty Transmitter Test.

Example: `SOURce1:BB:BTO:DTT:STD`
calls the default settings.

Example: See also Example"To configure a dirty transmitter" on page 167.

Usage: Event

Manual operation: See "Set To Default" on page 40

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe <Table>

Opens the table settings.

Parameters:
<Table> NOTable | SHORt | LONG

Example: `SOURce1:BB:BTO:PTYP DH1`
calls the default settings.
`SOURce1:BB:BTO:DTT:TABL LONG`
See also Example"To configure a dirty transmitter" on page 167.

Example: calls the default settings.

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:CFOFfset <CfOffset>

Sets a carrier frequency offset.

The carrier frequency offset shows the deviation of the transmitted initial center frequency from carrier frequency.

Parameters:
<CfOffset> integer

Range: -150 to 150
*RST: 1
Default unit: kHz

Example: `SOURce1:BB:BTO:PTYP DH1`
sets the packet type.
`SOURce1:BB:BTO:DTT:TABL LONG`
sets the table type
`SOURce1:BB:BTO:DTT:TABL:LONG:SET2:CFOF 14`
sets a carrier frequency offset.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Carrier Frequency Offset (kHz)" on page 42

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:MINDex <MIndex>

Sets the modulation index, that specifies the frequency deviation.

The modulation index h is defined as:

$$h = \frac{2\Delta f}{f_{symbol}}$$

with

f_{symbol}= "symbol rate" , set with the command [:SOURce<hw>]:BB:BTOoth:SRATe:VARiation

Δf = "frequency deviation", set with the command [:SOURce<hw>]:BB:BTOoth:MSETtings:FDEViation

According to the Bluetooth standard, the modulation index is allowed to vary between 0.28 and 0.35.

Parameters:

<MIndex> float

Range: 0.28 to 0.55
Increment: 0.01
*RST: 0.28

Example:

```
SOURce1:BB:BTO:PTYP DH1
```
sets the packet type.
```
SOURce1:BB:BTO:DTT:TABL LONG
```
enters the table type
```
SOURce1:BB:BTO:DTT:TABL:LONG:SET2:MIND 0.3
```
enters a modulation index.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Modulation Index" on page 43

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STATe <State>

Activates the corresponding parameter set for the long table.

For basic rate packets, each set applies to 20 ms of signal.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 1

Example:

```
SOURce1:BB:BTO:PTYP DH1
```
sets the packet type.
```
SOURce1:BB:BTO:DTT:TABL LONG
```
sets the table type
```
SOURce1:BB:BTO:DTT:TABL:LONG:SET2:STAT ON
```
activates the set 2 in the long table.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "State" on page 42

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STERror <StError>

Sets a symbol timing error in ppm.

This parameter modifies the symbol clock frequency by the set value.

Parameters:

<StError> integer

Range: -150 to 150
*RST: 1
Default unit: ppm

Example:
`SOURce1:BB:BTO:PTYP DH1`
sets the packet type.
`SOURce1:BB:BTO:DTT:TABL LONG`
sets the table type
`SOURce1:BB:BTO:DTT:TABL:LONG:SET2:STER -20`
sets a symbol timing error.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Symbol Timing Error (ppm)" on page 43

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:CFOFfset <CfOffset>

Sets a carrier frequency offset.

The carrier frequency offset shows the deviation of the transmitted initial center frequency from carrier frequency.

Parameters:

<CfOffset> integer

Range: -150 to 150
*RST: 1
Default unit: kHz

Example:
`SOURce1:BB:BTO:PTYP DH1`
sets the packet type.
`SOURce1:BB:BTO:DTT:TABL SHOR`
sets the table type
`SOURce1:BB:BTO:DTT:TABL:SHOR:SET2:CFOF 65`
sets a carrier frequency offset.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Carrier Frequency Offset (kHz)" on page 42

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STATe <State>

Activates the corresponding parameter set in the short table. If a set deactivated, its parameters are skipped in the sequence. Instead, the next active set is used.

For EDR packets, each set applies to 20 packets.

Parameters:
<State> 1 | ON | 0 | OFF

*RST: 1

Example:
```
SOURce1:BB:BTO:PTYP DH1
```
sets the packet type.
```
SOURce1:BB:BTO:DTT:TABL SHOR
```
sets the table type
```
SOURce1:BB:BTO:DTT:TABL:SHOR:SET2:STAT ON
```
activates the set 2 in the short table.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "State" on page 42

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STERror <StError>

Sets a symbol timing error in ppm.

The symbol timing error modifies the symbol clock frequency by the set amount.

Parameters:
<StError> integer

Range: -150 to 150
Increment: 1
*RST: 1

Example:
```
SOURce1:BB:BTO:PTYP DH1
```
sets the packet type.
```
SOURce1:BB:BTO:DTT:TABL SHOR
```
enters the table type
```
SOURce1:BB:BTO:DTT:TABL:SHOR:SET2:STER 20
```
enters a symbol timing error.

Example: See also Example"To configure a dirty transmitter" on page 167.

Manual operation: See "Symbol Timing Error (ppm)" on page 43

8.3 Channel configuration commands - LE

Example: To configure general channel settings for LE

```
// ******************************************************************
// Set time unit to ms.
// ******************************************************************
SOURce1:BB:BTOoth:UNIT:TIME MS

// ******************************************************************
// Select channel type, test packet, packet format, sequence length,
// controller role. Enable CRC corruption for every second packet.
// ******************************************************************
```

```
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe TPAC
SOURce1:BB:BTOoth:PFORmat L2M
SOURce1:BB:BTOoth:USLength 2
SOURce1:BB:BTOoth:BCRole CENTral
SOURce1:BB:BTOoth:CCRC:STATe 1

// ******************************************************************
// Alternatively set duty cycle for ADV_DIRECT_IND
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe ADIN
SOURce1:BB:BTOoth:DCYCle LOW
```


[:SOURce<hw>]:BB:BTOoth:BCRole <BcRole>

Sets the Bluetooth controller role.

Depending on the selected channel type different roles are assigned to the controller. For channel type "Data", you can assign Central or Peripheral.

If the channel type is "Advertising", the parameter is read only and displayed directly above the graph.

Parameters:

<BcRole> CENTral | PERipheral | ADVertiser | SCANner | INITiator

CENTral
Selects Central as controller role.

PERipheral
Selects Peripheral as controller role.

ADVertiser|SCANner|INITiator
Assigned roles depending on the selected packet type of the respective channel type.

*RST: CENTral

Example: See Example"To configure general channel settings for LE" on page 174.

Manual operation: See "Bluetooth Controller Role" on page 48

[:SOURce<hw>]:BB:BTOoth:CCRC:STATe <State>

Enables/disables the corruption of CRC for every second generated packet. If enabled, only 50% of packets are generated with correct CRC.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure general channel settings for LE" on page 174.

Manual operation: See "Corrupted CRC Every 2nd Packet" on page 49

[:SOURce<hw>]:BB:BTOoth:CTYPe <CType>

Determines the channel type. Advertising and data are available.

Parameters:

<CType> ADVertising | DATA | | CS

ADVertising
Selects channel type advertising.

DATA
Selects channel type data. Devices in a connected state transmit data channel packets in connection events with a start point and an interval.

CS
Requires R&S SMW-K178.
Selects channel type channel sounding.

*RST: ADVertising

Example: See Example"To configure general channel settings for LE" on page 174.

Manual operation: See "Channel Type" on page 46

[:SOURce<hw>]:BB:BTOoth:DCYCle <DCycle>

Specifies duty cycle for directed advertising (packet type ADV_DIRECT_IND).

Parameters:

<DCycle> LOW | HIGH

*RST: HIGH

Example: See Example"To configure general channel settings for LE" on page 174.

Options: R&S SMW-K117

Manual operation: See "Duty Cycle" on page 48

[:SOURce<hw>]:BB:BTOoth:PFORmat <PFormat>

Selects the packet format that is the format according to the physical layer (PHY) that supports the packet type or PDU type.

Parameters:

<PFormat> L1M | L2M | LCOD | L2M2B

L1M
LE uncoded PHY with 1 Msymbol/s modulation.

L2M
LE uncoded PHY with 2 Msymbol/s modulation and bandwidth time product BT = 0.5.

LCOD
LE coded PHY with 1 Msymbol/s modulation.

L2M2B
LE uncoded PHY with 2 Msymbol/s modulation and bandwidth time product BT = 2.

*RST: L1M

Example: See Example"To configure general channel settings for LE" on page 174.

Options: L2M and LCOD require option R&S SMW-K117.
L2M2B requires option R&S SMW-K178.

Manual operation: See "Packet Format" on page 48
See "PHY" on page 128

[:SOURce<hw>]:BB:BTOoth:UPTYpe <UpType>

Selects the packet type.

The available packets depend on the selected channel type and installed options. The tables below provide an overview.

Table 8-1: R&S SMW-K60 packet/PDU types

<UpType>	Packet/PDU type	<UpType>	Packet/PDU type
AIND	ADV_IND	ERSP	LL_ENC_RSP
ADINd	ADV_DIRECT_IND	SEReq	LL_START_ENC_REQ
ANINd	ADV_NONCONN_IND	SERSp	LL_START_ENC_RSP
SREQ	SCAN_REQ	URSP	LL_UNKNONW_RSP
SRSP	SCAN_RSP	FREQ	LL_FEATURE_REQ
CREQ	CONNECT_IND	FRSP	LL_FEATURE_RSP
ADCind	ADV_SCAN_IND	TPACket	TEST PACKET
DATA	DATA	PEReq	LL_PAUSE_ENC_REQ
CUReq	LL_CONNECTION_UPDATE_IND	PERSp	LL_PAUSE_ENC_RSP
CMReq	LL_CHANNEL_MAP_IND	VIND	LL_VERSION_IND
TIND	LL_TERMINATE_IND	RIND	LL_REJECT_IND
EREQ	LL_ENC_REQ		

Table 8-2: R&S SMW-K117 packet/PDU types

<UpType>	Packet/PDU type	<UpType>	Packet/PDU type
PREQ	LL_PHY_REQ	ACINd	AUX_CHAIN_IND
PRSP	LL_PHY_RSP	ASINd	AUX_SYNC_IND
PUIN	LL_PHY_UPDATE_IND	ASReq	AUX_SCAN_REQ
LREQ	LL_LENGTH_REQ	ASPSp	AUX_SCAN_RSP
LRSP	LL_LENGTH_RSP	ACRSp	AUX_CONNECT_RSP
SFR	LL_PERIPHERAL_FEATURE_REQ	ACReq	AUX_CONNECT_REQ
CPR	LL_CONNECTION_PARAM_REQ	MUCH	LL_MIN_USED_CHANNELS_IND
CPRS	LL_CONNECTION_PARAM_RSP	CONT	CONTINUOUS
REIN	LL_REJECT_EXT_IND	CTEQ	LL_CTE_REQ
PIR	LL_PING_REQ	CTEP	LL_CTE_RSP
PIRS	LL_PING_RSP	PSIND	LL_PERIODIC_SYNC
AEINd	ADV_EXT_IND	CAReq	LL_CLOCK_ACCURACY_REQ
AAINd	AUX_ADV_IND	CARSp	LL_CLOCK_ACCURACY_RSP

Table 8-3: R&S SMW-K178 packet/PDU types

<UpType>	Packet/PDU type	<UpType>	Packet/PDU type
CSSEq	CS_SEQUENCE	CSREQ	LL_CS_REQ
CSRQ	LL_CS_SEC_REQ	CSRSP	LL_CS_RSP
CSRP	LL_CS_SEC_RSP	CSIND	LL_CS_IND
CCRQ	LL_CS_CAPABILITIES_REQ	CTI	LL_CS_TERMINATE_IND
CCRP	LL_CS_CAPABILITIES_RSP	CFRQ	LL_CS_FAE_REQ
COREQ	LL_CS_CONFIG_REQ	CFRP	LL_CS_FAE_RSP
CORSP	LL_CS_CONFIG_RSP	CCMI	LL_CS_CHANNEL_MAP_IND

For more information, refer to the specifications document.

Parameters:

<UpType> AIND | ADINd | ANINd | SREQ | SRSP | CREQ | ADCind | DATA | CUReq | CMReq | TIND | EREQ | ERSP | SEReq | SERSp | URSP | FREQ | FRSP | TPACket | PEReq | PERSp | VIND | RIND | PREQ | PRSP | PUIN | LREQ | LRSP | SFR | CPR | CPRS | REIN | PIR | PIRS | AEINd | AAINd | ACINd | ASINd | ASReq | ASPSp | ACRSp | ACReq | MUCH | CONT | CTEQ | CTEP | PSINd | CAReq | CARSp | CSSEQ | CSRQ | CSRP | CCRQ | CCRP | COREQ | CORSP | CSREQ | CSRSP | CSIND | CTI | CFRQ | CFRP | CCMI

*RST: AIND

Example: IdPDbBtoCsCtrlRfu
See Example"To configure general channel settings for LE" on page 174.

Manual operation: See "Packet Type" on page 46

[:SOURce<hw>]:BB:BTOoth:USLength <UsLength>

Selects the number of frames or events depending on the packet type. The signal repeats after the specified number of frames/events.

For SCAN_REQ and CONNECT_IND packet, the sequence length is expressed in "Frames".

For AUX_SCAN_REQ and AUX_CONNECT_REQ packet, the sequence length is expressed in "Frames".

For LL_TERMINATE_IND packets, a default value according to the specification is given:

Central: PeripheralLatency + 6

Peripheral: 6

For all other packet types the sequence length is expressed in "Events".

Parameters:

<UsLength> integer

Range: depends on the number of states in dirty transmitter test to dynamic

*RST: 1

Example: See Example"To configure general channel settings for LE" on page 174.

Manual operation: See "Sequence Length" on page 48

[:SOURce<hw>]:BB:BTOoth:MFORmat <ModFmt>

Sets the LE PHY for continuous payload transmission. This transmission requires a CONTINUOUS packet:

```
:SOURce1:BB:BTOoth:UPTYpe CONT
```

Parameters:

<ModFmt> L1M | L2M | LCOD

L1M: LE 1M
L2M: LE 2M
LCOD: LE coded
See also `[:SOURce<hw>]:BB:BTOoth:PFORmat` on page 177.

*RST: L1M

Example: See Example"To configure general channel settings for LE" on page 174.

Options: L2M and LCOD require R&S SMW-K117.

Manual operation: See "Modulation Format" on page 49

[:SOURce<hw>]:BB:BTOoth:DURation <Duration>

Sets the transmission duration for continuous payload transmission. This transmission requires a CONTINUOUS packet:

`:SOURce1:BB:BTOoth:UPTYpe CONT`

Command sets the values in ms. Query returns values in s.

The duration range, increment and default value depend on the modulation format, symbols per a bit and payload type.

For more information, refer to the specifications document.

Parameters:

<Duration> float

Range: depends on settings
Increment: depends on settings
*RST: depends on settings
Default unit: ms

Example: See Example"To configure general channel settings for LE" on page 174.

Manual operation: See "Duration" on page 49

8.4 Event and frame configuration commands - LE

Example: Configure event and frame configuration settings

```
// ******************************************************************
// For ADV_SCAN_IND, select advertising event interval.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe ADC
SOURce1:BB:BTOoth:ECONfiguration:AEINterval 20

// ******************************************************************
// Alternatively set advertising event interval for ADV_DIRECT_IND.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe ADIN
SOURce1:BB:BTOoth:ECONfiguration:ADINterval 3.75
// ******************************************************************
// Set advertising event delay, activate channel 37.
// ******************************************************************
SOURce1:BB:BTOoth:ECONfiguration:AEDelay 0
SOURce1:BB:BTOoth:ECONfiguration:ACTable:CHANnel0:STATe 1
// ******************************************************************
// For packet type SCAN_REQ, set length of the window,
// time interval.
```

```
// ****************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe SREQ
SOURce1:BB:BTOoth:ECONfiguration:SWINdow 10
SOURce1:BB:BTOoth:ECONfiguration:SINTerval 3500

// ****************************************************************
// For packet type CONNECT_IND set transmit window,
// start point of the transmit window,
// LL connection timeout and time interval.
// ****************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe CREQ
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:WSIZe 8.25
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:WOFFset 800
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:LCTimeout 7500
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval 6400

// ****************************************************************
// Alternatively select packet type LL_CONNECTION_UPDATE_IND,
// set transmit window, start point of the transmit
// window, LL connection timeout and time interval.
// ****************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe CUR
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NWSize 8.25
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NWOFfset 800
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout 7500
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval 6400

// ****************************************************************
// Set time interval for advertising channel and events.
// Set time delay for advertising events.
// ****************************************************************
SOURce1:BB:BTOoth:ECONfiguration:APINterval 1.3
SOURce1:BB:BTOoth:ECONfiguration:AEINterval 15
SOURce1:BB:BTOoth:ECONfiguration:AEDelay 5
```

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ACTable:CHANnel<ch0>:STATe <State>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:DCTable:CHANnel<ch0>:STATe <State>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DCMTable:CHANnel<ch0>:STATe <State>

Indicates used and unused data channels.

Note: The previously used syntax `...:SET<ch>:STATe` has been replaced by `...:CHANnel<ch>:STATe`. Compatibility to the previous commands is given.

This parameter is relevant for data event and advertising frame configuration with the packet types LL_CHANNEL_MAP_IND, CONNECT_IND.

Within the option R&S SMW-K117, the following packet types are also relevant for the setting: AUX_CONNECT_IND, AUX_EXT_IND, AUX_ADV_IND, AUX_CHAIN_IND, AUX_SYNC_IND, AUX_SCAN_RSP.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example:
`SOURce1:BB:BTO:ECON:ACT:CHAN:STAT ON`
State in Advertising Channel Table and Secondary Advertising Channel Table
`SOURce1:BB:BTO:ECON:DCT:CHAN:STAT ON`
State in Data Channel Table and Secondary Advertising Channel Table
`SOURce1:BB:BTO:ECON:PCON:DCMT:CHAN:STAT ON`
State in Data Channel Map Table

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Channel Table" on page 57

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEDelay <AeDelay>

Sets a time delay between the start times of two consecutive advertising events. The value is added to the advertising event interval.

Command sets the values in ms. Query returns values in s.

Parameters:

<AeDelay> float

Range: 0 s to 10E-3 s
Increment: 0.1E-3
*RST: 0
Default unit: ms

Example:
`SOURce1:BB:BTO:ECON:AEDelay 5`
Sets a delay of 5 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Advertising Event Delay" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ADINterval <AdInterval>

Sets the time interval between two consecutive advertising events for packet type "ADV_DIRECT_IND" and duty cycle high.

Command sets the values in ms. Query returns values in s.

Parameters:

<AdInterval> float

Range: 1.05E-3 s to 3.75E-3 s
Increment: 0.01E-3
*RST: 3.75E-3
Default unit: ms

Example:
`SOURce1:BB:BTO:ECON:ADIN 13`
Sets a time interval of 13 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Advertising Event Interval" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEINterval <AeInterval>

Sets the time interval between two consecutive advertising events, with regard to the starting points.

Command sets the values in ms. Query returns values in s.

Parameters:

<AeInterval> float

Range: 5E-3 s to depends on oversampling
Increment: 0.1E-3
*RST: 20E-3
Default unit: ms

Example:
`SOURce1:BB:BTO:ECON:AEIN 15`
Sets a time interval of 15 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Advertising Event Interval" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:APINterval <ApInterval>

Sets the time interval between packets starting points of two consecutive packets in the advertising channel.

Parameters:

<ApInterval> float

Range: 1.3E-3 to 28E-3
Increment: 0.1E-3
*RST: 10E-3
Default unit: ms

Example: `SOURce1:BB:BTO:ECON:APIN 1.3`
Sets a time interval of 1.3 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Advertising Packet Interval" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LCMode <LcMode>

Selects the link layer connection mode. In order to provide safe transmission of payload data, the data in the packet can be encrypted. If activated, the payload data follows MIC (Message authentication Code).

Parameters:

<LcMode> UENC | ENC

UENC
Payload data is transmitted without encoding.

ENC
The link layer connection runs in encrypted mode.

*RST: UENC

Example: `SOURce1:BB:BTO:ECON:LCM UENC`
without encoding.
`SOURce1:BB:BTO:ECON:LCM ENC`
in encrypted mode.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "LL Connection Mode" on page 55

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LTKey <LtKey>, <BitCount>

Indicates the time the controller needs to receive the long-term key from the host. After this time, the controller is ready to enter into the last phase of encryption mode setup.

Parameters:

<LtKey> numeric

*RST: #H0

<BitCount> integer

Range: 128 to 128
*RST: 128

Example:
```
SOURce1:BB:BTO:ECON:LCM ENC
SOURce1:BB:BTO:ECON:LTK
#H00000000000000000000000000000000,128
```
In encrypted mode, the code can be edited.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Long Term Key(hex)" on page 56

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MNINterval <MNInterval>

Specifies the minimum allowed connection interval.

Command sets the values in ms. Query returns values in s.

Parameters:

<MNInterval> float

Range: 7.5E-3 s to depending on Max. Interval
Increment: 1.25E-3 s
*RST: 7.5E-3

Example:
```
SOURce1:BB:BTO:ECON:PCON:MNIN 7.5
```
Sets a time interval of 7.5 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Options: R&S SMW-K117

Manual operation: See "Min. Interval" on page 84

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MXINterval <MInterval>

Specifies the maximum allowed connection interval.

Command sets the values in ms. Query returns values in s.

Parameters:

<MInterval> float

Range: 7.5E-3 s to 4000E-3 s
Increment: 1.25E-3
*RST: 7.5E-3

Example:
```
SOURce1:BB:BTO:ECON:PCON:MXIN 12.5
```
Sets a time interval of 12.5 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Options: R&S SMW-K117

Manual operation: See "Max. Interval" on page 84

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet<ch0>:STATe <State>

Enables / disables Offset0 to Offset5 of the offset setting table.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configure event and frame configuration settings" on page 180.

Options: R&S SMW-K117

Manual operation: See "Offset Setting Table" on page 85

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet<ch0>:VALue <Offset>

Specifies Offset0 to Offset5 of the offset setting table.

Command sets the values in ms. Query returns values in s.

Parameters:

<Offset> float

Range: 0 s to depending on Max. Interval
Increment: 1.25
*RST: 0
Default unit: ms

Example:
```
SOURce1:BB:BTO:ECON:PCON:OFFSet0:VALue 7
SOURce1:BB:BTO:ECON:PCON:OFFSet0:VALue?
// Response: "7.5"
```
Sets the Offset0 to 7.5 ms. The setting 7 ms is automatically changed to the closest multiple of 1.25 ms, which is 7.5 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Options: R&S SMW-K117

Manual operation: See "Offset Setting Table" on page 85

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PAINterval <Interval>

Sets the time interval between the start of two AUX_SYNC_IND PDUs from the same advertising set.

Command sets the values in ms. Query returns values in s.

Parameters:

<Interval> float

Range: 7.5E-3 s to depending on oversampling
Increment: 0.01E-3
*RST: 20E-3
Default unit: ms

Example: `SOURce1:BB:BTOoth:ECON:PCON:PAINterval 10`
Sets a time interval of 10 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Periodic Advertising Interval" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PPERiodicity <PPeriodicity>

Specifies a value the connection interval is preferred to be a multiple of.

Parameters:

<PPeriodicity> float

Range: 0 to depends on Max. Interval
Increment: 0.01E-3
*RST: 0

Example: See Example"Configure event and frame configuration settings" on page 180.

Options: R&S SMW-K117

Manual operation: See "Preferred Periodicity" on page 84

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RCECount <RCECount>

Specifies the ReferenceConnEventCount field of LL_CONNECTION_PARAM_REQ.

Parameters:

<RCECount> integer

Range: 0 to 65535
*RST: 0

Example: See Example"Configure event and frame configuration settings" on page 180.

Options: R&S SMW-K117

Manual operation: See "Ref. Connection Event Count" on page 85

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PNUMber <PNumber>

Sets the number of Tx packets per event.

Each connection contains at least one data channel packet. The maximum number of packets per event is determined by the duration of the connection event interval.

Parameters:

<PNumber> integer

Range: 1 to depends on connection event interval
*RST: 1

Example: `SOURce1:BB:BTO:ECON:PNUM 2580`
Sets the number of Tx packets per event.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "No. Of Tx Packets/Event" on page 55

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SDCI?

Queries the number of the first active data channel.

Return values:

<SelectedChannel> integer

Range: 0 to 36
*RST: 0

Example: `SOURce1:BB:BTOoth:ECONfiguration:SDCI?`

Example: See also Example"Configure event and frame configuration settings" on page 180.

Usage: Query only

Manual operation: See "Selected Data Channel Index" on page 56

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SINTerval <SInterval>

Sets the time interval between the starting points of two consecutive windows during which the scanner is operating in an advertising channel.

Command sets the values in ms. Query returns values in s.

Parameters:
<SInterval> float

Range: 10E-3 s to depends on oversampling and the number of advertising channel table states
Increment: 0.625E-3
*RST: 10E-3
Default unit: ms

Example: `SOURce1:BB:BTO:ECON:SINT 3.5`
Sets a time interval of 3.5 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Scan Interval" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SWINdow <SWindow>

Sets the length of the window during which the scanner is operating in the advertising channel.

Note that the scan window is less or equal to the value of the scan interval.

Command sets the values in ms. Query returns values in s.

Parameters:
<SWindow> float

Range: 10E-3 s to 10240E-3 s
Increment: 0.625E-3
*RST: 10E-3
Default unit: ms

Example: `SOURce1:BB:BTO:ECON:SWIN 10`
Sets the length of the window to 10 ms.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Scan Window" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WOINfo?

Requires data event and advertising frame configuration with the packet type CONNECT_IND.

Queries the start point of the transmit window.

Return values:
<WoInfo> string

Example: `SOURce1:BB:BTO:UPTY CREQ`
Sets packet type CONNECT_IND
`SOURce1:BB:BTO:ECON:PCON:WOIN?`
Queries the start point of the transmit window.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Usage: Query only

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WSINfo?

Requires data event and advertising frame configuration with the packet type CONNECT_IND.

Queries the size of the transmit window, regarding to the start point.

Return values:
<WsInfo> string

Example: `SOURce1:BB:BTO:UPTY CREQ`
Sets packet type CONNECT_IND
`SOURce1:BB:BTO:ECON:PCON:WSIN?`
Queries the size of the transmit window.

Example: See also Example"Configure event and frame configuration settings" on page 180.

Usage: Query only

Manual operation: See "Transmit Window Size" on page 54

8.5 Channel sounding commands - LE

8.5.1 CS general commands

Example: To configure CS sequence settings

```
:SOURce1:BB:BTOoth:CINTerval 10
// The connection interval is 10 microseconds.
:SOURce1:BB:BTOoth:EINTerval 2
// The number of event intervals is two.
:SOURce1:BB:BTOoth:EOFFset?
// Response: "500"
// The event offset is 500 microseconds.
:SOURce1:BB:BTOoth:CS:ROLE?
// Response: "INITIATOR"
// The instrument initiates a channel sounding procedure.
```

Commands:

[:SOURce<hw>]:BB:BTOoth:CS:CINTerval <ConnectInterval>

Sets the time of the LE connection interval. The anchor points of two consecutive CS events define the length of this interval.

Parameters:

<ConnectInterval> float

Range: 7.5 to 4000
Increment: 0.1
*RST: 7.5

Example: See Example"To configure CS sequence settings" on page 191.

Manual operation: See "Connection Interval" on page 50

[:SOURce<hw>]:BB:BTOoth:CS:EINTerval <EventInterval>

Sets the number of LE connection event intervals.

Parameters:

<EventInterval> integer

Range: 1 to 65535
*RST: 1

Example: See Example"To configure CS sequence settings" on page 191.

Manual operation: See "Event Intervals/Event_Interval" on page 50
See "Event_Interval" on page 124
See "Event_Interval" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:EOFFset <EventOffset>

Sets the time between the anchor point of the LE connection event and the beginning of the CS event.

Parameters:

<EventOffset> integer

Range: 500 to 4e6
*RST: 500

Example: See Example"To configure CS sequence settings" on page 191.

Manual operation: See "Event Offset" on page 50

[:SOURce<hw>]:BB:BTOoth:CS:ROLE <Role>

Sets the role of the channel sounding device that is the R&S SMW200A.

Parameters:

<Role> INITIATOR | REFLECTOR

INITIATOR
The instrument initiates a CS procedure.

REFLECTOR
The instrument responds to a CS procedure.

*RST: INITIATOR

Example: See Example"To configure CS sequence settings" on page 191.

Manual operation: See "Role" on page 50

8.5.2 CS subevent commands

Example: To configure CS subevent settings

```
// ****************************************************************************
// Configure general settings of a CS subevent.
// ****************************************************************************
// Configure general subevent settings.
:SOURce1:BB:BTOoth:CS:SLENgth 1250
// CS subevent sequence length is 1250 microseconds.
:SOURce1:BB:BTOoth:CS:INTerval 1875
// CS subevent interval is 1875 microseconds.
:SOURce1:BB:BTOoth:CS:SSCHeduling?
// Response: "AUTO"
// CS step scheduling is automatic.
:SOURce1:BB:BTOoth:CS:SNUMber?
// Response: "1"
// Number of subevents is 1 subevent.
```

```
// ******************************************************************************
// Configure channel selection settings of a CS subevent.
// ******************************************************************************
:SOURce1:BB:BTOoth:CS:CFCHm?
// Response: "#H00000000000000000001,80"
// CSFilteredChM value is 00000000000000000001 in hexadecimal reperesentation.
:SOURce1:BB:BTOoth:CS:CMRepetition 1
// Sets one cycle of the ChM field for non-Mode-0 steps within the CS procedure.
:SOURce1:BB:BTOoth:CS:CSEL?
// Response: "SEL_3B"
// The channel selection algorithm is Algorithm #3b.
// Optionally, enable and configure Algorithm #3c parameters.
:SOURce1:BB:BTOoth:CS:CSEL SEL_3C
:SOURce1:BB:BTOoth:CS:CTCShape HAT
// The channel has a rising ramp and a falling ramp.
:SOURce1:BB:BTOoth:CS:CTCJump JUMP_2
```

Commands:

[:SOURce<hw>]:BB:BTOoth:CS:SLENgth <SubLength>

Sets the subevent length that is the duration of a CS subevent.

You can set values in multiples of 625 µs. Settable subevent lengths depend on the number of event intervals, the connection interval, the event offset and the subevent interval.

Parameters:

<SubLength> integer

Range: 1250 to 4e6
*RST: 1250

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Subevent Length" on page 92

[:SOURce<hw>]:BB:BTOoth:CS:SINTerval <SubInterval>

Sets the subevent interval. This interval is the time in multiples of 625 µs between the beginning of a CS subevent and the beginning of the next CS subevent within the same CS event.

For `:SOURce1:BB:BTO:CS:SNUM 1`, the subevent interval is 0µs.

For `:SOURce1:BB:BTO:CS:SNUM 2` or higher, settable subevent intervals depend on the number of event intervals, the connection interval, the event offset and the subevent length.

See also `[:SOURce<hw>]:BB:BTOoth:CS:SNUMber` on page 194.

Parameters:

<SubInterval> integer

Range: 0 to 2.7e11
*RST: 0

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Subevent Interval" on page 92

[:SOURce<hw>]:BB:BTOoth:CS:SSCHeduling <StepScheduling>

Sets the step scheduling mode.

Parameters:

<StepScheduling> AUTO | MANUAL

AUTO
Automatic CS step scheduling. The subevent length, the subevent interval and the number of subevents are configurable.
The number of CS steps is 2.

MANUAL
Manual CS step scheduling. The subevent length is 1250 μs, the subevent interval is 0 μs and the number of subevents is 1.
The number of CS steps is configurable.

*RST: AUTO

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Step Scheduling" on page 93

[:SOURce<hw>]:BB:BTOoth:CS:SNUMber <SubNumber>

Sets number of subevents. Settable values depend on the subevent interval.

Parameters:

<SubNumber> integer

Range: 1 to 32
*RST: 1

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Number of Subevents" on page 93

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:NOSTep <NumOfSteps>

Sets or display the number of CS steps.

Setting requires manual step scheduling. Settable minimum values are 1 or equal to the number of non-zero Mode-0 steps. See also [:SOURce<hw>]:BB:BTOoth:CS:SSCHeduling on page 194.

Parameters:

<NumOfSteps> integer

Range: 2 to 160
*RST: 2

Example: See Example"To configure CS steps for subevent 0" on page 196.

Manual operation: See "Number of Steps" on page 94

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SSPace?

Queries the subevent space in microseconds.

Return values:

<SubeventSpace> integer

Range: 150 to 65535
*RST: 150

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "Subevent Space (µs)" on page 94

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:TFCS <TFcs>

Sets the frequency change period (T_FCS) between consecutive CS steps. The period ranges from 15 µs to 150 µs.

Parameters:

<TFcs> TFCS_15 | TFCS_20 | TFCS_30 | TFCS_40 | TFCS_50 | TFCS_60 | TFCS_80 | TFCS_100 | TFCS_120 | TFCS_150

TFCS_x, x represents values in microseconds.

*RST: TFCS_150

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "T_FCS (µs)" on page 94

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MZSTeps <Mode0Steps>

Parameters:

<Mode0Steps> integer

Range: 1 to 3
*RST: 1

Manual operation: See "Mode-0 Steps" on page 94

8.5.3 CS step configuration commands

Example: To configure CS steps for subevent 0

```
// ****************************************************************************
// Configure general CS step settings of the first subevent "Subevent 0".
// ****************************************************************************
// Configure general subevent settings.
:SOURce1:BB:BTOoth:CS:SLENgth 1250
// CS subevent sequence length is 1250 microseconds.
:SOURce1:BB:BTOoth:CS:INTerval 1875
// CS subevent interval is 1875 microseconds.
:SOURce1:BB:BTOoth:CS:SSCHeduling?
// Response: "AUTO"
// CS step scheduling is automatic.
:SOURce1:BB:BTOoth:CS:SNUMber?
// Response: "1"
// Number of subevents is 1 subevent.
```

Commands:

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMODe <mainMode>

Sets the main mode for the first subevent `SEVent0`. All following subevents use the same main mode.

For an overview on available submodes per main mode, see Table 5-8.

Parameters:

<mainMode> MODE1 | MODE2 | MODE3

MODE1
Mode-1 mode with no submode available.

MODE2
Mode-2 mode with submodes Mode-1 and Mode-3 available.

MODE3
Mode-3 mode with submodes Mode-1 and Mode-2 available.

*RST: MODE1

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Main_Mode" on page 100

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SMODe <SubMode>

Sets the submode of the main mode.

Parameters:

<SubMode> MODE1 | MODE2 | MODE3 | NONE

See the table Table 5-8 for an overview on available submodes per main mode.

*RST: NONE

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Sub_Mode" on page 101

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMASteps <MMMaxSteps>

Sets the maximum number of main mode steps.

Parameters:

<MMMaxSteps> integer

Range: 2 to 255
*RST: 2

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Main_Mode_Max_Steps" on page 101

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMISteps <MMMinSteps>

Sets the minimum number of main mode steps.

Parameters:

<MMMinSteps> integer

Range: 2 to 255
*RST: 2

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Main_Mode_Min_Steps" on page 101

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMSTeps?

Queries the number of main mode CS steps.

Return values:

<MMSTeps> integer

Range: 2 to 160
*RST: 2

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "Main_Mode_Steps" on page 101

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMRepetition <MMRepetition>

Sets the main mode repetition.

Parameters:

<MMRepetition> integer

Range: 0 to 3
*RST: 0

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Main_Mode_Repetition" on page 101

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SMSTep?

Sets the number of submode CS steps.

Return values:

<SubModeStep> integer

Range: 0 to 160
*RST: 0

Example: See Example"To configure CS steps for subevent 0" on page 196.

Usage: Query only

Manual operation: See "Sub_Mode_Steps" on page 101

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MONE:TIPO <TIPO>
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MZERo:TIPO <TIPO>

Sets the time "T_IP1" for Mode-0 and Mode-1 CS steps.

Parameters:

<TIPO> TIP1_10 | TIP1_20 | TIP1_30 | TIP1_40 | TIP1_50 | TIP1_60 | TIP1_80 | TIP1_145

TIP1_x, x represents values in microseconds.

*RST: TIP1_145

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "T_IP1" on page 102

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:TSW?
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:TSW?

Sets the time "T_SW" for Mode-2 or Mode-3 CS steps.

Return values:

<Tsw> TSW_0 | TSW_1 | TSW_2 | TSW_4 | TSW_10

TSW_x, x represents values in microseconds.

*RST: TSW_0

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "T_SW" on page 105

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:NAP?
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:NAP?

Sets the number of antenna path in the N_AP field for Mode-2 and Mode-3 CS steps.

Return values:

<Nap> NAP_1 | NAP_2 | NAP_3 | NAP_4

NAP_x, x represents the path number.

*RST: NAP_1

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "N_AP" on page 105

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:TPM <Tpm>
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:TPM <Tmp>

Sets the time "T_PM" for Mode-2 or Mode-3 CS steps.

Parameters:

<Tmp> TPM_10 | TPM_20 | TPM_40 | TPM_652

TPM_x, x represents values in microseconds.

*RST: TPM_40

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "T_PM" on page 105

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTHRee:TIPT <TIPT>
[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MTWO:TIPT <TIPT>

Sets the time "T_IP2" for Mode-2 or Mode-3 CS steps.

Parameters:

<TIPT> TIP2_10 | TIP2_20 | TIP2_30 | TIP2_40 | TIP2_50 | TIP2_60 | TIP2_80 | TIP2_145

TIP2_x, x represents values in microseconds.

*RST: TIP2_145

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "T_IP2" on page 105

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:STYPe <SeqType>

Sets the sequence type.

Parameters:

<SeqType> SOUNDING | RANDOM

SOUNDING
Sounding sequence

RANDOM
Random sequence

*RST: SOUNDING

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Sequence Type" on page 103

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:SEQLength <SeqLen>

Sets the sequence length. The length is discrete and depends on the sequence type.

Parameters:

<SeqLen> SL_32 | SL_64 | SL_96 | SL_128

*RST: SL_32

Example: See Example"To configure CS steps for subevent 0" on page 196.

Manual operation: See "Sequence Length" on page 103

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPAYload <UserPayload>

Selects a data list file as the data source for a random CS sequence.

This sequence uses the CS_SYNC_User_Payload for CS step configuration modes Mode-1 or Mode-3.

Select the file from the default instrument directory or a specific directory.

Parameters:

<UserPayload> string

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Select Data List" on page 104

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPPattern <Pattern>

Selects the user payload pattern for a random CS sequence.

This pattern is the payload type for CS step configuration modes Mode-1 or Mode-3.

Parameters:

<Pattern> PRBS09 | RE1S | RE2S | PRBS15 | RE3S | RE4S | RE5S | RE6S | UPLD

PRBS09|PRBS15
Pseudo random bit sequence with 9-bit length or 15-bit length in accordance with the IUT-T.

RE1S|RE2S|RE3S|RE4S|RE5S|RE6S
Repeated 8-digit sequences of zeroes and ones.

UPLD
Uses the CS_SYNC_User_Payload. Set this payload via a data list file and the following command:
`:SOURce1:BB:BTOoth:CS:SEVent<ch0>:UPAYload`
See also `[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:UPAYload` on page 200.

*RST: PRBS09

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "User Payload Pattern" on page 104

8.5.4 CS step info commands

Example: To configure CS step settings for a subevent

```
// ****************************************************************************
// Configure general settings of a CS subevent.
// ****************************************************************************
// Configure general subevent settings.
:SOURce1:BB:BTOoth:CS:SLENgth 1250
// CS subevent sequence length is 1250 microseconds.
:SOURce1:BB:BTOoth:CS:INTerval 1875
// CS subevent interval is 1875 microseconds.
:SOURce1:BB:BTOoth:CS:SSCHeduling?
// Response: "AUTO"
// CS step scheduling is automatic.
:SOURce1:BB:BTOoth:CS:SNUMber?
// Response: "1"
// Number of subevents is 1 subevent.
```

Commands:

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:MTYPe?

Queries the mode type for individual CS steps.

For the first CS step, the mode type is the Mode-0. For the other CS steps, the mode type is the main mode in the CS step configuration.

Return values:

<ModeType> MODE0 | MODE1 | MODE2 | MODE3

For a description, see `[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMODe` on page 196.

*RST: MODE0

Example: See Example"To configure CS step settings for a subevent" on page 202.

Usage: Query only

Manual operation: See "Mode Type" on page 109

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CINDex <ChannlIndex>

Queries the channel index for individual CS steps.

Parameters:

<ChannlIndex> integer

Range: 0 to 78
*RST: 0

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Channel Index" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CAADdress <AccessAddress>, <BitCount>

Sets or queries the 32-bit CS access address for individual CS steps.

Setting require manual step scheduling:

```
:SOURce1::BB:BTOoth:CS:SSCHeduling MANUAL
```

See also `[:SOURce<hw>]:BB:BTOoth:CS:SSCHeduling` on page 194.

Parameters:

<AccessAddress> numeric

*RST: #H00000000

<BitCount> integer

Range: 32 to 32
*RST: 32

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "CS Access Address" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:SCONtent <SeqContent>, <BitCount>

Queries the content and the length of a sounding sequence or random sequence. The content depends on the subevent mode.

For CS test packets, you can set the content for a sounding sequence and random sequence.

Parameters:

<SeqContent> numeric

*RST: #H00000000

<BitCount> integer

Range: 32 to 128
*RST: 32

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Sounding Sequence Content/Random Sequence Content" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CSIGnal <CompanionSignal>

Sets the companion signal.

Parameters:

<CompanionSignal> NONE | P2 | M2 | P4 | M4 | M2P2 | M4P4

NONE
Companion signal is disabled.

P2|P4
Positive companion signal with values 2 or 4.

M2|M4
Negative companion signal with values -2 or -4.

M2P2|M4P4
Positive and negative companion signal with values -2 and 2 or -4 and 4.

*RST: NONE

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Companion Signal" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:DATA <DataSource>

Sets the data source for the companion signal.

Parameters:

<DataSource> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

*RST: PN09

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Companion Signal" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:DLISt <DataList>

Selects a data list file as the data source for the companion signal.

Select the file from the default instrument directory or a specific directory.

Parameters:
<DataList> string

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Companion Signal" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:PATTern <Pattern>, <BitCount>

Sets the data pattern for the companion signal.

Parameters:
<Pattern> numeric
*RST: #H0

<BitCount> integer
Range: 1 to 64
*RST: 1

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "Companion Signal" on page 110

[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>][:STEP<st0>]:CTEXtension <CsToneExt>

Enables CS tone extension for mode-2 and mode-3 CS steps.

Parameters:
<CsToneExt> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS step settings for a subevent" on page 202.

Manual operation: See "CS Tone Ext." on page 112

8.5.5 CS channel table commands

[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CFRequency?

Queries the center frequency of the channel.

Return values:

<CenterFreq> float

For a description, see also table Table 2-13.

Range: 2402 to 2480
Increment: 2
*RST: 2402

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "Center Frequency (MHz)" on page 95

[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CINDex?

Queries the channel index of the channel.

Return values:

<CsChannelIndex> integer

For a description, see also table Table 2-13.

Range: 0 to 78
*RST: 0

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "Channel Index" on page 96

[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CTYPe?

Queries the channel type that is Channel Sounding for all channels.

Return values:

<ChannelType> CS

CS
Channel type is Channel Sounding.

*RST: CS

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "Channel Type" on page 96

[:SOURce<hw>]:BB:BTOoth:CS:CTABle[:CHANnel<ch0>]:CALLowed <ChannelAllowed>

Enables transmission of the subevent via the selected channel.

Parameters:

<ChannelAllowed> 1 | ON | 0 | OFF

For a description, see also table Table 2-13.

1|ON
Enables transmission of the subevent for the selected channel.

0|OFF
Disables transmission of the subevent for the selected channel.

*RST: 0

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Channel Allowed" on page 96

8.5.6 CS security commands

[:SOURce<hw>]:BB:BTOoth:CS:CIVC <CsIvC>, <BitCount>

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_IV_C parameter. The parameter is 64-bit in hexadecimal representation.

Parameters:

<CsIvC> numeric
CS_IV_C value in hexadecimal representation.
*RST: #H0

<BitCount> integer
Fixed bit count of 64 bits.
Range: 64 to 64
*RST: 64

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "CS_IV_C(hex)" on page 97

[:SOURce<hw>]:BB:BTOoth:CS:CIVP <CsIvP>, <BitCount>

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_IV_P parameter. The parameter is 64-bit in hexadecimal representation.

Parameters:

<CsIvP> numeric
CS_IV_P value in hexadecimal representation.
*RST: #H0

<BitCount> integer

Fixed bit count of 64 bits.

Range: 64 to 64
*RST: 64

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "CS_IV_P(hex)" on page 97

[:SOURce<hw>]:BB:BTOoth:CS:CINC <CsInC>, <BitCount>

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_IN_C parameter. The parameter is 32-bit in hexadecimal representation.

Parameters:

<CsInC> numeric

CS_IN_C value in hexadecimal representation.

*RST: #H0

<BitCount> integer

Fixed bit count of 32 bits.

Range: 32 to 32
*RST: 32

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "CS_IN_C(hex)" on page 97

[:SOURce<hw>]:BB:BTOoth:CS:CINP <CsInP>, <BitCount>

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_IN_P parameter. The parameter is 32-bit in hexadecimal representation.

Parameters:

<CsInP> numeric

CS_IN_P value in hexadecimal representation.

*RST: #H0

<BitCount> integer

Fixed bit count of 32 bits.

Range: 32 to 32
*RST: 32

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "CS_IN_P(hex)" on page 97

[:SOURce<hw>]:BB:BTOoth:CS:CSPVc <csPvC>

Parameters:

<csPvC> 64 bits

Manual operation: See "CS_PV_C(hex)" on page 97

[:SOURce<hw>]:BB:BTOoth:CS:CPVP <CsPvP>, <BitCount>

Requires packet type CS SEQUENCE or LL_CS_SEC_REQ.

Sets the CS_PV_P parameter. The parameter is 64-bit in hexadecimal representation.

Parameters:

<CsPvP> numeric

CS_PV_P value in hexadecimal representation.

*RST: #H0

<BitCount> integer

Fixed bit count of 64 bits.

Range: 64 to 64
*RST: 64

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "CS_PV_P(hex)" on page 97

8.5.7 CS channel selection commands

[:SOURce<hw>]:BB:BTOoth:CS:CFCHm? <BitCount>

Queries the value of the field CSFilteredChM.

This value determines the bit map for the Channel Sounding channel map update procedure. The parameter is 64-bit in hexadecimal representation.

Parameters:

<BitCount> integer

Fixed bit count of 80 bits.

Range: 80 to 80
*RST: 80

Return values:

<CsFilteredChM> numeric

CSFilteredChM value in hexadecimal representation.

*RST: #H0

Example: See Example"To configure CS subevent settings" on page 192.

Usage: Query only

Manual operation: See "CSFilteredChM(hex)" on page 98

[:SOURce<hw>]:BB:BTOoth:CS:CMRepetition <ChMRepetition>

Sets the 3-bit ChM_Repetition field.

The value equals the number of cycles of the ChM field for non-Mode-0 steps within a CS procedure.

Parameters:

<ChMRepetition> integer

Range: 1 to 3
*RST: 1

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "ChM_Repetition" on page 98

[:SOURce<hw>]:BB:BTOoth:CS:CSEL <ChSel>

Sets the algorithm to select the channels.

Parameters:

<ChSel> SEL_3B | SEL_3C

SEL_3B
Sets for Algorithm #3b channel selection algorithm.

SEL_3C
Sets for Algorithm #3c channel selection algorithm.
For related parameters, see Table 5-7.

*RST: SEL_3B

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "ChSel" on page 98

[:SOURce<hw>]:BB:BTOoth:CS:CTCJump <ChThreeCJump>

Determines the number of skipped channels when rendering the channel shapes. The Ch3cJump field has a length of 1 octet and relates to the channel index values.

Configure this field when using the channel selection algorithm Algorithm #3c:

```
:SOURce1:BB:BTOoth:CS:CSEL SEL_3C
```

Parameters:
<ChThreeCJump> JUMP_2 | JUMP_3 | JUMP_4 | JUMP_5 | JUMP_6 | JUMP_7 | JUMP_8

For Ch3cJump field parameters, see Table 5-7.

*RST: JUMP_2

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Ch3cJump" on page 99

[:SOURce<hw>]:BB:BTOoth:CS:CTCShape <ChThreeCShape>

Sets the bits of the Ch3cShape field. The field has a length of 4 bits and sets the shaping method of the rising and falling ramps of the channels.

Configure this field when using the channel selection algorithm Algorithm #3c:

```
:SOURce1:BB:BTOoth:CS:CSEL SEL_3C
```

Parameters:
<ChThreeCShape> HAT | X

HAT
Channel with a rising ramp and a falling ramp.

X
Channel with interleaved rising and falling ramps.

*RST: HAT

Example: See Example"To configure CS subevent settings" on page 192.

Manual operation: See "Ch3cShape" on page 99

8.6 Packet configuration commands - LE

Example: To configure advertising packets

```
// ******************************************************************
// Configure packet for ADV_SCAN_IND: switch off whitening,
// set Tx device address type, AdvA, data source and length
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe ADC
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:DWHitening 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:TATYpe PUBL
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ANUap #H017412,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ALAP #H9E8B00,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:DATA PN09
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:DLENgth 31
```

```
// ******************************************************************
// Alternatively set periodic advertising interval for AUX_SYNC_IND
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe ASIN
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PAINterval

// ******************************************************************
// Select packet type AUX_ADV_IND. (All parameters of
// extended header are configurable with AUX_ADV_IND packet
// type.) Set channel selection,
// Tx device address type, advertising mode.
// Enable extended header for advertising PDUs. Enable all
// flags: AdvA, TargetA, AdvData Info, Aux Ptr, Sync Info,
// TxPow. Set Tx power value and ACAD length and pattern.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe ADV
SOURce1:BB:BTOoth:UPTYpe AAIN
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CSELection CS1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:TATYpe PUBL
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:AMODe NCNS
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:EHEader:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:AADDress:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:TADDress:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:ADINfo:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:APTR:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:SINFo:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:TPOWer:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:TPOWer -100
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ALENgth 16
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD PN16


// ******************************************************************
// Alternatively set user-defined pattern.
// ******************************************************************
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD PATTern
SOURce1:BB:BTOoth:ECONfiguration:PCON:ACAD:APATtern #B011000011,9
// ******************************************************************
// Alternatively set pattern from data list.
// ******************************************************************
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD DLISt
SOURce1:BB:BTOoth:ECON:PCON:ACAD:ASEL "p:/pattern1.dm_iqd


// ******************************************************************
// Enable AdvData Info flag, set advertising data ID and
// advertising data set ID.
// ******************************************************************
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:ADINfo:STATe ON
```

```
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ADID #H01FF,12
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ASID #H0F,4
// ******************************************************************
// Enable and specify AuxPtr for the secondary advertising
// channel: select AUX channel, set clock accuracy, offset unit,
// AUX offset, AUX PHY.
// ******************************************************************
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:APTR:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:DCTable:CHANnel0:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CACCuracy T500
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:AOUNits U30
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:AOFFset 100
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:APHY L1M
// ******************************************************************
// Enable and specify SyncInfo field for the AUX_SYNC_IND
// packet: set sync packet offset, offset unit, periodic adv
// interval, sleep clock accuracy, access address, CRC initial
// value. Reset event counter. Configure channel map.
// ******************************************************************
SOURce1:BB:BTOoth:ECONfiguration:PCON:EHFLags:SINFo:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PAINterval 20
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SCACcuracy SCA0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress #HACDE48AC,32
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CIV #H000000,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SPOFfset 100
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SOUNits U30
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OADJust 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SPOFfset?
// 99.9
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ECOunter 0
SOURce1:BB:BTOoth:ECONfiguration:PCON:DCMTable:CHANnel0:STATe 1

// ******************************************************************
// Configure advertiser, scanner and initiator device addresses.
// Company_Assigned and Company_Id in Advertiser´s Device Address
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ACAS #H000000,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ACID #H000000,24
// Company_Assigned and Company_Id in Scanners Device Address
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SCAS #H000000,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SCID #H000000,24
// Company_Assigned and Company_Id in Initiators Device Address
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ICAS #H000000,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ICID #H000000,24
// ******************************************************************
```

Example: To configure data packets

```
// *******************************************************************
// Configure signal for DATA: select channel type, packet type,
// packet format, sequence length, role, enable CRC corruption.
// *******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe CUR
SOURce1:BB:BTOoth:PFORmat L1M
SOURce1:BB:BTOoth:USLength 12
SOURce1:BB:BTOoth:BCRole CENTral
SOURce1:BB:BTOoth:CCRC:STATe 1

// *******************************************************************
// Configure packet type DATA: access address, CRC initial,
// NESN start, SN start values, data source, data length
// *******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe DATA
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress #HDAB85479,32
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CIValue #H000000,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NSValue 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SSValue 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:DATA PN09
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:DLENgth 251

// *******************************************************************
// Configure payload of LL_CONNECTION_UPDATE_IND: transmit
// window size and offset, connection event interval, Peripheral
// latency, LL connection timeout, connection instant.
// *******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe CUR
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress #HDAB85479,32
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CIValue #H000000,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NSValue 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SSValue 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NWSize 1.25
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NWOFfset 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval 7.5
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PSLatency 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout 100
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant 0

// *******************************************************************
// Configure the payload of LL_FEATURE_REQ: set packet
// type, feature set length and configure feature set.
// *******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe FREQ
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSLength 8
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit0:STATe 1
```

```
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit1:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit2:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit3:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit4:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit5:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit6:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit7:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit8:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit9:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit10:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit11:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit12:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit13:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit14:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit15:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit16:STATe 0

// ******************************************************************
// Configure the payload of LL_CONNECTION_PARAM_REQ: max. and min.
// interval, Peripheral latency, LL connection timeout, preferred
// periodicity, reference connection even count
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe CPR
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MXINterval 10
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MNINterval 7.5
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PSLatency 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout 100
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PPERiodicity 1.25
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:RCECount 10
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet0:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet0:VALue 3.75
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet1:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet1:VALue 5
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet2:STATe ON
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet2:VALue 6.25
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet3:STATe OFF
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet4:STATe OFF
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OFFSet5:STATe OFF

// ******************************************************************
// Configure the payload of LL_LENGTH_REQ: max. Rx and TX
// payload octets, max. time to receive and transmit a packet.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe LREQ
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MROCtets 27
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MTOCtets 27
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MRTime 0.328
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MTTime 0.328
```

```
// ******************************************************************
// Set the payload of LL_PHY_REQ: specify preferred Tx, Rx PHYs.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe PREQ
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:L1M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:L2M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:LCOD:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:L1M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:L2M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:LCOD:STATe 0

// ******************************************************************
// Set the payload of LL_PHY_UPDATE_IND: specify PHYs for
// Central-to-Peripheral and Peripheral-to-Central direction and instant.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe PUIN
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:L1M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:L2M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:LCOD:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:L1M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:L2M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:LCOD:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant 1

// ******************************************************************
// Set the payload of LL_REJECT_EXT_IND: set reject opcode
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe REIN
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ROPCode #H02,8

// ******************************************************************
// Set the payload of LL_MIN_USED_CHANNELS_IND: set the controller
// role to Peripheral, set the packet type, specify PHYs and minimum
// used channels requirement
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:BCRole PERipheral
SOURce1:BB:BTOoth:UPTYpe MUCH
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L1M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L2M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:LCOD:STATe 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:MUCHannels 2

// ******************************************************************
// Set header and payload of LL_PERIODIC_SYNC_IND: enable CTE and
```

```
// configure CTE method, set event counter properties, specify PHYs
// and address type.
// ******************************************************************
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe PSIN
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CPResent 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CTIMe 0.016
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CTYPe AOD1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ANTNumber 4
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ANTGain0?
// Response: "0"
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ANTGain1 3
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ANTGain2 -3
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ANTGain3 10
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ID #HAAAA,16
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SPOFfset 245.7
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SOUNits U30
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:OADJust 1
// Enabling offset adjust sets the Sync packet offset to 300 µs.
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SOUNits U300
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CECount 65535
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:LPECounter 65535
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SID #H1,4
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ATYPe PUBL
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SCACcuracy SCA0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L1M:STATe 1
// Enabling another PHY automatically disables the previous PHY.
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L2M:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:LCOD:STATe 1
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L1M:STATe? 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L2M:STATe? 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:ACASsigned #H000080,24
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SCECounter 65535
```


8.6.1 General configuration

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DWHitening <DWhitening>

Activates or deactivates the Data Whitening. Evenly distributed white noise is ideal for the transmission and real data can be forced to look similar to white noise with different methods called Data Whitening. Applied to the PDU and CRC fields of all packet types, whitening is used to avoid long equal seqeunces in the data bit stream.

Parameters:

<DWhitening> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Data Whitening" on page 59

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress <AAddress>, <BitCount>

Sets the access address of the link layer connection (32-bit string).

Parameters:

<AAddress> numeric

*RST: #HACDE48AC

<BitCount> integer

Range: 32 to 32
*RST: 32

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "Access Address" on page 59

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CIValue <CiValue>, <BitCount>

Sets the initialization value for the CRC (Cyclic Redundancy Check, 24 bits) calculation. A packet has been received correctly, when it has passed the CRC check.

Parameters:

<CiValue> numeric

*RST: #H0

<BitCount> integer

Range: 24 to 24
*RST: 24

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "CRC Initial Value(hex)" on page 60

8.6.2 Header configuration

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CSELection <CSelection>

Specifies the algorithm of channel selection.

Parameters:

<CSelection> CS1 | CS2

Algorithm #1 or algorithm #2

*RST: CS1

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Channel Selection" on page 61

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSValue <NsValue>

Sets the start value of the next expected packet from the same device in the LL connection ("N"ext"E"xpected "S"equence"N"umber). This parameter can be set in the first event. From the second event this field is not indicated.

Parameters:

<NsValue> integer

Range: 0 to 1
*RST: 1

Example: See Example"To configure data packets" on page 214.

Manual operation: See "NESN Start Value" on page 60

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SSValue <SsValue>

Sets the sequence number of the packet. This parameter can be set in the first event. From the second event, this field is not indicated.

Parameters:

<SsValue> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "SN Start Value" on page 61

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CPResent <State>

Activates the CTEInfo field in the header of Bluetooth LE data packets in the LE uncoded PHY.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "CTEInfo Present" on page 61

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CTIMe <CTime>

Sets the CTETime comprising the length of constant tone extension field of the Bluetooth LE PDU.

Parameters:

<CTime> float

Range: 16E-6 to 160E-6
Increment: 8E-6
*RST: 16E-6

Example: See Example"To configure data packets" on page 214.

Manual operation: See "CTETime" on page 62

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CTReq <CTReq>

Sets the CTE type in the CTETypeReq field of the CtrData field of the LL_CTE_REQ PDU.

Parameters:

<CTReq> AOD1 | AOA | AOD2

AOA
AoA Constant Tone Extension

AOD1
AoD Constant Tone Extension with 1 µs time slots

AOD2
AoD Constant Tone Extension with 2 µs time slots

*RST: AOA

Example: See Example"To configure data packets" on page 214.

Manual operation: See "CTETypeReq" on page 89

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CTYPe <CType>

Sets the type of constant tone extension. The type specifies the CTE AoA/AoD method and for AoD the length of the switching and I/Q sampling slots.

Parameters:

<CType> AOD1 | AOA | AOD2

AOA
AoA Constant Tone Extension

AOD1
AoD Constant Tone Extension with 1 µs time slots

AOD2
AoD Constant Tone Extension with 2 µs time slots

*RST: AOA

Example: See Example"To configure data packets" on page 214.

Manual operation: See "CTEType" on page 63

[:SOURce<hw>]:BB:BTOoth:ECONfig:PCONfig:ANTGain<ch0> <AntennaGain>

Specifies the gain of the antenna. You can specify the antenna gain infomation of up for four individual antennas for direction finding.

Parameters:

<AntennaGain> float

Range: -10 to 10
Increment: 0.01
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "AntennaX Gain" on page 63

[:SOURce<hw>]:BB:BTOoth:ECONfig:PCONfig:ANTNumber <AntennaNum>

Specifies the number of antenas for angle of departure (AoD) direction finding method. You select up to four antennas, that are used for direction finding.

Parameters:

<AntennaNum> integer

Range: 1 to 4
*RST: 1

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Antenna Number" on page 63

8.6.3 Payload configuration

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD <Data>

Specifies the pattern source used for additional controller advertising data (ACAD).

Parameters:

<Data> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

ALL0 / ALL1
All 0 or all 1 pattern

PATTern
User-defined pattern. The pattern can be specified via:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD:APATtern` on page 224

PNxx
Pseudo-random bit sequences (PRBS) of a length of xx bits.
The length in bit can be 9, 11, 15, 16, 20, 21, or 23.

DLISt
Internal ACAD data list is used. The data list can be specified via:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD:ASELection` on page 225

*RST: PN09

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "ACAD" on page 70

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD:APATtern <DPattern>, <BitCount>

Specifies user-defined pattern. The settings is relevant for

`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD PATTern`

Parameters:

<DPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "AList / Pattern" on page 70

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACAD:ASELection <DSelection>

Specifies data list file. The settings is relevant for

`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACADDLISt`

Parameters:

<DSelection> string

Path and file name.

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "AList / Pattern" on page 70

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACID <Acid>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACASsigned <AcAssigned>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCASsigned <ScAssigned>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCID <Scid>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICASsigned <IcAssigned>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICID <Icid>, <BitCount>

Sets the advertiser´s device address. For advertising channel packets, the format of the device address differs, depending on the selected address type.

- "Public Address Types"
  The public address is given from the registration authority IEEE and is composed of:
  – LSB: 24 bits = company_assigned
  – MSB: 24 bits = company_id
- "Random Address Type" is a 48-bits random static device address.
- "Private Address Type"
  A private address is optional and composed of:
  – LSB: 24 bits = hash
  – MSB: 24 bits = random

Parameters:

<Icid> numeric

*RST: #HACDE48

<BitCount> integer

Range: 24 to 24
*RST: 24

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "Initiator's Device Addr" on page 77

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ADID <Adid>, <BitCount>

Specifies "Advertising Data ID" in hexadecimal format to be signaled within an extended header.

Parameters:

<Adid> numeric

*RST: #H000

<BitCount> integer

Range: 12 to 12
*RST: 12

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Advertising Data ID(hex)" on page 71

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ALAP <Lap>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ILAP <Lap>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SLAP <Lap>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TLAP <Lap>, <BitCount>

Sets the lower address part (LAP) of Bluetooth device address. Commands for the advertising `..:ALAP`, initiating `..:ILAP`, scanning `..:SLAP` PDUs of advertising channel type are provided. In addition, a command is provided for scanner's or initiator's target device address to which the advertisement is directed `..:TLAP`.

Parameters:

<Lap> numeric

*RST: #H000080

<BitCount> integer

Range: 24 to 24
*RST: 24

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Target's Device Addr" on page 65

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ALENgth <Length>

Specifies the length of ACAD data pattern.

Parameters:

<Length> integer

Range: 0 to 62
*RST: 27

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "ACAD Length" on page 70

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AMODe <AMode>

Indicates the mode of the advertisement.

Parameters:

<AMode> NCNS | CNS | NCS

NCNS: Non-connectable, non-scannable
CNS: Connectable, non-scannable
NCS: Non-connectable, non-scannable

*RST: NCNS

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Advertising Mode" on page 67

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ANUap <NapUap>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:INUap <NapUap>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SNUap <NapUap>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TNUap <NapUap>, <BitCount>

Sets the non-significant address part (NAP) and upper address part (UAP) of Bluetooth device address. Commands for the advertising `...:ANUap`, initiating `...:INUap`, and scanning `...:SNUap` PDUs of advertising channel type are provided. In addition, a command is provided for scanner’s or initiator’s target device address to which the advertisement is directed `...:TNUap`.

Parameters:

<NapUap> numeric

*RST: #HACDE48

<BitCount> integer

Range: 24 to 24
*RST: 24

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Target's Device Addr" on page 65

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AOFFset <AOffset>

Specifies the time from the start of the packet containing the AuxPtr field to the approximate start of the auxiliary packet. The offset is determined by multiplying the value by the unit, see

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AOUNits

Parameters:

<AOffset> float

Range: 0 to 245.7 or 246 to 2457 depending on offset unit

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "AUX Offset" on page 72

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AOUNits <Unit>

Indicates the units used by the "Aux Offset" parameter, see

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AOFFset

Parameters:

<Unit> U30 | U300

U30: 30 µs
U300: 300 µs

*RST: U30

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Offset Units" on page 72

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:APHY <APhy>

Sets the physical layer (PHY) to transmit the auxiliary packet.

Parameters:

<APhy> L1M | L2M | LCOD | L2M2B

For a description, see [:SOURce<hw>]:BB:BTOoth:PFORmat on page 177.

*RST: L1M

Example: See Example"To configure advertising packets" on page 211.

Options: L2M and LCOD require option R&S SMW-K117.
L2M2B requires option R&S SMW-K178.

Manual operation: See "AUX PHY" on page 72

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ASID <Asid>, <BitCount>

Specifies the "Advertising Set ID" in hexadecimal format to be signaled within an extended header.

Parameters:

<Asid> numeric

*RST: #H0

<BitCount> integer

Range: 4 to 4
*RST: 4

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Advertising Set ID(hex)" on page 71

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CACCuracy <CAccuracy>

Specifies the clock accuracy of the advertiser used between the packet containing this data and the auxiliary packet.

Parameters:

<CAccuracy> T500 | T50

T500: 51 ppm to 500 ppm
T50: 0 ppm to 50 ppm

*RST: T500

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Clock Accuracy" on page 72

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CID <Cid>, <BitCount>

Sets the company identifier of the manufacturer of the Bluetooth Controller. A 16 bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type LL_VERSION_IND.

Parameters:

<Cid> numeric
*RST: 0

<BitCount> integer
Range: 16 to 16
*RST: 16

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Company Id(hex)" on page 84

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant <CInstant>

Sets a connection instant for indicating the connection event at which the new connection parameters are taken in use.

Parameters:

<CInstant> integer
Range: 1 to depends on sequence length
*RST: 1

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Connection Instant" on page 82
See "Connection Instant" on page 129

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval <CInterval>

Sets the time interval between the start points of two consecutive connection events for the packet type DATA and all CONTROL_DATA packet types.

Command sets the values in ms. Query returns values in s.

Parameters:

<CInterval> float
Range: 7.5E-3 s to depends on oversampling
Increment: 1.25E-3 s
*RST: 7.5E-3 s
Default unit: ms

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Connection Event Interval" on page 55

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA <Data>

Selects the pattern source used for the payload.

Parameters:

<Data> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

ALL0 / ALL1
All 0 or all 1 pattern

PATTern
User-defined pattern. The pattern can be specified via:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DPATtern` on page 231

PNxx
Pseudo-random bit sequences (PRBS) of a length of xx bits.
The length in bit can be 9, 11, 15, 16, 20, 21, or 23.

DLISt
Internal data list is used. The data list can be specified via:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DSELection` on page 232

*RST: PN09

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "Data Source" on page 65

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DPATtern <DPattern>, <BitCount>

Specifies the user-defined pattern. The setting is relevant for

`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA PATTern`

Parameters:

<DPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Data Source" on page 65

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DSELection <DSelection>

Selects a data list file from the default directory or from the specific directory.

Using data list (`DLISt`) data requires one of the following commands:

- `BB:BTO:ECON:PCON:DATA DLISt`
  See `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA` on page 231.
- `BB:BTO:DTT:TPC:UPS DLISt`
  See `[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPSource` on page 271.

Parameters:

<DSelection> string

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "Data Source" on page 65

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DLENgth <DLength>

Sets the payload data length in bytes.

Parameters:

<DLength> integer

Range: 0 to 255 (advertiser) or 251 (data)
*RST: 31

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "Data Length" on page 65

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ECODe <ECode>, <BitCount>

Sets the error code value to inform the remote device why the connection is about to be terminated in case of LL_TERMINATE_IND packet. On the other hand, this parameter for LL_REJECT_IND packet is used for the reason a request was rejected. A 8 bit value is set.

Note: This parameter is relevant for data frame configuration and the packet type:

- LL_TERMINATE_IND
- LL_REJECT_IND

Parameters:

<ECode> numeric

*RST: #H00

<BitCount>	integer Range: 8 to 8 *RST: 8
Example:	`SOURce1:BB:BTO:ECON:PCON:ECOD #H00,8` Sets the error code.
Manual operation:	See "Error Code(hex)" on page 82

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ECOunter <ECounter>

Counts the AUX_SYNC_IND packets that the SyncInfo field describes.

Parameters:

<ECounter>	integer Range: 0 to 65535 *RST: 0
Example:	See Example"To configure advertising packets" on page 211.
Options:	R&S SMW-K117
Manual operation:	See "Event Counter" on page 74

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EDIVersifier <EDiversifier>, <BitCount>

Sets the encrypted diversifier of the Central for device identification. The parameter is an initialization vector provided by the host in the HCI_ULP_Start_Encryption command.

Parameters:

<EDiversifier>	numeric *RST: #H0000
<BitCount>	integer Range: 16 to 16 *RST: 16
Example:	`SOURce1:BB:BTO:ECON:PCON:EDIV #H0000,16` Sets the encrypted diversifier of the Central.
Manual operation:	See "Encrypted DIVersifier(hex)" on page 82

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHEader:STATe <State>

Enables / disables extended header for advertising packets with scanning PDUs.

Parameters:

<State>	1 | ON | 0 | OFF *RST: 1

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Extended Header" on page 67

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:AADDress:STATe <State>

If enabled, the R&S SMW200A includes the signaling of non-significant advertising address part (NAP) and upper address part (UAP).

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "AdvA" on page 68

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:ADINfo:STATe <State>

Enables / disables the signaling of advertising data information consisting of "Advertising Data ID" and "Advertising Set ID".

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "AdvDataInfo" on page 69

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:APTR:STATe <State>

Enables / disables secondary advertising channel.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "AuxPtr" on page 69

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:CINFo: STATe <State>

Activates the CTEInfo field in the extended header of Bluetooth LE advertising packets in the LE uncoded PHY.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Manual operation: See "CTEInfo" on page 68

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:SINFo: STATe <State>

Enables / disables the signaling of SyncInfo field for periodic advertisement.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "SyncInfo/SyncInfo Configuration" on page 69

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags: TADDress:STATe <State>

Enables / disables the signaling of non-significant address part (NAP) and upper address part (UAP) of a target address.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "TargetA" on page 68

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EHFLags:TPOWer: STATe <State>

Enables the signaling of required transmit power.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "TxPow(dBm)" on page 69

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:FSBit<ch0>:STATe <State>

Requires link layer control PDUs LL_FEATURE_REQ, LL_FEATURE_RSP or LL_PERIPHERAL_FEATURE_REQ, see `[:SOURce<hw>]:BB:BTOoth:UPTYpe` on page 177.

Enables features of the feature set within the the link layer control PDU. See also Table 5-5.

Suffix:

<ch0> 0 to 27
Bit number that relates to a feature

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "FeatureSet configuration table" on page 90

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:FSLength <FsLength>

Enables that the feature set length is indicated.

Parameters:

<FsLength> integer
Range: 1 to 26
*RST: 8

Example: See Example"To configure data packets" on page 214.

Manual operation: See "FeatureSet Length" on page 83

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:HLENgth <HLength>

Requires data event and advertising frame configuration with the packet type CONNECT_IND.

Sets the difference from the current channel to the next channel.

The Central and Peripherals determine the data channel in use for every connection event from the channel map. Hop_length is set for the LL connection and communicated in the CONNECT_IND and LL_CHANNEL_MAP_IND packets.

Parameters:

<HLength> integer

Range: 5 to 16
*RST: 5

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Hop Length" on page 79

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:LCTimeout <LcTimeout>

Defines the maximum time between two correctly received Bluetooth LE packets in the LL connection before the connection is considered lost for the packet type CONNECT_IND.

Command sets the values in ms. Query returns values in s.

Parameters:

<LcTimeout> float

Range: 100E-3 s to 32000E-3 s
Increment: 10E-3 s
*RST: 100E-3 s
Default unit: ms

Example: See Example"To configure data packets" on page 214.

Manual operation: See "LL Connection Timeout" on page 78

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MIVector <MiVector>, <BitCount>

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SIVector <SiVector>, <BitCount>

Sets the portion of Central or the portion of the Peripheral of the initialization vector (IVm/IVs).

Parameters:

<SiVector> numeric

*RST: #H0

<BitCount> integer

Range: 32 to 32
*RST: 32

Example: `SOURce1:BB:BTO:ECON:PCON:MIV #H0000000000000000,32`
(Central).
`SOURce1:BB:BTO:ECON:PCON:SIV #H0000000000000000,32`
(Peripheral).

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MROCtets <MROctets>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTOCtets <MTOctets>

Specifies the maximum allowed payload length of a packet to be received (`..:MROCtets`) or transmitted (`..:MTOCtets`). Information is signaled via LL_LENGTH_REQ and LL_LENGTH_RSP.

Parameters:

<MTOctets> integer

Range: 27 to 251
*RST: 27

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "MaxRxOctets/MaxTxOctets" on page 85

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MSKD <Mskd>, <BitCount>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SSKD <Sskd>, <BitCount>

Sets the portion of Central or the portion of the Peripheral of the session key diversifier (SKDm/SKDs).

Parameters:

<Sskd> numeric

*RST: #H0

<BitCount> integer

Range: 64 to 64
*RST: 64

Example: `SOURce1:BB:BTO:ECON:PCON:MSKD #H0000000000000000,64`
(Central).
`SOURce1:BB:BTO:ECON:PCON:SSKD #H0000000000000000,64`
(Peripheral).

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MRTime <MRTime>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTTime <MTTime>

Specifies the maximum allowed time to receive (`...:MRTime`) or transmit (`...:MTTime`) a packet. Information is signaled via LL_LENGTH_REQ and LL_LENGTH_RSP.

Parameters:

<MTTime> float

Range: 0.328E-3 to 17.04E-3
Increment: 0.001E-3
*RST: 17.04E-3

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "MaxRxTime/MaxTxTime" on page 86

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MUCHannels <Muchannels>

Specifies the minimum number of channels to be used on the specified PHYs, see `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L1M:STATe` etc.

Parameters:

<Muchannels> integer

Range: 2 to 37
*RST: 2

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "Min Used Channels" on page 87

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:L1M:STATe <MTSP>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:L2M:STATe <MTSP>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MTSPhy:LCOD:STATe <MTSP>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:L1M:STATe <STMP>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:L2M:STATe <STMP>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:STMPhy:LCOD:STATe <STMP>

Specifies the physical layers in Central-to-Peripheral (`...:MTSPhy:..`) or Peripheral-to-Central (`...:STMPhy:..`) direction. Information is signaled via LL_PHY_UPDATE_IND.

You can enable one or more PHYs:

- `L1M`: for LE uncoded 1 Msymbol/s PHY.
- `L2M`: for LE uncoded 2 Msymbol/s PHY.
- `LCOD`: for LE coded 1 Msymbol/s PHY.

Parameters:

<STMP> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "M_TO_S_PHY/S_TO_M_PHY" on page 86

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval <NcInterval>

Sets the time interval new connection events for the packet types CONNECT_IND and LL_CONNECTION_UPDATE_IND.

Command sets the values in ms. Query returns values in s.

Parameters:

<NcInterval> float

Range: 7.5E-3 s to depends on oversampling
Increment: 1.25E-3 s
*RST: 7.5E-3 s
Default unit: ms

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Connection Event Interval" on page 78

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout <NlcTimeout>

Defines the maximum time between two correctly received Bluetooth LE packets in the LL connection before the connection is considered lost only for the packet type LL_CONNECTION_UPDATE_IND.

Command sets the values in ms. Query returns values in s.

Parameters:

<NlcTimeout> float

Range: 100E-3 s to 32000E-3 s
Increment: 10E-3 s
*RST: 100E-3 s
Default unit: ms

Example: See Example"To configure data packets" on page 214.

Manual operation: See "LL Connection Timeout" on page 78

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSLatency <NsLatency>

Requires a data event and advertising frame configuration with the packet type LL_CONNECTION_UPDATE_IND.

Sets the number of consecutive connection events the Peripheral can ignore for asymmetric link layer connections.

Parameters:

<NsLatency> integer

Range: 0 to depends on LL connection timeout and connection event interval

*RST: 0

Example:

`SOURce1:BB:BTO:UPTY CUR`

sets packet type LL_CONNECTION_UPDATE_IND

`SOURce1:BB:BTO:ECON:PCON:NSLatency 10`

sets the number of consecutive connection events.

Manual operation: See "Peripheral Latency" on page 78

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWOFfset <NwOffset>

Sets the start point of the transmit window for data event and advertising frame configuration with the packet type LL_CONNECTION_UPDATE_IND.

Command sets the values in ms. Query returns values in s.

Parameters:

<NwOffset> float

Range: 0 s to depends on connection event interval
Increment: 1.25E-3 s
*RST: 0
Default unit: ms

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Transmit Window Offset" on page 77

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWSize <NwSize>

Sets the size of the transmit window, regarding to the start point for data event and advertising frame configuration with the packet type LL_CONNECTION_UPDATE_IND.

Parameters:

<NwSize> float

Range: 1.25E-3 to depends on connection event interval
Increment: 1.25E-3
*RST: 1.25E-3

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Transmit Window Size" on page 77

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:OADJust <State>

Adjusts the "Sync Packet Offset" automatically to the next value, which is a multiple of the ""Offset Units".

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Offset Adjust" on page 74

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L1M:STATe <State>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:L2M:STATe <State>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHYS:LCOD:STATe <State>

Specifies the physical layers for which the Peripheral has a minimum number of used channels requirement. Information is signaled via LL_MIN_USED_CHANNELS_IND.

You can enable one or more PHYs:

- `L1M`: for LE uncoded 1 Msymbol/s PHY.
- `L2M`: for LE uncoded 2 Msymbol/s PHY.
- `LCOD`: for LE coded 1 Msymbol/s PHY.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "PHYs" on page 87

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TATYpe <TaType>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RATYpe <RaType>

Selects the address type of the controller device.

Depending on the Bluetooth controller role either Tx or Rx or both address types are assigned. Subdivided into private and random, a Bluetooth LE device address consits of 48 bits. The format of the device address differs depending on the selected address type.

Parameters:

<RaType> PUBLic | RANDom

PUBlic
Allocates a unique 48 bit address to each Bluetooth LE device. The public address is given from the registration authority IEEE.

RANDom
Allocates a 48-bit address to each Bluetooth LE device. A random address is optional.

*RST: PUBLic

Example:
```
SOURce1:BB:BTO:ECON:PCON:TATY PUBL
SOURce1:BB:BTO:ECON:PCON:RATY RAND
```

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ROPCode <ROpcode>, <BitCount>

Specifies the Opcode of rejected LL control PDU. information is signaled via LL_REJECT_EXT_IND.

Parameters:

<ROpcode> numeric

*RST: #H00

<BitCount> integer

Range: 8 to 8
*RST: 8

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "Reject Opcode" on page 85

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:L1M:STATe <RPhys>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:L2M:STATe <RPhys>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RPHYs:LCOD:STATe <RPhys>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:L1M:STATe <TPhys>

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:L2M:STATe <TPhys>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPHYs:LCOD:STATe <TPhys>

Specifies preferred physical layers in Rx (`..:RPHYs:..`) or Tx (`..:TPHYs:..`) direction. Information is signaled via LL_PHY_REQ and LL_PHY_RSP.

You can enable one or more PHYs: `:L1M:` for LE uncoded 1 Msymbol/s PHY, `:L2M:` for LE uncoded 2 Msymbol/s PHY, and `:LCOD:` for LE coded 1 Msymbol/s PHY.

Parameters:

<TPhys> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure data packets" on page 214.

Options: R&S SMW-K117

Manual operation: See "TX PHYS/RX PHYS" on page 86

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RVECtor <RVector>, <BitCount>

Sets the random vector of the Central for device identification.

The parameter is an initialization vector provided by the Host in the HCI_ULP_Start_Encryption command.

Parameters:

<RVector> numeric
*RST: #H0

<BitCount> integer
Range: 64 to 64
*RST: 64

Example: `SOURce1:BB:BTO:ECON:PCON:RVEC #H0000000000000000,64`
Sets the random vector of the Central.

Manual operation: See "Random Vector(hex)" on page 82

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCACcuracy <ScAccuracy>

Defines the clock accuracy of the Central with specified encoding.

This parameter is used by the Peripheral to determine required listening windows in the LL connection. It is a controller design parameter known by the bluetooth controller.

Parameters:

<ScAccuracy> SCA0 | SCA1 | SCA2 | SCA3 | SCA4 | SCA5 | SCA6 | SCA7
*RST: SCA0

Example: `SOURce1:BB:BTO:ECON:PCON:SCAC SCA1`
Sets the encoding value.

Manual operation: See "Sleep Clock Accuracy" on page 79

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SLATency <SLatency>

Requires data event and advertising frame configuration with the packet type CONNECT_IND.

Sets the number of consecutive connection events the Peripheral can ignore for asymmetric link layer connections.

Parameters:

<SLatency> integer

Range: 0 to depends on LL connection timeout and connection event interval

*RST: depends on LL connection timeout and connection event interval

Example: `SOURce1:BB:BTO:UPTY CREQ`
Sets packet type CONNECT_IND.
`SOURce1:BB:BTO:ECON:PCON:SLAT 10`
Sets the number of consecutive connection events.

Manual operation: See "Peripheral Latency" on page 78

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SOUNits <Unit>

Indicates the units used by the "Sync Packet Offset" parameter, see

`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SPOFfset`

Parameters:

<Unit> U30 | U300

U30
30 µs

U300
300 µs

*RST: U30

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Offset Units" on page 74

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SPOFfset <SPOffset>

Specifies the time from the start of the AUX_ADV_IND packet containing the SyncInfo field to the start of the AUX_SYNC_IND packet. The offset is determined by multiplying the value by the unit, see

`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SOUNits`

Parameters:

<SPOffset> float

Range: 0 to 245.7 or 246 to 2457 depending on offset unit

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "Sync Packet Offset" on page 73

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SVNumber <SvNumber>, <BitCount>

Sets a unique value for each implementation or revision of an implementation of the Bluetooth Controller. A 16-bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type:

LL_VERSION_IND.

Parameters:

<SvNumber> numeric

*RST: 0

<BitCount> integer

Range: 16 to 16
*RST: 16

Example: `SOURce1:BB:BTO:ECON:PCON:SVN #H0000,16`
Sets the sub version number.

Manual operation: See "SubVersion Number(hex)" on page 84

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TPOWer <TPower>

Sets the required transmit power to be signaled within an extended header.

Parameters:

<TPower> integer

Range: -127 to 126
*RST: 0

Example: See Example"To configure advertising packets" on page 211.

Options: R&S SMW-K117

Manual operation: See "TxPow(dBm)" on page 69

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:UTYPe <UType>, <BitCount>

Enables that an invalid control packet is indicated.

The CtrType field indicates the value of the LL control packet that caused the transmission of this packet.

Parameters:

<UType> numeric
*RST: #H0

<BitCount> integer
Range: 8 to 8
*RST: 8

Example: `SOURce1:BB:BTO:ECON:PCON:UTYP #H00,8`
Enables that an invalid control packet is indicated.

Manual operation: See "Unknown Type(hex)" on page 83

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:VNUMber <VNumber>, <BitCount>

Sets the company identifier of the manufacturer of the Bluetooth controller. An 8-bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type LL_VERSION_IND.

Parameters:

<VNumber> numeric
*RST: 0

<BitCount> integer
Range: 8 to 8
*RST: 8

Example: `SOURce1:BB:BTO:ECON:PCON:VNUM #H00,8`
Sets the version number.

Manual operation: See "Version Number(hex)" on page 83

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WOFFset <WOffset>

Sets the start point of the window transmit for data event and advertising frame configuration with the packet type CONNECT_IND.

Command sets the values in ms. Query returns values in s.

Parameters:

<WOffset> float

Range: 0 s to depending on connection event interval
Increment: 1.25E-3 s
*RST: 0 s
Default unit: ms

Example: See Example"Configure event and frame configuration settings" on page 180.

Manual operation: See "Transmit Window Offset" on page 54
See "Transmit Window Offset" on page 77

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WSIZe <WSize>

Sets the size of the transmit window, regarding to the start point for data event and advertising frame configuration with the packet type CONNECT_IND.

Parameters:

<WSize> float

Range: 1.25E-3 to depends on connection event interval
Increment: 1.25E-3
*RST: 1.25E-3

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Transmit Window Size" on page 77

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ATYPe <AType>

Sets the address type in the payload of Bluetooth LE LL_PERIODIC_SYNC_IND packets.

Parameters:

<AType> PUBLic | RANDom

*RST: PUBLic

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Address Type" on page 88

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CECount <CECount>

Specifies the connection event count in the CtrData field of the LL_PERIODIC_SYNC_IND control data PDU.

Parameters:

<CECount> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Connection Event Count" on page 87

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ID <Id>, <BitCount>

Specifies the ID in the CtrData field of the LL_PERIODIC_SYNC_IND PDU.

Parameters:

<Id> numeric

*RST: #HAAAA

<BitCount> integer

Range: 16 to 16
*RST: 16

Example: See Example"To configure data packets" on page 214.

Manual operation: See "ID(hex)" on page 87

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:LPECounter <LPECounter>

Specifies the lastPaEventCounter field in the CtrData field of the LL_PERIODIC_SYNC_IND PDU.

Parameters:

<LPECounter> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Last Pa Event Counter" on page 88

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MCLReq <MCLReq>

Specifies the minimum CTE length in the CtrData field of the LL_CTE_Req PDU.

Parameters:

<MCLReq> float

Range: 16E-6 to 160E-6
Increment: 8E-6
*RST: 16E-6

Example: See Example"To configure data packets" on page 214.

Manual operation: See "MinCTELenReq" on page 89
See "CTETypeReq" on page 89

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L1M:STATe <State>

Sets the LE 1M PHY in the CtrData field of the LL_PERIODIC_SYNC_IND PDU.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "PHY" on page 88

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:L2M:STATe <State>

Sets the LE 2M PHY in the CtrData field of the LL_PERIODIC_SYNC_IND PDU.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "PHY" on page 88

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:PHY:LCOD:STATe <State>

Sets the LE Coded PHY in the CtrData field of the LL_PERIODIC_SYNC_IND PDU.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "PHY" on page 88

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCECounter <SCECounter>

Parameters:

<SCECounter> integer
Range: 0 to 65535
*RST: 0

Example: See Example"To configure data packets" on page 214.

Manual operation: See "Sync Connection Event Counter" on page 89

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SID <Sid>, <BitCount>

Specifies the SID in the CtrData field of the LL_PERIODIC_SYNC_IND.

Parameters:

<Sid> numeric

*RST: #H0

<BitCount> integer

Range: 4 to 4
*RST: 4

Example: See Example"To configure data packets" on page 214.

Manual operation: See "SID(hex)" on page 88

8.6.4 Cs payload configuration

Example: To configure CS control PDUs

```
// ****************************************************************************
// Configure settings of an LE uncoded PHY test packet.
// ****************************************************************************
// Set for a data channel test packet in the LE uncoded PHY.
:SOURce1:BB:BTOoth:CTYPe  CS
:SOURce1:BB:BTOoth:UPTYpe CCRQ
// Sets for an LL_CS_CAPABILITIES_REQ control PDU.
:SOURce1:BB:BTOoth:PFORmat L2M

// ****************************************************************************
// Configure and check LL_CS_CONFIG_REQ PDU settings.
// ****************************************************************************
:SOURce1:BB:BTOoth:CS:CDATa:CID 1
// The Config_ID is one.
:SOURce1:BB:BTOoth:CS:CMRepetition 1
// Sets one cycle of the ChM field for non-Mode-0 steps within the CS procedure.
:SOURce1:BB:BTOoth:CS:CDATa:MMODe MODE1
// The main mode is Mode-1.
:SOURce1:BB:BTOoth:CS:CDATa:MMRepetition 0
// The main mode repetition bit is zero.
:SOURce1:BB:BTOoth:CS:CDATa:MMISteps 2
// The minimum number of main mode steps is two.
:SOURce1:BB:BTOoth:CS:CDATa:MMASteps 2
// The maximum number of main mode steps is two.
// Enable the companion signal.
:SOURce1:BB:BTOoth:CS:CDATa:MZSTeps 1
// There is one Mode-0 step.
:SOURce1:BB:BTOoth:CS:CDATA:CSIGnal 1
:SOURce1:BB:BTOoth:CS:CDATA:RFU 0
```

```
// ****************************************************************************
// Configure and check LL_CS_CAPABILITIES_REQ PDU settings.
// ****************************************************************************
:SOURce1:BB:BTOoth:CS:CDATA:CSPCapability?
// Response: "LE2M"
// The PHY is LE 2M.
:SOURce1:BB:BTOoth:CS:CDATa:MAPath 1
:SOURce1:BB:BTOoth:CS:CDATa:MPSupported 1
:SOURce1:BB:BTOoth:CS:CDATa:MTYPe?
// Response: "MODE3"
// The mode type is Mode-3.
:SOURce1:BB:BTOoth:CS:CDATa:NANT?
// Response: "1"
// The number of antenna elements is 1.
:SOURce1:BB:BTOoth:CS:CDATa:NCONfig?
// Response: "1"
// There is one unique Cs configuration. You can have up to four independent
// Cs configurations.
:SOURce1:BB:BTOoth:CS:CDATa:NFAE 1
// The transmitting LE device only supports an FAE of zero.
:SOURce1:BB:BTOoth:CS:CDATa:SPEStimate?
// Response: "0"
// The device does not support PCT estimates from a sounding sequence.
:SOURce1:BB:BTOoth:CS:CDATa:TSW TSW_1
// The duration of the antenna switch period is one microsecond.

// Configure timing capabilities.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition0:TIPO:CAPabitility 1
// Enables the T_IP1 capability for bit position 0. The T_IP1 time is 10 microseconds.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition1:TIPO:CAPabitility?
// Response: "0"
// The T_IP1 capability for bit position 1 is disabled.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition0:TIPT:CAPabitility 1
// Enables the T_IP2 capability for bit position 0. The T_IP2 time is 10 microseconds.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition1:TIPT:CAPabitility?
// Response: "0"
// The T_IP2 capability for bit position 1 is disabled.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition0:TFCAPabitility 1
// Enables the T_FCS capability for bit position 0. The T_FCS time is 15 microseconds.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition1:TFCAPabitility?
// Response: "0"
// The T_FCS capability for bit position 1 is disabled.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition0:TPCAPabitility 1
// Enables the T_PM capability for bit position 0. The T_PM time is 10 microseconds.
:SOURce1:BB:BTOoth:CS:CDATa:BPOSition1:TPCAPabitility?
// Response: "0"
// The T_PM capability for bit position 1 is disabled.

// ****************************************************************************
// Configure and check LL_CS_TERMINATE_IND PDU settings.
```

```
// ****************************************************************************
:SOURce1:BB:BTOoth:CS:CDATa:ECODe #HFF,8
// Sets the error code "FF" in hexadecimal representation.

// ****************************************************************************
// Configure and check LL_CS_IND PDU settings.
// ****************************************************************************
:SOURce1:BB:BTOoth:CS:CDATa:EOFFset 500
// Sets an event offset of 500 microseconds.

// ****************************************************************************
// Configure and check LL_CS_REQ PDU settings.
// ****************************************************************************
:SOURce1:BB:BTOoth:CS:CDATa:MPLength 2.5
// The maximum procedure length is 2.5 milliseconds.
```

Commands:

[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TFCapability <TfcsCapability>

Enables the T_FCS capability including the T_FCS time per bit position.

Suffix:

BPOSition<ch0> — 0 to 9
Bit position (optional suffix)

Parameters:

<TfcsCapability> — 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_FCS_Capability Table" on page 118

[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TIPO:CAPability <TIOCapability>

Enables the T_IP1 capability including the T_IP1 time per bit position.

See also `[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MZERo:TIPO` on page 198.

Suffix:

BPOSition<ch0> — 0 to 7
Bit position (optional suffix)

Parameters:

<TIOCapability> — 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_IP1_Capability Table" on page 117

[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TIPT:CAPability <TITCapability>

Enables the T_IP2 capability including the T_IP2 time per bit position.

Suffix:

BPOSition<ch0> 0 to 7
Bit position (optional suffix)

Parameters:

<TITCapability> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_IP2_Capability Table" on page 118

[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:BPOSition<ch0>]:TPCapability <TpmCapability>

Enables the T_PM capability including the T_PM time per bit position.

Suffix:

BPOSition<ch0> 0 to 2
Bit position (optional suffix)

Parameters:

<TpmCapability> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_PM_Capability Table" on page 119

[:SOURce<hw>]:BB:BTOoth:CS:CDATa[:CHANnel<ch0>]:CFAE <ChFae>

Sets the value of the fractional frequency offset actuation error (FAE) value per channel.

Suffix:

CHANnel<ch0> 0 to 71
Channel number (optional suffix)

Parameters:

<ChFae> integer
Range: -128 to 127
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Channel FAE Table" on page 129

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:ACI <ACI>

Sets the antenna configuration index (ACI) field. The value has a length of 1 octet or 0 to 7 in decimal representation.

Parameters:

<ACI> ACI0 | ACI1 | ACI2 | ACI3 | ACI4 | ACI5 | ACI6 | ACI7

*RST: ACI0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "ACI" on page 125
See "ACI" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CECount <ConnEventCount>

Sets the 16-bit connEventCount field bits in hexadecimal representation.

Parameters:

<ConnEventCount> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "connEventCount" on page 123
See "connEventCount" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CCID:STATe <State>

Enables the CS configuration ID. Set this ID with the following command:

`[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CID` on page 256

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "State" on page 119

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CID <ConfigId>

Sets the 6-bit Config_ID field that is the CS configuration ID. Settable ID values are 2 bits in decimal representation. All other values are for future use.

Parameters:

<ConfigId> integer

Range: 0 to 3
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Config_ID" on page 119

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSAThreec <CsaThreec>

Enables the channel selection algorithm #3c.

Parameters:

<CsaThreec> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Channel Selection Algorithm #3c" on page 116

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSIGnal <CompanionSignal>

Enables the companion signal.

See also "Companion Signal" on page 110.

Parameters:

<CompanionSignal> 1 | ON | 0 | OFF
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Companion_Signal" on page 116

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:ECODe <ECode>, <BitCount>

Sets an 8-bit error code. For an LL_CS_TERMINATE_IND packet, informs the remote device about the termination of the connection.

Parameters:

<ECode> numeric
*RST: #H00

<BitCount> integer
Range: 8 to 8
*RST: 8

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Error Code(hex)" on page 128

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:EOFFset <EventOffset>

Sets the time value of the Offset field. The value has a length of three octets or 9 bits.

Parameters:

<EventOffset> integer
Range: 500 to 4e6
*RST: 500

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Offset" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MAPath <MaxAntPath>

Sets the maximum Num_Ant paths.

Parameters:

<MaxAntPath> integer

Range: 1 to 4
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Max_Ant_Path" on page 115

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMASteps <MMMaxSteps>

Sets the maximum number of main mode steps.

Parameters:

<MMMaxSteps> integer

Range: 2 to 255
*RST: 2

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Main_Mode_Max_Steps" on page 120

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMISteps <MMMinSteps>

Sets the minimum number of main mode steps.

Parameters:

<MMMinSteps> integer

Range: 2 to 255
*RST: 2

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Main_Mode_Min_Steps" on page 120

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMODe <MainMode>

Sets the main mode of the CS LL Control PDU.

For an overview on available submodes per main mode, see Table 5-8.

Parameters:

<MainMode> MODE1 | MODE2 | MODE3

For a description, see `[:SOURce<hw>]:BB:BTOoth:CS[:SEVent<ch0>]:MMODe` on page 196.

*RST: MODE1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Main_Mode" on page 120

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MMRepetition <MMRepetition>

Sets the main mode repetition.

Parameters:

<MMRepetition> integer

Range: 0 to 3
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Main_Mode_Repetition" on page 120

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MPLength <MPLength>

Sets the time value of the Max_Procedure_Len field. The value has a length of two octets or 6 bits.

Parameters:

<MPLength> float

Range: 2.5 to 40959375
Increment: 0.001
*RST: 2.5

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Max_Procedure_Len" on page 124

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MPSupported <MPSupported>

Sets the bits of the Max_Procedures_Supported field.

Parameters:

<MPSupported> integer

Range: 0 to 4
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Max_Procedures_Supported" on page 117

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MTYPe?

Queries the CS LL control packet mode type that is Mode-3.

Return values:

<ModeType> MODE3

*RST: MODE3

Example: See Example"To configure CS control PDUs" on page 251.

Usage: Query only

Manual operation: See "Mode_Types" on page 114

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:MZSTeps <Mode0Steps>

Sets the number of Mode-0 steps.

Parameters:

<Mode0Steps> integer

Range: 1 to 3
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Mode_0_Steps" on page 120

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NANT <NumAnt>

Sets the bits of the Num_Ant field. This field indicates the number of antenna elements of the channel sounding device.

Parameters:

<NumAnt> integer

Range: 1 to 4
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Num_Ant" on page 115

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NCONfig <NumConfig>

Sets the Num_Configs field that relates to the number of independent CS configurations.

Parameters:

<NumConfig> integer

Range: 1 to 4
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Num_Configs" on page 117

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NFAE <NoFae>

Sets the No_FAE bit. This bit indicates if the transmitting LE device supports a fractional frequency offset actuation error (FAE) or not.

Parameters:

<NoFae> 1 | ON | 0 | OFF

1|ON
The transmitting LE device only supports an FAE of zero.

0|OFF
The transmitting LE device supports FAE values as listed in an FAE table.

*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "No_FAE" on page 116

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NRSCapability <NRSCapability>

Sets the NADM random sequence capability.

Parameters:

<NRSCapability> NONADM | NADM

NONADM
NADM disabled

NADM
NADM enabled

*RST: NONADM

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "NADM_Random_Sequence_Capability" on page 115

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:NSCapability <NSCapability>

Sets the NADM sounding sequence capability.

Parameters:

<NSCapability> NONADM | NADM

NONADM
NADM disabled

NADM
NADM enabled

*RST: NONADM

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "NADM_Sounding_Capability" on page 115

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:OMAX <OffsetMax>

Sets the time value of the Offset_Max field. The value has a length of 3 octets or 9 bits.

Parameters:

<OffsetMax> integer

Range: 500 to 16777215
*RST: 500

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Offset_Max" on page 124

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:OMIN <OffsetMin>

Sets the time value of the Offset_Min field. The value has a length of 3 octets or 9 bits.

Parameters:

<OffsetMin> integer

Range: 500 to 4e6
*RST: 500

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Offset_Min" on page 123

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PCOunt <ProcCount>

Sets the bits in the Procedure_Count field. The value has a length of 2 octets.

Parameters:

<ProcCount> integer

Range: 1 to 65535
*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Procedure_Count" on page 125

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PDELta <PwrDelta>

Sets the bits in the Pwr_Delta field. The value has a length of 1 octets or 3 bits.

Parameters:

<PwrDelta> integer

Range: 0 to 255
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Pwr_Delta" on page 126
See "Pwr_Delta" on page 128

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PHY?

Queries the PHY field value.

This value indicates the TX PHY of the remote device to which the Pwr_Delta field in this PDU applies.

Return values:

<Phy> L1M | L2M | LCOD | L2M2B

For a description, see `[:SOURce<hw>]:BB:BTOoth:PFORmat` on page 177.

*RST: L1M

Example: See Example"To configure CS control PDUs" on page 251.

Usage: Query only

Manual operation: See "PHY" on page 120
See "PHY" on page 125

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PINTerval <ProcInterval>

Sets the procedure interval in the Procedure_Interval field. The value has a length of two octets or 6 bits.

Parameters:

<ProcInterval> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Procedure_Interval" on page 125

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:PPANtenna <PPAntenna>

Sets the bits in the Preferred_Peer_Ant field. The value has a length of one octet or 3 bits.

The table Table 5-11 lists all possible values and their meaning.

Parameters:

<PPAntenna> ANT0 | ANT1 | ANT2 | ANT3

*RST: ANT0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Preferred_Peer_Ant" on page 125

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RAONly <RttAaOnly>

Queries or sets the time values of the RTT_AA_Only_N field.

Setting the value depends on the bits of the RTT_Capability field via the command:

`:SOURce1:BB:BTOoth:CS:CDATa:RCAPability`

See also the table Table 5-9 for an overview.

Parameters:

<RttAaOnly> AR150 | AR10 | AR0

*RST: AR150

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "RTT_AA_Only" on page 114

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RCAPability <RttCapability>

Sets the bits in the RTT_Capability field.

These bits determine the time values for the RTT_AA_Only_N field, the RTT_Sounding_ N field and the RTT_Random_Sequence_N field.

Parameters:

<RttCapability> CAP0 | CAP1 | CAP2

See the table Table 5-9 for an overview.

*RST: CAP0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "RTT_Capability" on page 114

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RFU <RFU>

Sets the bits that are reserved for future use (RFU).

The number of RFU bits can vary depending on the CS_Control_Data PDU.

Parameters:

<RFU> integer

Range: 0 to 3
*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "RFU" on page 117

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RTYPe <RttType>

Sets the RTT type determined by the 4-bit RTT_Type field. This field indicates the round trip time (RTT) variant within the CS procedure.

Parameters:

RttType RAAOT | R32SS | R96SS | R32RS | R64RS | R96RS | R128RS

For a description, see the table Table 5-10.

*RST: RAAOT

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "RTT_Type" on page 121

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TFCS <TFcs>

Sets the frequency change period (T_FCS) between consecutive CS steps. The period ranges from 15 µs to 150 µs.

Parameters:

<TFcs> TFCS_15 | TFCS_20 | TFCS_30 | TFCS_40 | TFCS_50 | TFCS_60 | TFCS_80 | TFCS_100 | TFCS_120 | TFCS_150

TFCS_x, x represents values in microseconds.

*RST: TFCS_150

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_FCS" on page 122

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TIONe <TipOne>

Sets the time "T_IP1" in microseconds.

Parameters:

<TipOne> TIP1_10 | TIP1_20 | TIP1_30 | TIP1_40 | TIP1_50 | TIP1_60 | TIP1_80 | TIP1_145

TP1_x, x represents values in microseconds.

*RST: TIP1_145

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_IP1" on page 122

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TITWo <TipTwo>

Sets the time "T_IP2" in microseconds.

Parameters:

<TipTwo> TIP2_10 | TIP2_20 | TIP2_30 | TIP2_40 | TIP2_50 | TIP2_60 | TIP2_80 | TIP2_145

TIP2_x, x represents values in microseconds.

*RST: TIP2_145

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_IP2" on page 122

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TPM <TPM>

Sets the time "T_PM" in microseconds.

Parameters:

<TPM> TPM_10 | TPM_20 | TPM_40 | TPM_652

TPM_x, x represents values in microseconds.

*RST: TPM_40

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_PM" on page 122

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:TSW <Tsw>

Sets the T_SW field values that relate to the duration of the antenna switch period.

The local controller uses this period when switching antennas during active transmissions.

Parameters:

<Tsw> TSW_0 | TSW_1 | TSW_2 | TSW_4 | TSW_10

Duration of the antenna switch period is 0, 1, 2, 4 or 10 microseconds.

*RST: n.a. (no preset. default: TSW_0)

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "T_SW" on page 117

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RRSequence <RRSequence>

Queries or sets the time values of the RTT_Random_Sequence_N field.

Setting the value depends on the bits of the RTT_Capability field via the command:

`:SOURce1:BB:BTOoth:CS:CDATa:RCAPability`

See also the table Table 5-9 for an overview.

Parameters:

<RRSequence> AR150 | AR10 | AR0

*RST: AR150

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "RTT_Random_Sequence_N" on page 115

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:RSOunding <RSOunding>

Queries or sets the time values of the RTT_Sounding_N field.

Setting the value depends on the bits of the RTT_Capability field via the command:

`:SOURce1:BB:BTOoth:CS:CDATa:RCAPability`

See also the table Table 5-9 for an overview.

Parameters:

<RSOunding> AR150 | AR10 | AR0

*RST: AR150

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "RTT_Sounding_N" on page 115

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SINTerval <SubInterval>

Sets or queries the subevent interval.

Setting requires `BB:BTOoth:CS:SNUMber 2` or higher. Query is for `BB:BTOoth:CS:SNUMber 1`.

See `[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SNUMber` on page 267.

Parameters:

<SubInterval> integer

Range: 0 to 2.7e11

*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Subevent_Interval" on page 124
See "Subevent_Interval" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SLENgth <SubLength>

Sets the subevent length in the Subevent_Len field. The value has a length of three octets or 9 bits.

Parameters:

<SubLength> integer

Range: 1250 to 4e6

*RST: 1250

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Subevent_Len" on page 125
See "Subevent_Len" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SNUMber <SubNumber>

Sets the number of subevents per event.

Parameters:

<SubNumber> integer

Range: 1 to 32

*RST: 1

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Subevent_Per_Event" on page 124
See "Subevents_Per_Event" on page 127

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SPEStimate <SPEstimate>

Sets the Sounding_PCT_Estimate bit. This bit indicates if the device supports phase correction term (PCT) estimates from a sounding sequence or not.

Parameters:

<SPEstimate> 1 | ON | 0 | OFF

1|ON
The Sounding_PCT_Estimate bit is 1. The device supports PCT estimates from a sounding sequence.

0|OFF
The Sounding_PCT_Estimate bit is 0. The device does not support PCT estimates from a sounding sequence.

*RST: 0

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Sounding_PCT_Estimate" on page 116

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:SMODe <SubMode>

Sets the submode of the main mode.

Parameters:

<SubMode> MODE1 | MODE2 | MODE3 | NONE

See the table Table 5-8 for an overview on available submodes per main mode.

*RST: NONE

Example: See Example"To configure CS control PDUs" on page 251.

Manual operation: See "Sub_Mode" on page 120

[:SOURce<hw>]:BB:BTOoth:CS:CDATa:CSPCapability?

Queries the value of the CS_SYNC_PHY_Capability field that is the LE 2M PHY.

Return values:

<SyncPhy> LE2M

*RST: LE2M

Example: See Example"To configure CS control PDUs" on page 251.

Usage: Query only

Manual operation: See "CS_SYNC_PHY_Capability" on page 115

8.7 Test packet configuration commands - LE

Example: To configure test packets

```
// ****************************************************************************
// Configure settings of an LE uncoded PHY test packet.
// ****************************************************************************
// Set for a data channel test packet in the LE uncoded PHY.
SOURce1:BB:BTOoth:CTYPe DATA
SOURce1:BB:BTOoth:UPTYpe TPAC
SOURce1:BB:BTOoth:PFORmat L1M

// Configure packet interval and header settings.
SOURce1:BB:BTOoth:DTTest:TPConfiguration:TPINterval 12.5
// Sets a test packet interval of 12.5 ms.
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:CPResent 0
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SWORd SW
// Fixed sync word value of 0x94826E8E.
// Alternatively, set a user-defined sync word.
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SWORd UPAT
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:USER FFFFFFFFF
// Sync word is 0xFFFFFFFFF.

// Configure payload settings.
SOURce1:BB:BTOoth:DTTest:TPConfiguration:UPSource PAT3
// Sets a fixed pattern 11111111 as payload.
SOURce1:BB:BTOoth:DTTest:TPConfiguration:UPLength 255
// Sets a payload length of 255 bytes.

// ****************************************************************************
// Also, configure LE coded PHY test packet settings.
// ****************************************************************************
SOURce1:BB:BTOoth:PFORmat LCOD
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SPBit TWO
// Sets 2 symbols per bit for forward erroc correction coding.
```


[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SPBit <SPB>

Specifies a coding for LE coded packets. The specification for Bluetooth wireless technology defines two values S for forward error correction: S = 2 symbol/bit and S = 8 symbol/bit.

Parameters:

<SPB> TWO | EIGHt

*RST: TWO

Example: See Example"To configure test packets" on page 269.

Options: R&S SMW-K117

Manual operation: See "Symbols per a Bit" on page 130

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SYNCword <syncWord>

Sets the 32-bit Sync Word in the packet header field in hexadecimal representation.

Parameters:

<syncWord> SW | UPAT

SW
Fixed value of 0x94826E8E.

UPAT
User-defined pattern allowing 8-digit hexadecimal input via the following command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:USERpatt` on page 270

*RST: SW

Example: See Example"To configure test packets" on page 269.

Manual operation: See "Sync Word" on page 131

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:USERpatt <userPatt>, <BitCount>

Sets a user-defined pattern of the 32-bit Sync Word.

Using this Sync Word requires the following setting:

```
SOURce1:BB:BTOoth:ECONfiguration:PCONfiguration:SYNCword UPAT
```

Parameters:

<userPatt> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 32
*RST: 1

Example: See Example"To configure test packets" on page 269.

Manual operation: See "User Pattern(hex)" on page 131

[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:TPINterval <TpInterval>

Sets the time interval between two consecutive test packets, regarding the starting points.

Command sets the values in ms. Query returns values in s.

Parameters:

<TpInterval> float

Range: 0.625E-3 s to 27.5E-3 s - depends on packet characteristics
Increment: 0.625E-3 s
*RST: 0.625E-3 s
Default unit: ms

Example: See Example"To configure test packets" on page 269.

Manual operation: See "Packet Interval" on page 130

[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPLength <UpLength>

Sets the payload length.

Parameters:

<UpLength> integer

Range: 0 to 255
*RST: 37

Example: See Example"To configure test packets" on page 269.

Manual operation: See "Payload Length" on page 132

[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPSource <UpSource>

Selects the data source used for the payload test packets.

Parameters:

<UpSource> PN09 | PAT1 | PAT2 | PN15 | PAT3 | PAT4 | PAT5 | PAT6 | DLIS

PN9|PN15
Pseudo random bit sequences (PRBS) with length in bits. The length can be 9 bits or 15 bits.

PAT1
Predefined pattern: 11110000

PAT2
Predefined pattern: 10101010

PAT3
Predefined pattern: 11111111

PAT4
Predefined pattern: 00000000

PAT5
Predefined pattern: 00001111

PAT6
Predefined pattern: 01010101

DLISt
Binary data from data lists as a data source. Set the data list file via the following command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DSELection on page 232

*RST: PN09

Example: See Example"To configure test packets" on page 269.

Manual operation: See "Payload Type" on page 131

8.8 Channel configuration commands - BR/EDR

[:SOURce<hw>]:BB:BTOoth:PTYPe <PType>

The available packets depend on the selected transport mode. All packet types as defined in the Bluetooth specifications are supported.

Parameters:

<PType> ID | NULL | POLL | FHS | DM1 | DH1 | DM3 | DH3 | DM5 | DH5 | AUX1 | ADH1 | ADH3 | ADH5 | AEDH1 | AEDH3 | AEDH5 | HV1 | HV2 | HV3 | DV | EV3 | EV4 | EV5 | EEV3 | EEV5 | EEEV3 | EEEV5

*RST: DH1

Example: `BB:BTO:PTYP NULL`
Sets a null packet.

Manual operation: See "Packet Type" on page 134

[:SOURce<hw>]:BB:BTOoth:SLENgth <SLength>

Sets the sequence length of the Bluetooth signal in number of frames. This signal is calculated in advance and output in the arbitrary waveform generator.

Parameters:

<SLength> integer

Range: depends on the number of states in dirty transmitter test to dynamic

*RST: 1

Example: `BB:BTO:SLEN 10`
sets the sequence length to 10 frames.

Manual operation: See "Sequence Length" on page 134

[:SOURce<hw>]:BB:BTOoth:STIMing <SlotTiming>

Selects the Rx slot timing mode.

Parameters:

<SlotTiming> TX | LOOPback

*RST: TX

Example:
`BB:BTO:PTYP DH3`
sets the packet type.
`BB:BTO:STIM LOOP`
selects loopback test mode.

Manual operation: See "Slot Timing" on page 134

8.9 Packet configuration commands - BR/EDR

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:ACKNowledgement <Acknowledgement>

Sets the ARQN bit of the packet header..

Parameters:

<Acknowledgement> NAK | ACK

NAK
Request to retransmit the previous payload.

ACK
Previous payload has been received successfully.

*RST: ACK

Example:

`BB:BTO:PTYP DH1`
selects the packet type DH1.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:ACKN ACK`
sets positive acknowledgement

Manual operation: See "Acknowledgment" on page 138

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDALap <BdaLap>, <BitCount>

Sets the lower address part of Bluetooth Device Address. The length of LAP is 24 bits or 6 hexadecimal figures.

Parameters:

<BdaLap> numeric

Range: #H000000 to #HFFFFFF
*RST: 80

<BitCount> integer

Range: 8 to 24
*RST: 24

Example:

`BB:BTO:PCON:BDAL #H000000,24`
Sets the lower address part.

Manual operation: See "Bluetooth Device Address (BD_ADDR)" on page 137

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDANap <BdaNap>, <BitCount>

Enters the non-significant address part of Bluetooth Device Address. The length of NAP is 16 bits or 4 hexadecimal figures.

Parameters:

<BdaNap> numeric

Range: #H0000 to #HFFFF
*RST: ABCD

<BitCount> integer

Range: 16 to 16
*RST: 16

Example: `BB:BTO:PCON:BDAN #H0000,16`
Sets the non-significant address part.

Manual operation: See "Bluetooth Device Address (BD_ADDR)" on page 137

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDAUap <BdaUap>, <BitCount>

Enters the upper address part of Bluetooth Device Address. The length of UAP is 8 bits or 2 hexadecimal figures.

Parameters:

<BdaUap> numeric

Range: #H00 to #HFF
Increment: 1
*RST: 48

<BitCount> integer

Range: 8 to 8
*RST: 8

Example: `BB:BTO:PCON:BDAN #H00,8`
Sets the non-significant address part.

Manual operation: See "Bluetooth Device Address (BD_ADDR)" on page 137

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:CODevice <CoDevice>, <BitCount>

A parameter received during the device discovery procedure, indicates the type of device and which types of service that are supported.

Parameters:

<CoDevice> numeric

Range: #H000000 to #HFFFFFF
*RST: #H0

<BitCount> integer

Range: 24 to 24
*RST: 24

Example: `BB:BTO:PTYP FHS`
Sets the packet type.
`BB:BTO:PCON:DSFP PED`
Enables the packet editor under data source for the packet.
`BB:BTO:PCON:COD #H020104,24`
Sets the class of device.

Manual operation: See "Class of Device" on page 140

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA <Data>

Selects the data source used for the payload.

Parameters:

<Data> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

*RST: PN09

Example:
`BB:BTO:PTYP FHS`
sets the packet type
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:DATA ALL1`
sets the data type.

Manual operation: See "Data Source" on page 138

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DPATtern <DPattern>, <BitCount>

Selects the data for a pattern.

Parameters:

<DPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example:
`BB:BTO:PCON:DATA PATT`
Sets the data type.
`BB:BTO:PCON:DATA:DPAT #B010101,6`
Selects the data for a pattern with the length of 6 bits.

Manual operation: See "Data Source" on page 138

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DSELection <DSelection>

The command selects data list file.

Parameters:

<DSelection> string

Increment: 1

Example:
`BB:BTO:PCON:DATA DLIS`
selects the data type.
`BB:BTO:PCON:DSEL bluetooth_1`
selects the file for the data.

Manual operation: See "Data Source" on page 138

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDPAttern <VdPattern>, <BitCount>

Sets the bit pattern for the voice data.

Parameters:

<VdPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

Example: `BB:BTO:PCON:DATA:PATT`
Selects the data type.
`BB:BTO:PCON:DATA:VDPA #B010101,6`
Selects the bit pattern for the voice data with the length of 24 bits.

Manual operation: See "Data Source (Voice Field)" on page 140

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDSElection <VdSelection>

Selects the data list for voice data.

Parameters:

<VdSelection> string

Example: `BB:BTO:PCON:VDAT DLIS`
selects the data type.
`BB:BTO:PCON:VDSE bluetooth_1`
selects the file for the data.

Manual operation: See "Data Source (Voice Field)" on page 140

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DLENgth <DLength>

Sets the payload data length in bytes.

Parameters:

<DLength> integer

Range: 0 to depends on packet type
Increment: 1
*RST: depends on packet type

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:DLEN 25`
sets the data length.

Manual operation: See "Data Length" on page 139

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DSFPacket <DsfPacket>

Selects the data source for the selected packet type.

Parameters:

<DsfPacket> PEDit | ADATa

PED
Enables the "Packet Editor". All packet fields can be configured individually.

ADAT
Fills the generated packets with the selected data source. Useful if predefined data contents are loaded with a data list file or the data contents of the packet are not of interest.

*RST: PEDit

Example: `BB:BTO:PCON:DSFP PED`
enables packet editor under data source for packet.

Manual operation: See "Data Source for Packet" on page 136

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DWHitening <DWhitening>

Activates the "Data Whitening".

Parameters:

<DWhitening> 1 | ON | 0 | OFF

*RST: 0

Example: `BB:BTO:PCON:DWH ON`
activates data whitening.

Manual operation: See "Data Whitening" on page 136

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:EIRPacketfollows <EirPacketFollow>

Indicates that an extended inquiry response packet can follow.

Parameters:

<EirPacketFollow> YES | NO

YES
Indicates that EIR packet follows.

NO
Indicates that EIR packet does not follow.

*RST: NO

Example: `BB:BTO:PCON:PTYP FHS`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enables the packet editor under data source for the packet
`BB:BTO:PCON:EIRP YES`
the EIR packet follows.

Manual operation: See "EIR packet follows" on page 139

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:HFControl <HfControl>

The command sets the FLOW bit in the header. This bit indicates start or stop of transmission of packets over the ACL logical transport.

Parameters:

<HfControl> GO | STOP

GO
Allows the other devices to transmit new data.

STOP
Stops the other devices from transmitting data temporarily.

*RST: GO

Example:
`BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet.
`BB:BTO:PCON:HFC GO`
allows the other devices to transmit new data.

Manual operation: See "Flow Control" on page 137

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:LFSWord <LapForSW>, <BitCount>

Sets the lower address part (LAP) of the sync word for FHS packets. The length of LAP is 24 bits or 6 hexadecimal figures.

Parameters:

<LapForSW> numeric

Range: #H000000 to #HFFFFFF
*RST: #H000080

<BitCount> integer

Range: 8 to 24
*RST: 24

Example:
`BB:BTO:PCON:LFSW #H000080,24`

Sets the lower address part.

Manual operation: See "LAP for Sync Word" on page 136

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:LTADdress <LtAddress>

The command enters the logical transport address for the header. Each Peripheral active in a piconet is assigned a primary logical transport address (LT_ADDR). The all-zero LT_ADDR is reserved for broadcast messages.

Parameters:

<LtAddress> integer

Range: 0 to 7
Increment: 1
*RST: 0

Example:

`BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:LTAD 0`
sets the logical transport address equal zero.

Manual operation: See "Logical Transport Address" on page 137

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PFControl <PfControl>

The command sets the FLOW bit in the payload (flow control per logical link).

Parameters:

<PfControl> GO | STOP

GO
Indicates the start of transmission of ACL packets after a new connection has been established.

STOP
Indicates the stop of transmission of ACL packets before an additional amount of payload data is sent.

*RST: GO

Example:

`BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:PFC GO`
allows the flow per logical link.

Manual operation: See "Flow Control" on page 139

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PLENgth <PLength>

Sets the packet length in symbols.

Parameters:

<PLength> integer

Range: 1 to depends on packet type
Increment: 1
*RST: depends on packet type

Example: `BB:BTO:PCON:DSFP ADAT`
fills the all data under data source for packet.
`BB:BTO:PCON:PLEN 1`
sets the packet length.

Manual operation: See "Packet Length" on page 142

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SLAP <State>

Activates synchronization of the lower address part (LAP) of the sync word and Bluetooth device address.

Parameters:

<State> 1 | ON | 0 | OFF
*RST: 1

Example: `BB:BTO:PCON:SLAP 0`
deactivates LAP synchronization.
`BB:BTO:PCON:LFSW #H000080,24`
sets LAP of the sync word separately.

Manual operation: See "Synchronize LAP with BD_ADDR" on page 136

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SNSValue <SnSvalue>

Sets the start value of the header SEQN bit. The SEQN bit is present in the header to filter out retransmissions in the destination. The signal generator is altering this bit automatically on consecutive frames, if a sequence length of at least 2 frames is set.

Parameters:

<SnSvalue> integer
Range: 0 to 1
*RST: 1

Example: `BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enables packet editor under data source for packet.
`BB:BTO:PCON:SNSV ONE`
sets the SEQN bit of the first CRC data packet at the start of a connection.

Manual operation: See "SEQN Start Value" on page 138

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SRMode <SrMode>

The command indicates the interval between two consecutive page scan windows, determines the behavior of the paging device.

Parameters:

<SrMode> R0 | R1 | R2

R0
The scan interval is equal to the scan window T w page scan (continuous nscan) and maximal 1.28s.

R1
The scan interval is maximal 1.28s.

R2
The scan interval is maximal 2.56s.

*RST: R0

Example:
`BB:BTO:PCON:PTYP FHS`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enables packet editor under data source for packet.
`BB:BTO:PCON:SRM R0`
sets the scan repetition mode.

Manual operation: See "Scan Repetition Mode" on page 140

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:VDATa <VData>

Selects the data source for the voice field.

Parameters:

<VData> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

*RST: PN09

Example:
`BB:BTO:PCON:VDAT ALL1`
sets the voice data type.

Manual operation: See "Data Source (Voice Field)" on page 140

8.10 Filter/clipping commands

[:SOURce<hw>]:BB:BTOoth:CLIPping:LEVel <Level>

Sets the limit for level 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.

Parameters:

<Level> integer

Range: 1 to 100
Increment: 1
*RST: 100
Default unit: PCT

Example: `SOURce1:BB:BTO:CLIP:LEV 80`
Sets the limit for level clipping to 80% of the maximum level.
`SOURce1:BB:BTO:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping Level" on page 148

[:SOURce<hw>]:BB:BTOoth:CLIPping:MODE <Mode>

The command 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: `SOURce1:BB:BTO:CLIP:MODE VECT`
Sets the amplitude as reference level.

Manual operation: See "Clipping Mode" on page 149

[:SOURce<hw>]:BB:BTOoth:CLIPping:STATe <State>

Activates level clipping.

The value is defined with the command `BB:BTO:CLIPping:LEVel`, the mode of calculation with the command `BB:BTO:CLIPping:MODE`.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: OFF

Example: `SOURce1:BB:BTO:CLIP:STAT ON`

Activates level clipping.

Manual operation: See "Filter/Clipping" on page 37

See "State" on page 148

[:SOURce<hw>]:BB:BTOoth:FILTer:FILTers?

Queries all configured baseband filters.

These filters are the common GFSK baseband filter and, for some EDR packets, a DPSK filter. See also Table 7-1.

Return values:

<filters> string

Example:

```
SOURce1:BB:BTO:FILT:FILT?
// Response: "GFSK, Root Raised Cosine (RRC)"
```

GFSK is a common baseband filter. Root raised cosine (RRC) is the π/4 DQPSK filter.

```
SOURce1:BB:BTO:TMOde?
// Response: "ESCO"
SOURce1:BB:BTO:PTYPe?
// Response: "EEV3"
SOURce1:BB:BTO:PTYPe EV3
SOURce1:BB:BTO:FILT:FILT?
// Response: "GFSK"
```

GFSK is the only filter.

Usage: Query only

Manual operation: See "Filter/Clipping" on page 37

[:SOURce<hw>]:BB:BTOoth:FILTer:TYPE <Type>

Selects the filters used for π/4 DQPSK and 8DPSK modulations. This opens a selection window containing all the filters available to the instrument.

Parameters:

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | DIRac | ENPShape | EWPShape

*RST: RCOSine

Example: `SOURce1:BB:BTO:FILT:TYPE RCOS`

Sets the filter type RCOSine.

Manual operation: See "Filter" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth <ILength>

Sets the impulse length (the number of filter taps).

Parameters:

<ILength> integer

Range: 1 to depends on oversampling
*RST: 32

Example: `SOURce1:BB:BTO:FILT:ILEN 10`
Sets the number of filter tabs to 10.

Manual operation: See "Impulse Length" on page 145

[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth:AUTO[:STATe] <State>

Activates the impulse length state.

If activated, the most sensible parameter values are selected. The value depends on the coherence check.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 1

Example: `SOURce1:BB:BTO:FILT:ILEN:AUTO ON`
Selects the most sensible parameters automatically.

Manual operation: See "Impulse Length" on page 145

[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling <OSampling>

Sets the upsampling factor.

Parameters:

<OSampling> integer

Range: 1 to 32
*RST: 10

Example: `SOURce1:BB:BTO:FILT:OSAM 10`
Sets the upsampling factor to 10.

Manual operation: See "Oversampling" on page 145

[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling:AUTO[:STATe] <State>

Activates the upsampling factor state. If activated, the most sensible parameter values are selected. The value depends on the coherence check. If deactivated, the values can be changed manually.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 1

Example: `SOURce1:BB:BTO:FILT:OSAM:AUTO ON`
The most sensible parameters are selected automatically.

Manual operation: See "Oversampling" on page 145

[:SOURce<hw>]:BB:BTOoth:FILTer:MINDex <MIndex>

Queries the modulation index resulting from the entered frequency deviation value.

Parameters:
<MIndex> string

Example: `SOURce1:BB:BTO:FILT:MIND?`
Queries the modulation index
`// Response: "0.5"`

Manual operation: See "Modulation Index" on page 147

[:SOURce<hw>]:BB:BTOoth:FILTer:MTYPe <MType>

Queries the modulation type used for the current packet selection.

Parameters:
<MType> string

Example: `SOURce1:BB:BTO:FILT:MTYP?`
Queries the modulation type

Manual operation: See "Modulation Type" on page 147

[:SOURce<hw>]:BB:BTOoth:MSETtings:FDEViation <FDeviation>

Sets the frequency deviation.

Parameters:
<FDeviation> float

Range: Depends on Bluetooth mode
Increment: 0.1
*RST: depends on Bluetooth mode

Example: `SOURce1:BB:BTO:MSET:FDEV 160`
Sets a frequency deviation of 160 kHz.

Manual operation: See "Frequency Deviation" on page 147

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:APCO25 <Apco25>

Sets the roll-off factor for filter type APCO25.

Parameters:
<Apco25> float

Range: 0.05 to 0.99
Increment: 0.01
*RST: 0.2

Example: `SOURce1:BB:BTO:FILT:PAR:APCO25 0.2`
Sets the roll-off factor to 0.2 for filter type APCO25.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:COSine <Cosine>

Sets the roll-off factor for the Cosine filter type.

Parameters:
<Cosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: `SOURce1:BB:BTO:FILT:PAR:COS 0.35`
Sets the roll-off factor to 0.35 for filter type Cosine.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:FGAuss <FGauss>

Sets the B x T for the Gauss filter type.

Parameters:
<FGauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `SOURce1:BB:BTO:FILT:PAR:FGA 0.5`
Sets B x T to 0.5 for the Gauss filter type for the GFSK section of the packet.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:GAUSs <Gauss>

Sets the B x T for the Gauss filter type.

Parameters:

<Gauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `SOURce1:BB:BTO:FILT:PAR:GAUS 0.5`
Sets B x T to 0.5 for the Gauss filter type for π/4 DQPSK or 8DPSK sections.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:LPASs <LPass>

Sets the cut off frequency factor for a lowpass filter (ACP Opt.).

Parameters:

<LPass> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `SOURce1:BB:BTO:FILT:PAR:LPAS 1`
Sets the cut off frequency factor for a lowpass filter.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146
See "Cut Off Frequency Factor" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:PGAuss <PGauss>

Sets the B x T for the Pure Gauss filter type.

Parameters:

<PGauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `SOURce1:BB:BTO:FILT:PAR:PGA 0.5`
Sets B x T to 0.5 for the Pure Gauss filter type.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:RCOSine <RCosine>

Sets the roll-off factor for the Root Cosine filter type.

Parameters:

<RCosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.4

Example:
```
SOURce1:BB:BTO:FILT:PAR:RCOS 0.22
```
Sets the roll-off factor to 0.22 for filter type Root Cosine.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:SPHase <SPhase>

Sets the BxT for the split phase filter type.

Parameters:

<SPhase> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 2

Example:
```
SOURce1:BB:BTO:FILT:PAR:SPH 0.5
```
Sets B x T to 0.5 for the Split Phase filter type.

Manual operation: See "B*T" on page 144
See "Roll Off Factor/B*T" on page 146

[:SOURce<hw>]:BB:BTOoth:SRATe:VARiation <Variation>

Sets the symbol rate.

Parameters:

<Variation> float

Range: 4E2 to 15E6
Increment: 1E-3
*RST: 1E6

Example:
```
BB:BTO:SRAT:VAR 1
```
sets the symbol rate variation to 1 MHz.

Manual operation: See "Symbol Rate Variation" on page 148

8.11 Power ramping commands

[:SOURce<hw>]:BB:BTOoth:PRAMping:FOFFset <FOffset>

Sets the offset of the falling edge of a burst. The offset is specified by the selected number of symbols.

Negative values shift the falling edge to earlier positions, which results in a corresponding number of skipped symbols at the end of the burst.

Positive values shift the falling edge to later positions, which results in a corresponding number of added 0 padding symbols following the burst.

Parameters:

<FOffset> integer

Range: -32 to 32
Increment: 1
*RST: 0

Example: `BB:BTO:PRAM:FOFF 8`
Adds eight symbols at the end of the burst.

Manual operation: See "Fall Offset" on page 150

[:SOURce<hw>]:BB:BTOoth:PRAMping:RFUNction <RFunction>

The command selects the form of the transmitted power, i.e. the shape of the rising and falling edges during power ramp control.

Parameters:

<RFunction> LINear | COSine

*RST: COSine

Example: `BB:BTO:PRAM:RFUN LIN`
sets linear shape for the rising and falling edges during power ramp control.

Manual operation: See "Ramp Function" on page 150

[:SOURce<hw>]:BB:BTOoth:PRAMping:ROFFset <ROffset>

Sets the offset of the rising edge of a burst. The offset is specified by the selected number of symbols.

Negative values shift the rising edge to earlier positions, which results in a corresponding number of added 0 padding symbols before the burst.

Positive values shift the rising edge to later positions, which results in a corresponding number of skipped symbols at the beginning of the burst.

Parameters:

<ROffset> integer

Range: -32 to 32
Increment: 1
*RST: -2

Example: `BB:BTO:PRAM:ROFF 8`
Skips eight symbols at the beginning of the burst.

Manual operation: See "Rise Offset" on page 150

[:SOURce<hw>]:BB:BTOoth:PRAMping:RTIMe <RTime>

Sets the ramp time, which extends the burst by a corresponding number of 0 padding symbols at the beginning and the end of a burst. During this period of time, power ramping is based on the specified ramp function.

Parameters:

<RTime> integer

Range: 1 to 32
Increment: 1
*RST: 2

Example: `BB:BTO:PRAM:TIME 2`
Extends the burst by 2 symbols at the beginning and end of the burst.

Manual operation: See "Ramp Time" on page 150

8.12 Trigger commands

Example: To configure an external trigger

```
// *****************************************************************
// Configure trigger in armed retrigger mode, set source, enable
// synchronization to external trigger, set external
// inhibit and delay.
// *****************************************************************
SOURce1:BB:BTOoth:TRIGger:SEQuence ARET
SOURce1:BB:BTOoth:TRIGger:SOURce EGT1
SOURce1:BB:BTOoth:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:BTOoth:TRIGger:EXTernal:INHibit 100
SOURce1:BB:BTOoth:TRIGger:EXTernal:DELay 10
```

Example: To configure an internal trigger

```
// ******************************************************************
// Configure trigger in single mode.
// Set source to internal, specify signal duration
// unit and duration.
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:SEQuence SING
SOURce1:BB:BTOoth:TRIGger:SOURce INT
SOURce1:BB:BTOoth:TRIGger:SLUNit SEQ

SOURce1:BB:BTOoth:TRIGger:SLUNit FRAMe
SOURce1:BB:BTOoth:TRIGger:SLENgth 2

// ******************************************************************
// Alternatively configure trigger in armed retrigger  mode.
// Set source to internal. Enable Bluetooth signal, start
// the trigger - signal generation starts.
// Stop signal generation and wait for a trigger
// event to restart signal generation.
// Query the current trigger signal generation status.
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:SEQuence ARETrigger
SOURce1:BB:BTOoth:TRIGger:SOURce INT
SOURce1:BB:BTOoth:STATe 1
SOURce1:BB:BTOoth:TRIGger:EXECute

SOURce1:BB:BTOoth:TRIGger:ARM:EXECute
// trigger event restarts signal generation
SOURce1:BB:BTOoth:TRIGger:RMODe?
// 1 (running)
SOURce1:BB:BTOoth:TRIG:SOUR OBAS
// sets triggering by the other path
SOURce1:BB:BTOoth:TRIG:INH 200
// sets a restart inhibit for 200 chips following a trigger event
SOURce1:BB:BTOoth:TRIG:OBAS:DEL 50
// sets a delay of 50 symbols for the trigger
```

[:SOURce<hw>]:BB:BTOoth[:TRIGger]:SEQuence <Sequence>

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

<Sequence> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Example: See Example"To configure an internal trigger" on page 292.

Manual operation: See "Mode" on page 152

[:SOURce<hw>]:BB:BTOoth:TRIGger:SOURce <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are the following trigger sources:

- `INTernal`: Internal manual triggering of the instrument
- `INTA|INTB`: Internal triggering by a signal from the other basebands
- 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
- For secondary instruments (`SCONfiguration:MULTiinstrument:MODE SEC`), triggering via the external baseband synchronization signal of the primary instrument:
  `SOURce1:BB:ARB:TRIGger:SOURce BBSY`
- `OBASeband|BEXTernal|EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators. The R&S SMW200A 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"To configure an external trigger" on page 291.

Example: See Example"To configure an internal trigger" on page 292.

Options: ELTRigger|ELCLock require R&S SMW-B10
BBSY require R&S SMW-B9

Manual operation: See "Source" on page 154

[:SOURce<hw>]:BB:BTOoth:TRIGger:RMODe <RMode>

Queries signal generation status for all trigger modes with Bluetooth modulation on.

Parameters:

<RMode> RUN | STOP
*RST: STOP

Example: See Example"To configure an internal trigger" on page 292.

Manual operation: See "Running/Stopped" on page 153

[:SOURce<hw>]:BB:BTOoth: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> Range: 1 to 31
Increment: 1

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 SMW200A user manual.

Manual operation: See "Trigger Time" on page 153

[:SOURce<hw>]:BB:BTOoth:TRIGger:TIME:TIME <Time>

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:

<Time> string

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 SMW200A user manual.

Manual operation: See "Trigger Time" on page 153

[:SOURce<hw>]:BB:BTOoth:TRIGger:TIME[:STATe] <Hour>, <Minute>, <Second>

Activates time-based triggering with a fixed time reference. If activated, the R&S SMW200A 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:

<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 SMW200A user manual.

Manual operation: See "Time Based Trigger" on page 153

[:SOURce<hw>]:BB:BTOoth:TRIGger:SLENgth <SLength>

Defines the length of the signal sequence that is output in the SINGle trigger mode.

Parameters:

<SLength> integer
Range: 1 to 7000
*RST: 1

Example: See Example"To configure an internal trigger" on page 292.

Manual operation: See "Signal Duration" on page 153

[:SOURce<hw>]:BB:BTOoth:TRIGger:SLUNit <SlUnit>

Defines the unit for the entry of the signal sequence length.

Parameters:

<SlUnit> FRAMe | SEQuence | EVENt

FRAMe
A single frame is generated after a trigger event.

SEQuence
A single sequence is generated after a trigger event.

*RST: SEQuence

Example: See Example"To configure an internal trigger" on page 292.

Manual operation: See "Signal Duration Unit" on page 152

[:SOURce<hw>]:BB:BTOoth:TRIGger:ARM:EXECute

Stops signal generation; a subsequent trigger event restarts signal generation.

Example: See Example"To configure an internal trigger" on page 292.

Usage: Event

Manual operation: See "Arm" on page 154

[:SOURce<hw>]:BB:BTOoth:TRIGger:EXECute

Executes a trigger.

Example: See Example"To configure an internal trigger" on page 292.

Usage: Event

Manual operation: See "Execute Trigger" on page 154

[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:SYNChronize:OUTPut <Output>

Enables signal output synchronous to the trigger event.

Parameters:

<Output> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"To configure an external trigger" on page 291.

Manual operation: See "Sync. Output to Ext. Trigger/Sync. Output to Trigger" on page 154

[:SOURce<hw>]:BB:BTOoth:TRIGger:OBASeband:DELay <Delay>

Sets the trigger delay (expressed as a number of samples) for triggering by the trigger signal from the second path.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Example: See Example"To configure an internal trigger" on page 292.

Manual operation: See "External Delay/Trigger Delay" on page 156

[:SOURce<hw>]:BB:BTOoth:TRIGger:OBASeband:INHibit <Inhibit>

For triggering via the other path, specifies the duration by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: See Example"To configure an internal trigger" on page 292.

Manual operation: See "External Inhibit/Trigger Inhibit" on page 155

[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:DELay <Delay>

Sets the trigger delay.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Example: See Example"To configure an external trigger" on page 291.

Manual operation: See "External Delay/Trigger Delay" on page 156

[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:INHibit <Inhibit>

Specifies the number of samples by which a restart is to be inhibited following an external trigger event.

Parameters:

<Inhibit> integer

Range: 0 to 21.47*symbRate
*RST: 0

Example: See Example"To configure an external trigger" on page 291.

Manual operation: See "External Inhibit/Trigger Inhibit" on page 155

8.13 Marker commands

Example: To configure a marker signal

```
// ******************************************************************
// Configure marker mode: set a marker at ARB sequence start.
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:OUTPut1:MODE RESTart
// SOURce1:BB:BTOoth:TRIGger:OUTPut1:MODE STARt
// SOURce1:BB:BTOoth:TRIGger:OUTPut1:MODE ACTive

// ******************************************************************
// Alternatively configure pulse marker. Set pulse
// divider and frequency
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:OUTPut1:MODE PULSe
SOURce1:BB:BTOoth:TRIGger:OUTPut1:PULSe:DIVider 2
SOURce1:BB:BTOoth:TRIGger:OUTPut1:PULSe:FREQuency?
// 500000

// ******************************************************************
// Alternatively configure bit pattern marker. Specify pattern.
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:OUTPut1:MODE PATTern
SOURce1:BB:BTOoth:TRIGger:OUTPut1:PATTern #H2,2
// ******************************************************************
// Alternatively configure on/off ratio marker. Set on/off time.
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:OUTPut1:MODE RAT
SOURce1:BB:BTOoth:TRIGger:OUTPut1:ONTime 40000
SOURce1:BB:BTOoth:TRIGger:OUTPut1:OFFTime 20000
```

Example: To configure marker delay

```
// ******************************************************************
// Enable fixed marker delay. Query the limit for minimum and maximum
// marker delay. Set delay for the marker signal output.
// ******************************************************************
SOURce1:BB:BTOoth:TRIGger:OUTPut1:DELay 1600
```

[:SOURce<hw>]:BB:BTOoth: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: 0.001
*RST: 0

Example: See Example"To configure marker delay" on page 298.

Manual operation: See "Delay" on page 158

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:FESHift <Shift>

Shifts the falling edge of the marker the specified number of samples.

Negative values result in a shift back of the marker edge.

Parameters:

<Shift> float

Range: dynamic to dynamic
Increment: 1E-6
*RST: 0

Example: `SOURce1:BB:BTO:TRIG:OUTP1:FESH 10`
Shifts the falling edge of marker 1 by 75 samples.

Example: See also Example"To configure a marker signal" on page 298.

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:MODE <Mode>

Defines the signal for the selected marker output.

Parameters:

<Mode> RESTart | STARt | ACTive | PULSe | PATTern | RATio | IACTive

RESTart
A marker signal is generated at the start of each signal sequence.

STARt
A marker signal is generated at the start of each event/frame.

ACTive
The marker masks the active part of the event/frame. At the start of each burst, the marker signal changes to high. It changes back to low after the end of each burst.

PULSe
A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the symbol rate by the divider. The input box for divider opens when "Pulse" is selected, and the resulting pulse frequency is displayed below.

PATTern
A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when pattern is selected.

RATio
A regular marker signal corresponding to the "Time Off" / "Time On" specifications in the commands `SOURce1:BB:BTO:TRIGger:OUTPut:OFFTime` and `SOURce1:BB:BTO:TRIGger:OUTPut:ONTime` is generated.

IACTive
The marker masks the inactive part of the event/frame. At the start of each burst, the marker signal changes to low. It changes back to high after the end of each burst.

*RST: RESTart

Example: See Example"To configure a marker signal" on page 298.

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:ONTime <OnTime>
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:OFFTime <OffTime>

Sets the duration of the ON and OFF periods.

*) 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 SMW200A user manual.

Parameters:

<OffTime> integer

Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 16777215

*RST: 1

Example: See Example"To configure a marker signal" on page 298.

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PATTern <Pattern>, <BitCount>

Selects the data for a pattern.

Parameters:

<Pattern> numeric

*RST: #H2

<BitCount> integer

Range: 1 to 64
*RST: 2

Example: See Example"To configure a marker signal" on page 298.

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PINDex <PIndex>

For Bluetooth LE data packets higher than one, sets the packet index. The index corresponds to the transmitted Tx event during the connection interval.

Parameters:

<PIndex> integer

Range: 1 to depends on "No. Of Tx Packets/Event" parameter
*RST: 1

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

Sets the divider for the clock frequency.

*) 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 SMW200A user manual.

Parameters:

<Divider> integer

Range: 2 (R&S SMW-B10) / 2* (R&S SMW-B9) to 1024
*RST: 2

Example: See Example"To configure a marker signal" on page 298.

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PULSe:FREQuency?

Queries the marker pulse frequency.

Return values:

<Frequency> float

Range: 2 to 1024
Increment: 1E-3
*RST: 2

Example: See Example"To configure a marker signal" on page 298.

Usage: Query only

Manual operation: See "Mode" on page 157

[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:RESHift <Shift>

Shifts the rising edge of the marker the specified number of samples.

Negative values result in a shift back of the marker edge.

Parameters:

<Shift> float

Range: dynamic to dynamic
Increment: 1E-6
*RST: 0

Example: `SOURce1:BB:BTO:TRIG:OUTPut2:RESH -20`
Shifts back the rising edge of marker 2 by 20 samples.

Example: See also Example"To configure a marker signal" on page 298.

Manual operation: See "Mode" on page 157

8.14 Clock commands

This section lists the remote control commands to configure the clock.

Example: To configure clock settings

```
// ******************************************************************
// Select internal clock.
// ******************************************************************
SOURce1:BB:BTOoth:CLOCk:SOURce INTernal
// ******************************************************************
// Alternatively select external clock. Set its mode.
// ******************************************************************
SOURce1:BB:BTOoth:CLOCk:SOURce ELCL
SOURce1:BB:BTOoth:CLOCk:MODe SAMP
```


[:SOURce<hw>]:BB:BTOoth:CLOCk:MODE <Mode>

Sets the type of externally supplied clock.

Parameters:

<Mode> SAMPle

*RST: SAMPle

Example: See Example"To configure clock settings" on page 302.

Options: R&S SMW-B10

Manual operation: See "Clock Mode" on page 160

[:SOURce<hw>]:BB:BTOoth: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: See Example"To configure clock settings" on page 302.

Options: ELCLock requires R&S SMW-B10

Manual operation: See "Clock Source" on page 159

Glossary: Specifications

Symbols

[1]: Bluetooth SIG: Bluetooth Core Specification, version 5.4
https://www.bluetooth.com/specifications/specs/

[2]: Bluetooth SIG: Channel Sounding, revision CR_PR
https://www.bluetooth.com/specifications/specs/

List of commands

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