# R&S®SMW-K68
# TETRA Release 2
# User Manual

1175681002
Version 18

ROHDE&SCHWARZ
Make ideas real

This document describes the following software options:

- R&S®SMW-K68 TETRA Release 2 (1413.4439.xx)

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


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


1175.6810.02 | Version 18 | R&S®SMW-K68

The following abbreviations are used throughout this manual: R&S®SMW200A is abbreviated as R&S SMW, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

# Contents

# 1 Welcome to the TETRA2 digital standard

The R&S SMW-K68 is a firmware application that adds functionality to generate signals in accordance with the standard Terrestrial Trunked Radio Release 2 (TETRA2).

The R&S SMW-K68 main features:

- Generating of a signal in accordance with ETSI EN 300 392-2.
- The TETRA frame (bit stream) is generated according to the selected burst type, i.e. control burst (CB), normal burst (NB) or synchronization burst (SB).
- The frames are generated for the uplink (mobile station [MS] transmitting) or the downlink (base station [BS] transmitting).
- The channel types AACH, BSCH, BNCH, TCH, STCH, SCH as well as the TETRA Release 2 specific channels like SCH-Q, etc. are generated.
- Channel coding including scrambling with system code, base color code, mobile country code and mobile network code are performed for all channels.
- Frame repetition can be selected via sequence length.
- The T1 test signal is generated for the V+D (voice and data) test on MS and BS DUTs.
- Test channel types can be set for the downlink and for the uplink.
- The bit stream can be generated either from pseudo-random sequences (CCITT O.153) or from user-selectable sequences.
- The R&S SMW calculates the appropriate TETRA2 T1, T2, T3 and T4 signal according to the specification.
- Additionally, user-defined test signal can be generated.

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

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

www.rohde-schwarz.com/manual/SMW200A

**Installation**

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

## 1.1 Accessing the TETRA dialog

**To open the dialog with TETRA settings**

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

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".

## 1.2 What's new

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

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

- Time-based triggering, see "Time Based Trigger" on page 18 and "Trigger Time" on page 18.
- Editorial changes

## 1.3 Documentation overview

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

www.rohde-schwarz.com/manual/smw200a

### 1.3.1 Getting started manual

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

### 1.3.2 User manuals and help

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

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

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

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

### 1.3.3 Tutorials

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

### 1.3.4 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

### 1.3.5 Instrument security procedures

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

### 1.3.6 Printed safety instructions

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

### 1.3.7 Data sheets and brochures

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

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

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

### 1.3.8 Release notes and open source acknowledgment (OSA)

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

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

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

### 1.3.9 Application notes, application cards, white papers, etc.

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

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

### 1.3.10 Videos

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

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


*Figure 1-1: Product search on YouTube*

## 1.4 Scope

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

In particular, it includes:

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

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

## 1.5 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 Required options

The basic equipment layout for generating TETRA Release 2 signals includes the:

- Standard or wideband Baseband Generator (R&S SMW-B10/-B9)
- Baseband main module (R&S SMW-B13) or wideband baseband main module (R&S SMW-B13XT)
- Frequency option (e.g. R&S SMW-B1003)
- Digital standard TETRA release 2 (R&S SMW-K68)

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

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

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

For more information, see data sheet.

# 3 TETRA2 configuration and settings

Access:

► Select "Baseband" > "TETRA".

The remote commands required to define these settings are described in Chapter 4, "Remote control commands", on page 46.

**Contents**

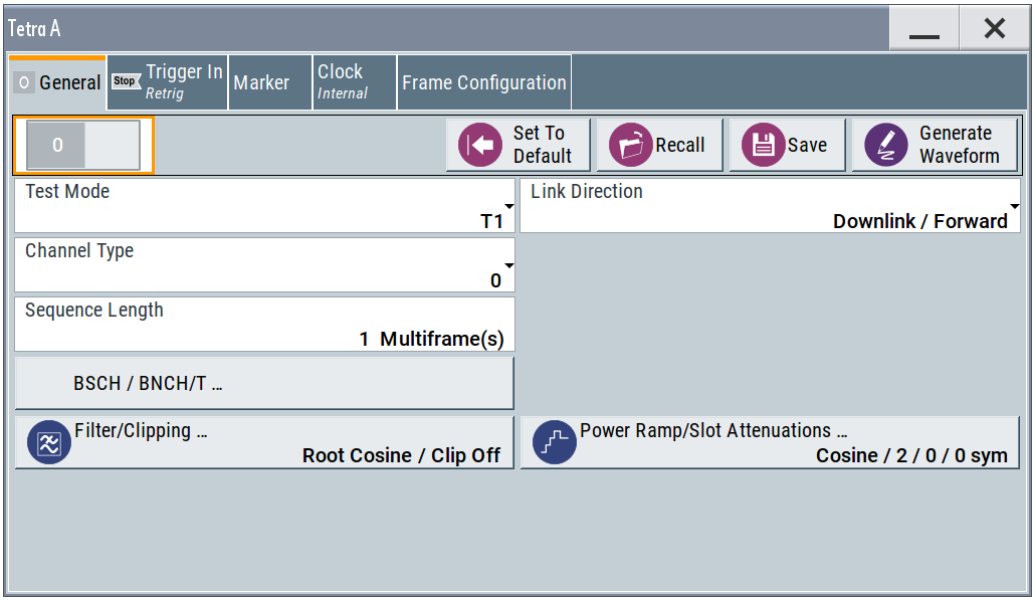


## 3.1 General settings

Access:

► Select "Baseband > TETRA > General".

This dialog provides access to the default, the "Save/Recall" settings and provides test mode, channel type and link direction selection. The selected test mode and link direction determine the available parameters.




**Settings:**



**State**
Enables or disables the TETRA standard.

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:STATe` on page 51

**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" |
| Test Mode | T1 |

| Parameter | Value |
|---|---|
| Link Direction | Downlink / Forward |
| Channel Type | 0 |
| Sequence Length | 1 Multiframe |
| Power Ramp/Slot Attenuation | cosine/ 2 / 0 / 0sym |
| Filter/Clipping | Root Cosine / clipping Off |
| Trigger/Marker | Auto/Int |
| Clock | Internal |

Remote command:
[:SOURce<hw>]:BB:TETRa:PRESet on page 49

**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 SMW user manual.

Remote command:
[:SOURce<hw>]:BB:TETRa:SETTing:LOAD on page 50
[:SOURce<hw>]:BB:TETRa:SETTing:STORe on page 51
[:SOURce<hw>]:BB:TETRa:SETTing:CATalog? on page 50
[:SOURce<hw>]:BB:TETRa:SETTing:DELete on page 50

**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:TETRa:WAVeform:CREate on page 52

**Test Mode**
Selects the test mode.

Several settings depend on the selected test model.

"T1" Test signal T1 (TETRA wanted signal, phase modulated)
This test mode enables the generation of test signals that comply with the TETRA air interface multiframe, frame and slot structure. The T1 test signal is generated according to EN 300 394-1V3.1.1 and is intended to be the wanted signal transmitted by the test system during frames 1 to 17 in all receiver tests.
The signal is pi/4-DQPSK or pi/8-D8PSK modulated. Frame 18 transmits information for control purposes.
To enable configuration of the T1 signal for different receiver tests, the channel type for the "T1" signal is user-selectable. Channel types 0 to 4, 21, 22 and 25 are available in the Downlink/Forward "Link Direction" and channel types 7 to 11, 21, 23 and 24 for the Uplink/Reverse direction.
The burst types Uplink/Reverse and Downlink/Forward are derived from the channel types. The instrument generates the Tx data for complete multiframes for the V+D service (voice and data). The contents of data fields are automatically inserted according to the burst type. The control block (cb), blocks 1 + 2 (bk), the synchronization block (sb) and the broadcast block (bb) for test signal T1 are generated according to the frame number and the channel type.

"T4" Test signal T4 (TETRA wanted signal, QAM modulated)
The test signal T4 comply with the TETRA air interface multiframe, frame and slot structure. The T4 test signal is intended to be the wanted signal transmitted by the test system during frames 1 to 17 in all receiver tests. Except form frame 18, the signal is 4-QAM, 16-QAM or 64-QAM modulated. Frame 18 transmits information for control purposes and is QAM and phase modulated (QAM + pi/4-DQPSK); the frame is generated according to EN 300 394-1.

"User Defined" Enables the generation of user-defined test signal.

"T2" Test signal T2 (TETRA interfere)
The T2 test signal is phase or QAM modulated, depending on the selected Modulation Type.

"T3" Test signal T3 (unmodulated interferer)
The T3 test signal is an unmodulated continuous sinusoidal out-of-band interfering signal.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TMODe` on page 52

**Link Direction**
Selects the transmission direction.

This parameter determines the available "Channel Types".

"Downlink/Forward" The transmission direction selected is from the base station (BS) to the terminal (MS). The signal corresponds to that of a BS.

"Uplink/Reverse" The transmission direction selected is from MS to the BS. The signal corresponds to that of a terminal.

Remote command:
`[:SOURce<hw>]:BB:TETRa:LDIRection` on page 49

**Channel Type**
(for "Test Model" set to T1 or T4)

Determines the channel type.

Remote command:
[:SOURce<hw>]:BB:TETRa:CTYPe on page 48

**Modulation Type**
(for "Test Model" set to "User Defined" or "T2")

Determines the modulation type, "Phase" or "QAM."

"Phase" The T2 test signal is a pi/4-DQPSK modulated continuous radio signal.

"QAM" The T2 test signal is 4-QAM, 16-QAM or 64-QAM modulated and spans a bandwidth of 25kHz, 50kHz, 100kHz or 150kHz.

Remote command:
[:SOURce<hw>]:BB:TETRa:MTYPe on page 49

**Downlink Burst Type**
(in Downlink "Link Direction" and for "Test Model" set to "T2" or "User Defined")

Determines whether a discontinuous or continuous downlink burst type is used.

Remote command:
[:SOURce<hw>]:BB:TETRa:DBTYpe on page 48

**Sequence Length**
Selects the sequence length of the arbitrary waveform file in the number of multiframes. One multiframe is the minimum sequence length for a T1 signal.

Remote command:
[:SOURce<hw>]:BB:TETRa:SLENgth on page 51

**BSCH / BNCH/T**
Accesses the "BSCH / BNCH/T" dialog, used to configure the frequency settings, the scrambling code and the content of the "Broadcast Synchronization Channel (BSCH)" and the "Broadcast Network Channel (BNCH/T)", see Chapter 3.8, "BSCH / BNCH/T", on page 30.

**Filter / Clipping**
Access to the dialog for setting baseband filtering, clipping and the sequence length of the arbitrary waveform component, see Chapter 3.9, "Filter / clipping settings", on page 38.

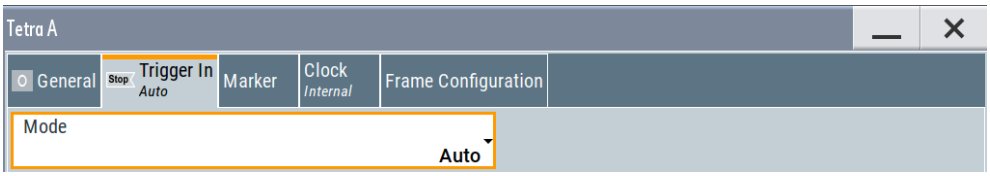
**Power Ramp/Slot Attenuations**
Calls the "Power Ramp Control" dialog. This dialog is used to set the power ramping parameters and for setting values for the level attenuation in dB (see Chapter 3.10, "Power ramp control", on page 42).

The currently selected ramp function and ramp time are displayed.

## 3.2 Trigger settings

Access:

► Select "Baseband" > "TETRA" > "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 3.5, "Local and global connectors settings", on page 24.
   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 SMW starts baseband signal generation after the configured trigger event.

**About baseband trigger signals**

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

**Settings:**

**Trigger settings common to all basebands**
To enable simultaneous signal generation in all basebands, the R&S SMW couples the trigger settings in the available basebands in any instrument's configuration involving signal routing with signal addition. For example, in MIMO configuration, routing and summing of basebands or of streams.

The icon indicates that common trigger settings are applied.

You can access and configure the common trigger source and trigger mode settings in any of the basebands. An arm or a restart trigger event applies to all basebands, too. You can still apply different delay to each of the triggers individually.

**Mode**
Selects trigger mode, i.e. determines the effect of a trigger event on the signal generation.

For more information, refer to chapter "Basics" in the R&S SMW user manual.

- "Auto"
  The signal is generated continuously.
- "Retrigger"
  The signal is generated continuously. A trigger event (internal or external) causes a restart.
- "Armed Auto"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously.
  An "Arm" stops the signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Armed Retrigger"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
  An "Arm" stops signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Single"
  The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".
  Every subsequent trigger event (internal or external) causes a restart.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:SEQuence` on page 78

**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:TETRa:TRIGger:SLUNit` on page 76

**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:TETRa:TRIGger:SLENgth` on page 76

**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:TETRa:TRIGger:RMODe` on page 76

**Time Based Trigger**
Requires trigger "Mode" > "Armed Auto"/"Single".

Activates time-based triggering with a fixed time reference.

The R&S SMW triggers signal generation when its operating system time ("Current Time") matches a specified time trigger ("Trigger Time"). As trigger source, you can use an internal trigger or an external global trigger.

How to: Chapter "Time-based triggering" in the R&S SMW user manual.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:TIME[:STATe]` on page 79

**Trigger Time**
Requires trigger "Mode" > "Armed Auto"/"Single".

Sets date and time for a time-based trigger signal.

Set a trigger time that is later than the "Current Time". The current time is the operating system time of the R&S SMW. If you set an earlier trigger time than the current time, time-based triggering is not possible.

How to: Chapter "Time-based triggering" in the R&S SMW user manual.

"Date" Sets the date of the time-based trigger in format YYYY-MM-DD.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:TIME:DATE` on page 78

"Time" Sets the time of the time-based trigger in format hh:mm:ss.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:TIME:TIME` on page 79

**Arm**
Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:ARM:EXECute on page 74

**Execute Trigger**
For internal trigger source, executes trigger manually.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:EXECute on page 75

**Source**
The following sources of the trigger signal are available:

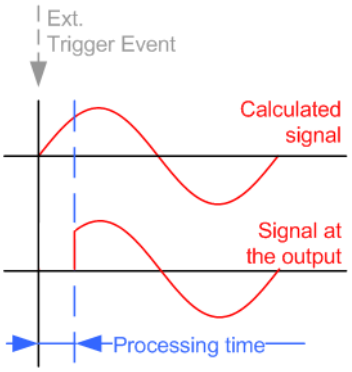
- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "Internal (Baseband A/B)"
  The trigger event is provided by the trigger signal from the other basebands.
  If common trigger settings are applied, this trigger source is disabled.
- "External Global Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the USER x connectors.
- "External Local Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1/2/3 connectors.
- "External Local Clock"
  The trigger event is the active edge of an external local clock signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1 connector.

How to: "Routing and activating a trigger signal" on page 16

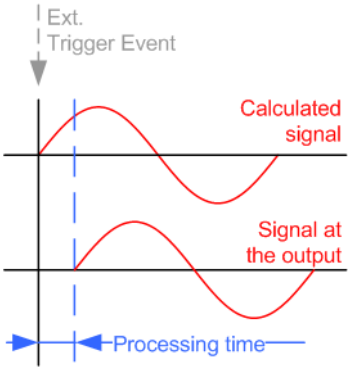
Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:SOURce on page 77

**Sync. Output to External Trigger/Sync. Output to Trigger**
Enables signal output synchronous to the trigger event.

- "On"
  Corresponds to the default state of this parameter.
  The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.




- "Off"
  The signal output begins after elapsing of the processing time. Signal output starts with sample 0. The complete signal is output.
  This mode is recommended for triggering of short signal sequences. Short sequences are sequences with signal duration comparable with the processing time of the instrument.




Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:SYNChronize:OUTPut` on page 75

**External Inhibit/Trigger Inhibit**
Applies for external trigger signal or trigger signal from the other path.

Sets the duration with that any following trigger event is suppressed. In "Retrigger" mode, for example, a new trigger event does not cause a restart of the signal generation until the specified inhibit duration does not expire.

For more information, see chapter "Basics" in the R&S SMW user manual.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal]:INHibit` on page 78
`[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:INHibit` on page 76

**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

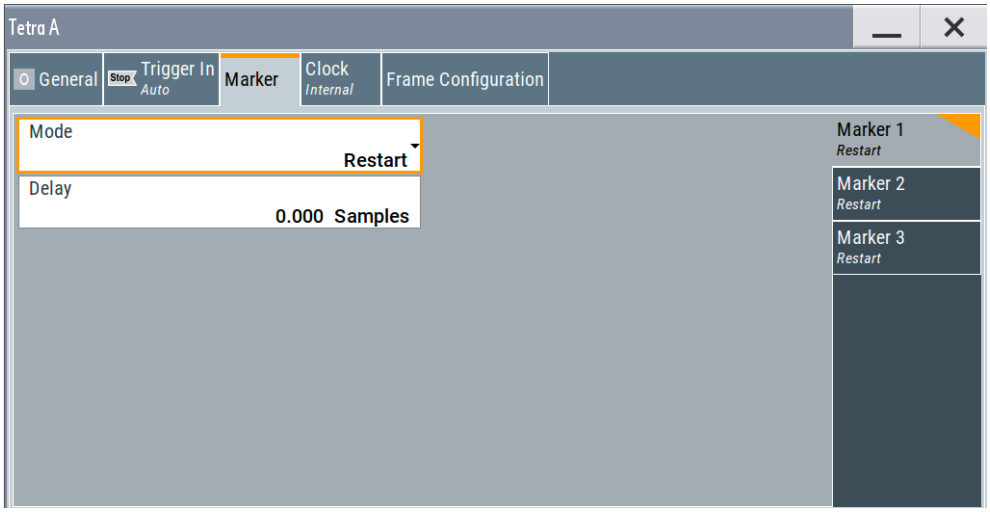
For more information, see chapter "Basics on ..." in the R&S SMW user manual.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal]:DELay` on page 77
`[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:DELay` on page 75

## 3.3 Marker settings

Access:

► Select "Baseband" > "TETRA" > "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 3.5, "Local and global connectors settings", on page 24.
   You can map marker signals to one or more USER x or T/M connectors.
3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMW adds the marker signal to the baseband signal. Also, R&S SMW outputs this signal at the configured USER x connector.

### About marker output signals

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

### Settings:



### Mode

Marker configuration for up to 3 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

How to: "Routing and activating a marker signal" on page 21

"Restart" A marker signal is generated at the start of each ARB sequence.

"Slot Start" A marker signal is generated at the start of each slot.

"Frame Start" A marker signal is generated at the start of each frame.

"Multiframe Start"
A marker signal is generated at the start of each multiframe.

"Hyperframe Start"
A marker signal is generated at the start of each hyperframe.

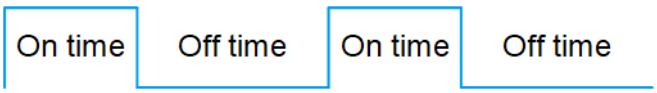
"Pulse" A regular marker signal is generated. The frequency is derived by dividing the sample rate by the divider. The input box for the divider opens when "Pulse" is selected, and the resulting pulse frequency is displayed below it.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 82
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 83

"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 64 bits and is defined in an input field which opens when pattern is selected.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PATTern` on page 82

"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.
The "On Time" and "Off Time" are each expressed as several samples and are set in an input field which opens when On/Off ratio is selected.




Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:ONTime` on page 82
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime` on page 82

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE` on page 81

**Delay**
Delays the marker signal at the marker output relative to the signal generation start.

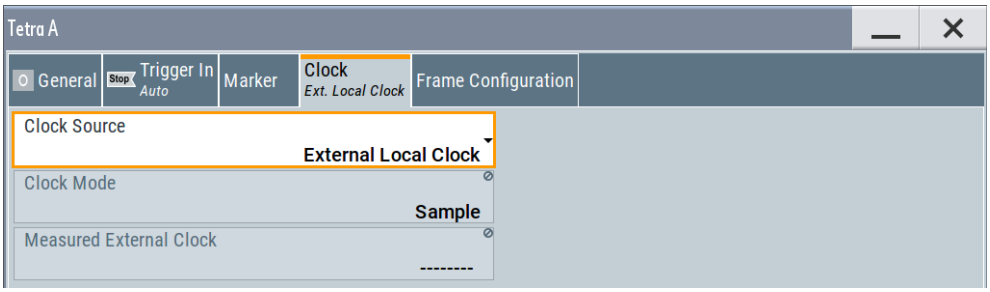
Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay` on page 81

## 3.4 Clock settings

Access:

► Select "Baseband" > "TETRA" > "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 clock signal.
2. For external clock signals, define the connector for signal input. See Chapter 3.5, "Local and global connectors settings", on page 24.
   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 SMW starts baseband signal generation with a symbol rate that equals the clock rate.

**About clock signals**

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

**Settings:**



**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.

How to: "Defining the clock" on page 23

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLOCk:SOURce` on page 84

**Clock Mode**
Sets the type of externally supplied clock.

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLOCk:MODE` on page 83

**Measured External Clock**
Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:
`CLOCk:INPut:FREQuency?`

## 3.5 Local and global connectors settings

Accesses a dialog to configure local connectors or global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.

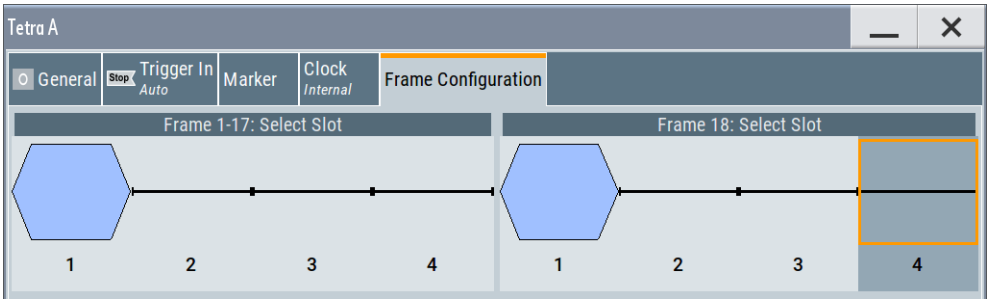
- "Trigger In", "Marker" and "Clock" tabs that are accessible via the "Baseband" block in the block diagram.


See also chapter "Local and global connectors settings" in the user manual.

## 3.6 Frame configuration settings

Access:

1. Select "Baseband > Tetra > Frame Configuration".




The dialog displays the frames slots graphically.

2. Select the slot to for configuration.

   The corresponding burst editor dialog opens, see Chapter 3.7, "Burst editor", on page 25.

## 3.7 Burst editor

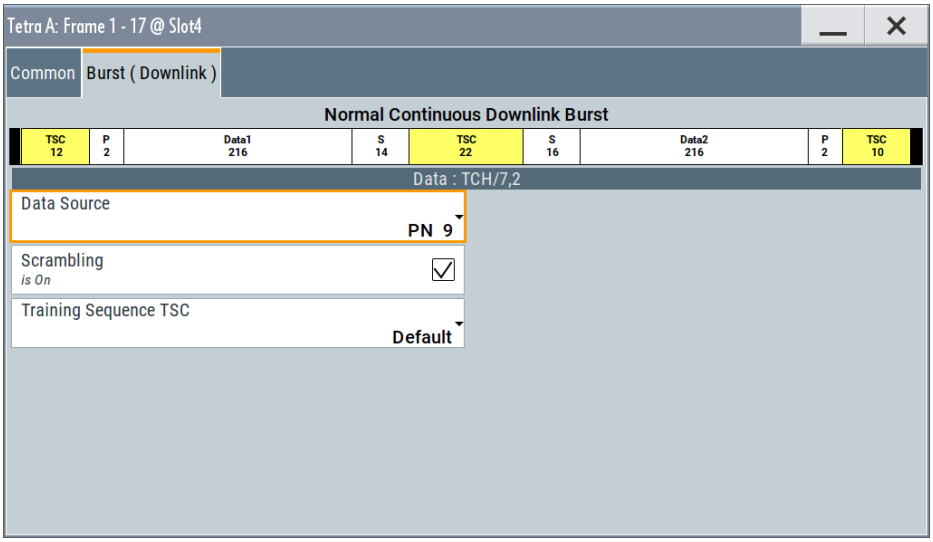
Access:

► Select "Frame Configuration > Frame: Select Slot > Frame".

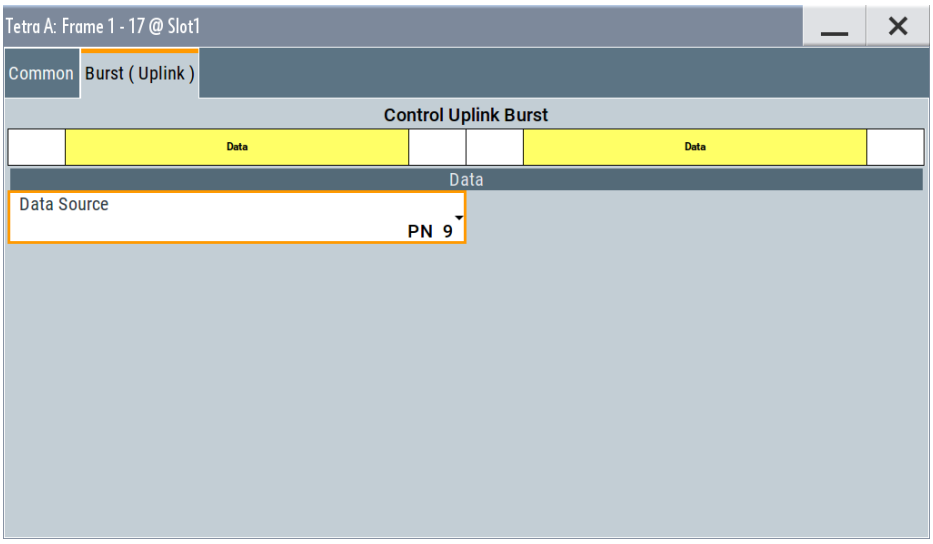
At the top of the dialog, the structure of the current burst type for the selected slot is displayed. Individual fields of the frame are color-coded:

| Field | Color |
|---|---|
| Data, Fixed, Mixed, Stealing | white |
| White Training Sequences: TSC, ETSC, SYNC | yellow |
| Tail, extended Tail | green |
| Guard, extended Guard | blue |

**normal burst:**




**control burst:**




The rest of the dialog displays the data contained in fields predefined by the standard for the current burst type. Data fields with variable content can be edited.

The following sections list all possible settings and displays for the various burst types. If a setting applies only to a particular burst type, it is mentioned for the corresponding parameter.

**Settings:**

**Common**
Selects the common settings for the selected slot.

**T2 Burst Type ← Common**
Selects the burst type for "Test Mode T2".

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:LDIRection<ch>:TBTYpe` on page 55

**(Sub-) Slot Level ← Common**
Sets the level for the selected (sub-)slot.

Subslots are used by control bursts only.

| | |
|---|---|
| "Off" | Attenuation is maximum. The (sub-) slot is inactive. |
| "Full" | The level corresponds to the level indicated in the display. |
| "Attenuated" | Level is reduced by the level attenuation set in "(Sub-)Slot Attenuation". |

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SLEVel` on page 61 for "Slot Level"
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSLevel` on page 62 for "Sub-Slot Level".

**(Sub-) Slot Attenuation ← Common**
Selects the level attenuation for the "(Sub-)Slot Level" attenuated setting.

Subslots are used by control bursts only.

Use the "Power Ramp Control" > "Slot Attenuations" dialog to define four different values for level attenuation.

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:BSATtenuation` on page 57 for "Slot-Attenuation".
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSATtenuation` on page 57 for "Sub-Slot Attenuation".

**Use Coded T1/T4 Data ← Common**
Enables/disables auto coding of the data.

If enabled, the selection of the data source is disabled.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:UBBNch on page 56

**Logical Channel Type ← Common**
Selects the logical channel type.

The available channels depend on the selected Test Mode and Link Direction.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:LCTYpe on page 59

**AACH-Q Mode ← Common**
(enabled for Frame 1- 17)

Sets the AACH-Q mode element that indicates whether the "Access-Assign PDU" follows in the AACH-Q.

The AACH-Q ("Access Assignment Channel, QAM") channel is present on all transmitted downlink slots (except slots containing BLCH-Q). It is used to indicate on each QAM physical channel the assignment of the uplink and downlink slots.

| | |
|---|---|
| "Access-Assign PDU" | The value of the AACH-Q mode element is set to 0, i.e. contents of "Access-Assign PDU" are present.<br>The "Access-Assign PDU" is used to convey information about the downlink slot in which it appears and also the access rights for the corresponding (same-numbered) uplink slot.<br>The fields of the "Access-Assign PDU" are defined with the corresponding parameters. |
| "Reserved Element" | The value must be set to all zeros. |

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:AMODe on page 56

**Access-Assign PDU ← Common**
(enabled for Frame 1- 17)

Enables configuration of the "Access-Assign PDU" content.

"Header" Sets the value for the information element Header.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APHeader on page 57

"Field1" Sets the value for the information element Field 1.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF1 on page 56

"Field2" Sets the value for the information element "Field2".

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF2 on page 57

**Burst (Downlink/Uplink)**
Selects the settings for the "Logical Channel Type" of the selected burst "Link Direction".

**Data Source ← Burst (Downlink/Uplink)**
Selects a data source for the "Data" field.

The data source for both channels can be defined separately, i.e. each (sub-)slot has its own data source.

If a burst contains multiple "Data" fields, they are treated as a continuous field. For instance, a pseudo-random sequence is continued without interruption from one "Data" field to the next.

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  - Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  - Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  - Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:

- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA` on page 58
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa` on page 60
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection` on page 59
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDSelection` on page 61
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DPATtern` on page 58
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDPattern` on page 60

**Scrambling ← Burst (Downlink/Uplink)**
Enables/disables auto scrambling.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SCRambling on page 59

**Training Sequence ← Burst (Downlink/Uplink)**
Determines whether the default or a user-defined training sequence (TSC) is used.

A user-defined training sequence can be created in the field "TSC User Defined".

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:TSOurce on page 62

**TSC User Defined ← Burst (Downlink/Uplink)**
Enters a user-defined TSC. The length of the training sequences depends on the burst type. The first user bit is equivalent to the first bit of the training sequence. All further sequences are inserted successively.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:TPATtern on page 62

## 3.8 BSCH / BNCH/T

Access:

► Select "General > BSCH/BNCH/T".

In the "BSCH / BNCH/T" dialog, the contents of the broadcast synchronization channel (BSCH) and the broadcast network channel (BNCH/T) are configured. The BSCH and the BNCH are the two possible broadcast control channels (BCCH) that are transmitted in downlink direction only.

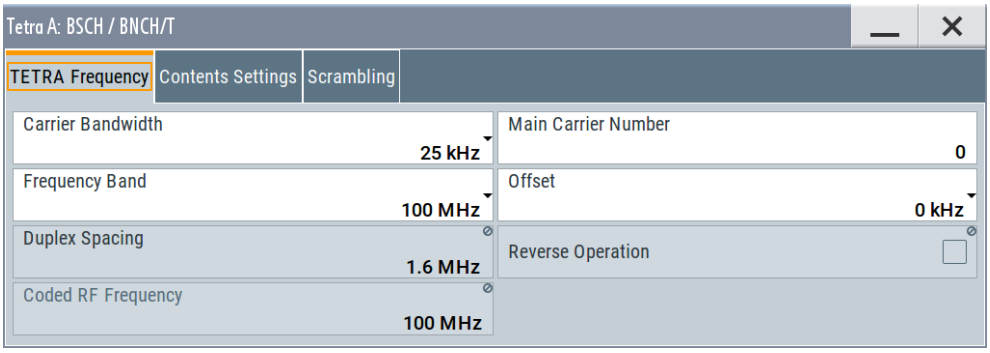
**Contents**



### 3.8.1 TETRA frequency

Access:

► Select "General > BSCH/BNCH/T > TETRA Frequency"




This section comprises the parameters necessary to set the carrier bandwidth and the frequency band.

**Settings:**



**Carrier Bandwidth**
Selects the carrier bandwidth, i.e. determines the carrier spacing.

The default value for all standard test modes is 25kHz. The carrier spacing of 50 kHz, 100 kHz and 150 kHz is enabled for "Test Mode" set to "User Defined" or "T4".

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:CBANdwidth` on page 64

**Main Carrier Number**
The "Main Carrier Number" divides the TETRA band into carriers with a spacing as set with the parameter "Carrier Bandwidth". The range is 0 to 4095 (12 bits).

The main carrier frequency is calculated as follows:

Main Carrier Frequency, kHz = "Main Carrier Number" * "Carrier Bandwidth"

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:MCNumber` on page 67

**Frequency Band**
Sets the "Frequency Band".

This setting affects the calculation of the transmission frequency. The frequency band information is inserted only in the TETRA BSCH protocol channel.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:FBANd` on page 66

**Offset**
Set the "Offset" to shift the center frequency in the channel spacing. The allowed offsets are +6.25, 0,–6.25 kHz and +12.50 kHz.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:OFFSet` on page 68

**Duplex Spacing**
(for Uplink direction only)

The "Duplex Spacing" and "Reverse Operation" parameters in the BNCH/T indicate the required uplink frequency with respect to the indicated downlink frequency. These parameters are defined in ETSI 300 392-2.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:DSPacing` on page 65

**Reverse Operation**
(for Uplink direction only)

Enables reverse operation.

Reverse operation is used to fix the uplink frequency relative to the downlink frequency. In normal operation, the uplink frequency is lower than the downlink frequency and in reverse operation, the uplink frequency is higher than the downlink frequency.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:ROPeration` on page 68

**Coded RF Frequency**
Displays the resulting RF frequency, calculated from the previous settings. The frequency is calculated from the "Frequency Band", "Main Carrier Number", "Offset", "Duplex Spacing" and "Reverse Operation" and transmitted in message channel BNCH/T when "Downlink MS V+D Testing" is selected.

The "Coded RF Frequency" is calculated as described in Table 3-1.

***Table 3-1: Calculation of coded RF frequency***

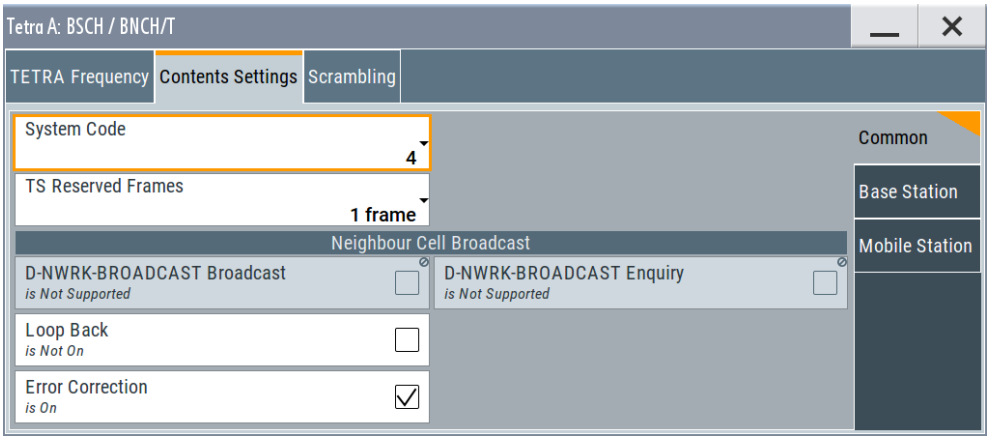
| "Link Direction" | "Reverse Operation" | "Coded RF Frequency", MHz |
|---|---|---|
| Downlink | - | Downlink coded RF Frequency = "Frequency Band" + ("Main Carrier Number"* "Carrier Bandwidth") + "Offset" |
| Uplink | Off<br>(Normal operation) | Uplink coded RF Frequency = Downlink coded RF Frequency - "Duplex Spacing" |
| | On | Uplink coded RF Frequency = Downlink coded RF Frequency + "Duplex Spacing" |

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:CRFRequency?` on page 64

### 3.8.2 Contents settings

Access:

1. Select "General > Link Direction > Downlink/ Forward".
2. Select "BSCH/BNCH/T > Contents Settings".




This dialog is enabled for downlink direction only. In the downlink mode, a synchronization burst is used to control the MS messages. In this burst, protocol elements are transmitted in BSCH and BNCH. The parameters are used to form the commands for the mobile station.This section comprises the parameters necessary to set the carrier bandwidth and the frequency band.

**Settings:**



**System Code**
Indicates whether the system is a TETRA V+D system or whether it is a "Direct Mode" transmission.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:SCODe on page 69

**TS reserved frames**
Determines the number of frames reserved over two multiframes period.

The way this field is processed, depends on the selected "Sharing Mode" on page 34. If MCCH sharing is indicated, the TS reserved frames field indicates which frames are reserved in this mode of operation. For the other values of sharing mode, the contents of the TS reserved frames field are ignored.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:TRFRames on page 70

**Frame 18 extension**
Enables the frame 18 extension element, i.e. indicates whether an MS is allowed to receive downlink information on all slots of the frame 18. If extension is allowed, only MSs which can receive consecutive slots are able to perform this function.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:FEEXtension on page 66

**Sharing Mode**
The sharing mode field indicates whether the BS is using continuous transmission, carrier sharing, MCCH sharing or traffic carrier sharing.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:SMODe on page 69

**U-plane DTX**
The "U-plane DTX" element indicates whether the BS supports discontinuous traffic transmission by the MS.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:UPDTx on page 71

**D-NWRK-BROADCAST broadcast**
Enables the support of the D-NWRK-BROADCAST PDU.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:DNBBroadcast on page 65

**D-NWRK-BROADCAST enquiry**
Enables the support of the D-NWRK-BROADCAST inquiry.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:DNBenquiry on page 65

**Cell service level**
Sets the cell service level information element, i.e. define the level of service an MS can receive in a cell. It can relate to the traffic loading in a cell.

The following service levels are supported:
- "Cell load unknown"
- "Low cell load"

- "Medium cell load"
- "High cell load"

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:CSLevel on page 65

**MS_TXPWR_MAX_CELL**
Sets the protocol information on the maximum transmission power for the mobile station. Allowed are values from 15 dBm to 45 dBm in 5 dB steps.

The MS_TXPWR_MAX_CELL parameter is used for cell selection and reselection, and for power adjustments.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:MTMCell on page 68

**Tx_on**
Determines the value of the Tx_on parameter, i.e. selects the test mode the MS operates in, "Reception ON" or "Transmission ON".

This parameter is necessary for the generation of test signal T1 or T4 transmitted by the test system.

"Transmission ON" The mobile station is requested to transmit.

"Reception ON" The mobile station is requested to receipt.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:TXON on page 70

**T1_T4_Burst_Type**
Sets the value of the special parameter T1_T4_Burst_Type, i.e. determines the logical channel the BS is expecting to receive.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:TTBType on page 70

**Error Correction**
Enables error correction.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:ECORrection on page 66

**Late Entry**
Sets the value of the late entry supported information element, used to indicate to the MS whether late entry can be supported by the cell.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:LENTry on page 67

**ACCESS_PARAMETER**
Sets the value of the ACCESS_PARAMETER information field. This parameter is used for subsequent power adjustments for the mobile station.

This protocol information field can have values from -53 dBm to -23 dBm in 2 dB steps.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:APARameter on page 63

**Tx_burst_type**
Sets the parameter Tx_burst_type and determines whether the MS under test transmit either a normal uplink burst or control uplink burst.

"Normal uplink burst" The mobile station transmits using normal uplink burst.

"Control uplink burst" The mobile station transmits using control uplink burst.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:TBTYpe on page 69

**Loop Back**
Enables the loop back for test purposes.

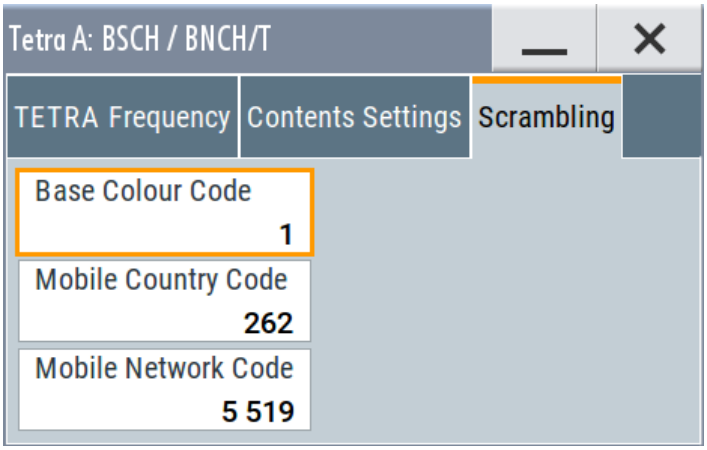
If enabled, the mobile station sets up a loop and returns the data when requested by the Tx_burst_type.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:LBACk on page 66

### 3.8.3 Scrambling

Access:

► Select "General > BSCH/BNCH/T > Scrambling".




The "Srcambling" section contains of the parameters necessary to configure the scrambling sequence.

The scrambling code is a 24-bit field composed of the "Mobile Country Code" (MCC) and "Mobile Network Code" (MNC) and is calculated as defined in EN 300 392. The MCC and MNC is a part of the MLE information contained within the SYNC PDU broadcast by the BS on the BSCH. The upper MAC adds a 6-bit color code which is

contained in the SYNC PDU. The combination of MCC, MNC and color code make up the scrambling code which the upper MAC passes to the lower MAC via the TMV-SAP. This scrambling code corresponds to the extended color code used for scrambling and descrambling in the lower MAC. The scrambling code corresponds to the 30-bit extended color code e(1), e(2),..., e(30).

***Table 3-2: Building of scrambling code***

| "Mobile Country Code (MCC)" | "Mobile Network Code (MNC)" | "Colour Code" |
|---|---|---|
| 10 bits | 14 bits | 6 bits |
| e(1) - e(10) | e(11) - e(24) | e(25) - e(30) |
| e(1) = msb[1)] of MCC | e(11) = msb of MNC | e(25) = msb of colour code |
| [1)]Most Significant Bit | | |

**Settings:**



**Base Colour Code**
Sets the colour code.

The base color code is the number of subscriber groups in a network.

See Table 3-2 for information on how the scrambling code is calculated.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:BCCode` on page 64

**Mobile Network Code**
Sets the mobile network code (MNC).

The MNC is the number of the TETRA network operator.

See Table 3-2 for information on how the scrambling code is calculated.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:MNCode` on page 68

**Mobile Country Code**
Sets the mobile country code.

The MCC is the number of the country in which the unit is operated.

See Table 3-2 for information on how the scrambling code is calculated.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:MCCode` on page 67

## 3.9 Filter / clipping settings

Access:

► Select "General > Filter/Clipping/ARB/IQ Settings".

The dialog contains the settings required to configure the baseband filter and to enable clipping.

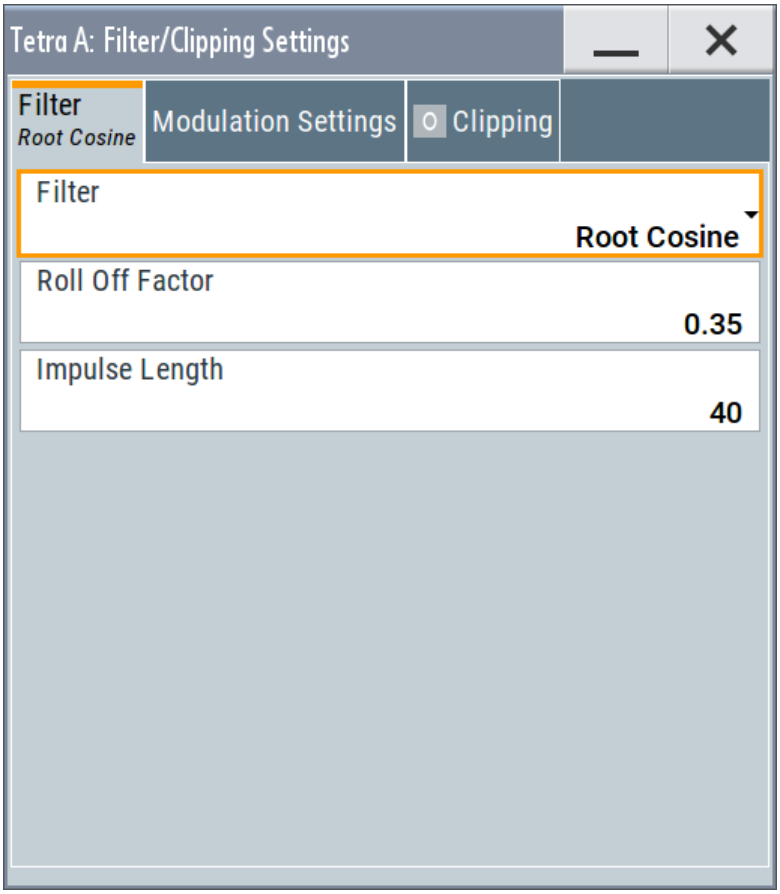
**Settings:**



### 3.9.1 Filter settings

Access:

► Select "General > Filter/Clipping".



**Settings:**



**Filter**
Selects the baseband filter.

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:TYPE` on page 73

**Roll Off Factor or BxT**
Sets the filter parameter.

The filter parameter ("Roll off Factor" or "BxT") depends on the currently selected filter type. This parameter is preset to the default for each of the predefined filters.

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine` on page 72
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:RCOSine` on page 72
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:PGAuss` on page 72
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:GAUSs` on page 72
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:SPHase` on page 72
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:APCO25` on page 72

**Cut Off Frequency Shift**
(available for filter parameter "Cosine" only)

Sets the value for the cut off frequency shift. The cut off frequency of the cosine filter can be adjusted to reach spectrum mask requirements.

The value range is -1.0 to 1.0.

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine:COFS` on page 73

**Cut Off Frequency Factor**
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:TETRa:FILTer:PARameter:LPASs` on page 72
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASSEVM` on page 72

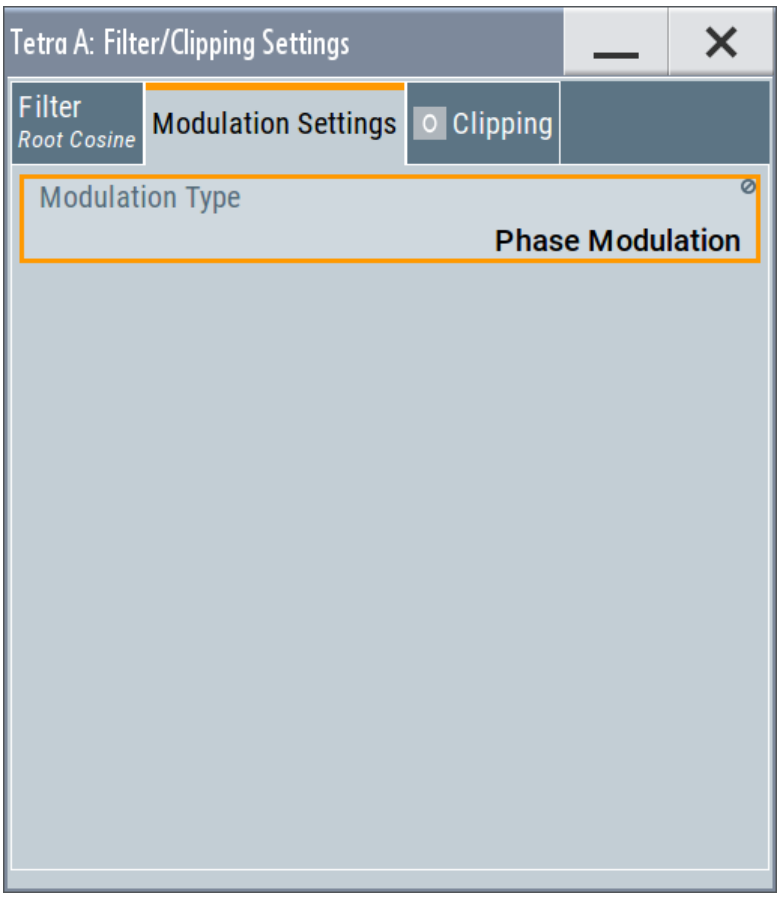
**Impulse Length**
Sets the number of filter tabs.

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:ILENgth` on page 72

### 3.9.2 Modulation settings

Access:

► Select "General > Filter/Clipping > Modulation".




This tab displays the used modulation type.

**Settings:**



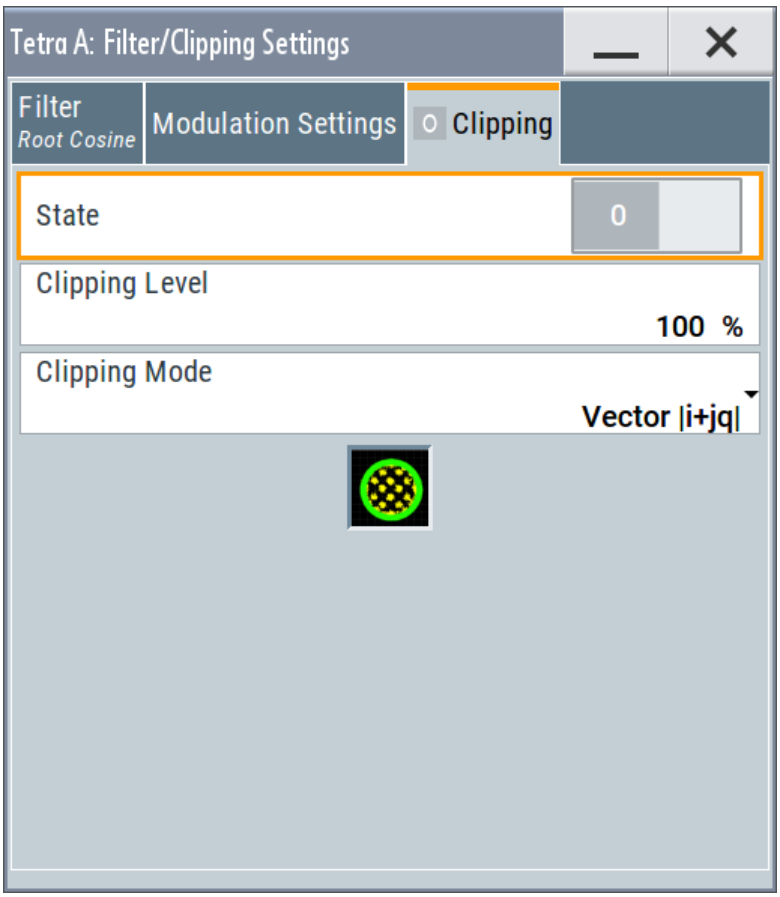
**Modulation Type**
Displays the modulation type as selected with the parameter "Modulation Type".

Remote command:
`[:SOURce<hw>]:BB:TETRa:MTYPe` on page 49

### 3.9.3 Clipping settings

Access:

► Select "General > Filter/Clipping > Clipping".




This tab contains the settings necessary ro configure the clipping.

**Settings:**



**Clipping State**
Switches baseband clipping on and off.

Baseband clipping is a simple and effective way of reducing the crest factor of the signal. Since clipping is done before to filtering, the procedure does not influence the spectrum. The EVM however increases.

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLIPping:STATe` on page 72

**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:TETRa:CLIPping:LEVel` on page 71

**Clipping Mode**
Selects the clipping method. The dialog displays a graphical illustration on how this two methods work.

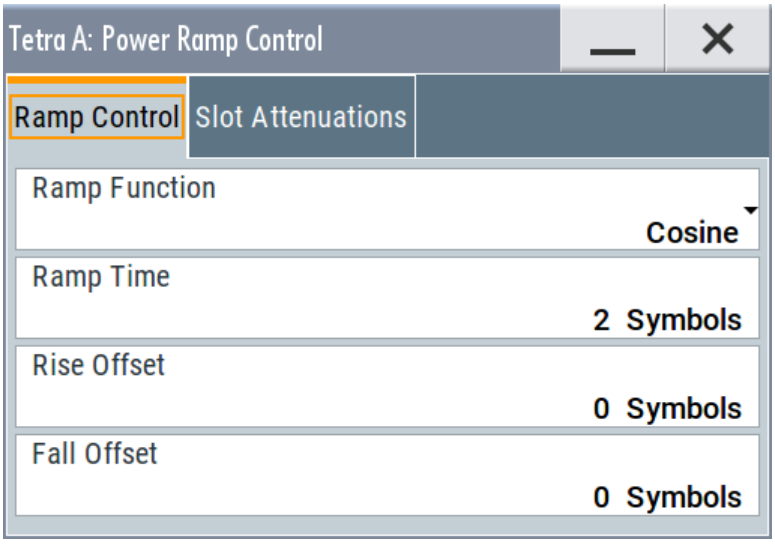
- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the angle changes.

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLIPping:MODE` on page 72

## 3.10 Power ramp control

Access:

► Select "General > Power Ramp/Slot Attenuations".




The dialog contains the settings for configuring the power ramping and level attenuation.The "Slot Attenuations" (used in "Frame Editor") section is used to define four possible values for level attenuation. You can select these values from the frame editor for the slot currently being edited.

This dialog provides access to the settings for power ramping and slot attenuation.

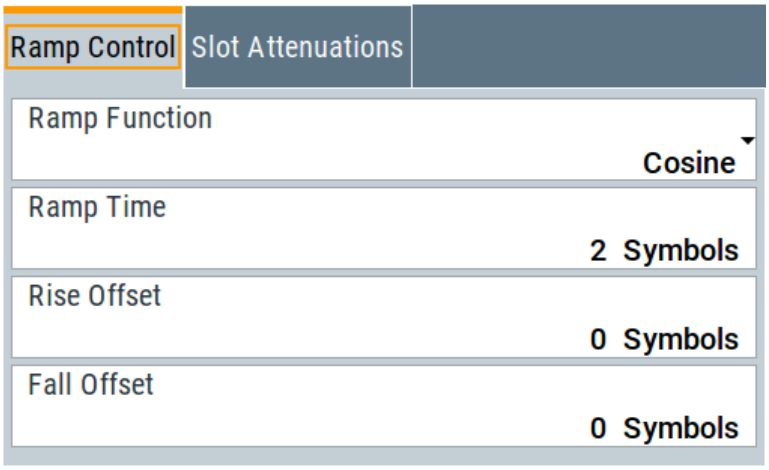
**Contents**



## 3.10.1 Ramp control

Access:

► Select "General > Power Ramp/Slot Attenuations > Ramp Control".




The dialog contains the settings for configuring the power ramping.

**Settings:**



**Ramp Function**
Selects the form of the transmitted power, i.e. the shape of the rising and falling during power ramp control.

"Linear" The transmitted power rises and falls 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:TETRa:PRAMping:RFUNction` on page 53

**Ramp Time**
Sets the power ramping rise time and fall time for a frame. The setting is expressed in symbols.

Do not switch the transmitted power abruptly at the end or the start of a frame, since the switching operation generates excessively strong non-harmonics. The switching operation is therefore stretched over several symbol clocks.

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:RTIMe` on page 54

**Rise Offset**
Sets the offset in the rising edge of the envelope at the start of a frame. A positive value causes a delay and a negative value causes an advance. The setting is expressed in symbols.

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:ROFFset` on page 53

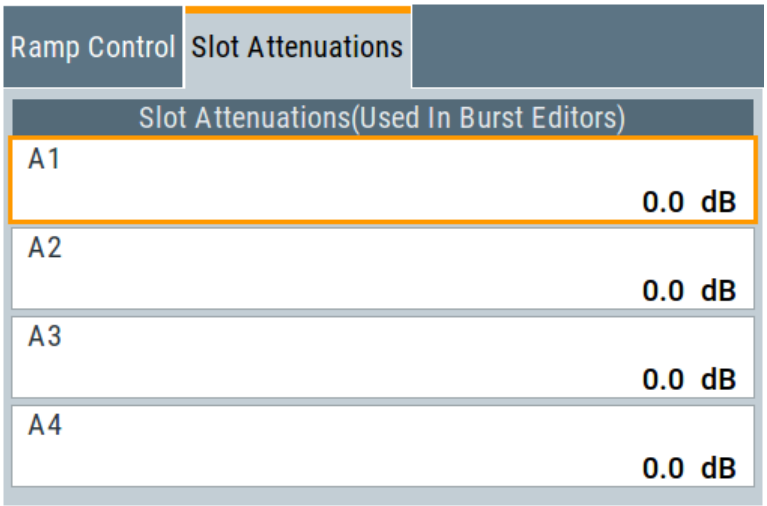
**Fall Offset**
Sets the offset in the falling edge of the envelope at the end of a frame. A positive value causes a delay and a negative value causes an advance. The setting is expressed in symbols.

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:FOFFset` on page 53

## 3.10.2 Slot attenuations

Access:

► Select "General > Power Ramp/Slot Attenuations > Slot Attenuations".



The dialog contains the settings for level attenuation. The "Slot Attenuations" (used in "Frame Editor") section is used to define four possible values for level attenuation. You can select these values from the frame editor for the slot currently being edited.

"Slot Level > Full" setting in the frame editor corresponds to 0 dB attenuation.

See "(Sub-) Slot Level" on page 27.

**Settings**



**Slot Attenuation A1 to A4**
Sets the four different values for level attenuation.

The frame editor can be used to set the level attenuation for the four slots to one of these predefined values independently of one another.

The set value determines the slot output power (slot power = RF power - attenuation). 0 dB attenuation corresponds to "Slot Level = Full".

This feature is provided to set a sequence of slots to different levels in order to measure transmission stability.

The frame editor is likewise used to assign the "Slot Level" attribute "Attenuated" to individual slots.

Remote command:
`[:SOURce<hw>]:BB:TETRa:SATTenuation<ch>` on page 54

# 4 Remote control commands

The following commands are required to perform signal generation with the TETRA options in a remote environment. We assume that the R&S SMW has already been set up for remote operation in a network as described in the R&S SMW documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

**Conventions used in SCPI command descriptions**

For a description of the conventions used in the remote command descriptions, see section "Remote Control Commands" in the R&S SMW user manual.

### Common suffixes

The following common suffixes are used in remote commands:

| Suffix | Value range | Description |
|---|---|---|
| `ENTity<ch>` | 1 .. 4 | entity in a multiple entity configuration with separate baseband sources<br>`ENTity3\|4` require option R&S SMW-K76 |
| `SOURce<hw>` | [1] to 4 | available baseband signals<br>only `SOURce1` possible, if the keyword `ENTity` is used |
| `OUTPut<ch>` | 1 to 3 | available markers |
| `TMODe<di>` | 1...4 | The numeric suffix to `TMODe` distinguishes between the test modes:<br>• `TMODe1` = Test Mode 1<br>• `TMODe2` = Test Mode 4<br>• `TMODe3` = User Defined<br>• `TMODe4` = Test Mode 2 |
| `SLOT<st>` | 1...8 | The numeric suffix to `SLOT` distinguishes between the slot numbers:<br>• `SLOT<1..4>` = Slots#1 to Slot#4 in Frame 1..17<br>• `SLOT<5..8>` = Slots#1 to Slot#4 in Frame 18 |
| `LDIRection<ch>` | 1...2 | The numeric suffix to `LDIRection` distinguishes between the link directions:<br>• `LDIRection1` = Downlink<br>• `LDIRection2` = Uplink |

**Using SCPI command aliases for advanced mode with multiple entities**

You can address multiple entities configurations by using the SCPI commands starting with the keyword `SOURce` or the alias commands starting with the keyword `ENTity`.

Note that the meaning of the keyword `SOURce<hw>` changes in the second case.

For details, see section "SCPI Command Aliases for Advanced Mode with Multiple Entities" in the R&S SMW user manual.

**Programming examples**

This description provides simple programming examples. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

At the beginning of the most remote control program, an instrument (p)reset is recommended to set the instrument to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

The following commands specific to the TETRA are described here:



## 4.1 General commands

**Example: Selecting test mode, link direction and channel type**

```
// set to default and query the TETRA standard version
SOURCe1:TETRa:PRESet
SOURce:BB:TETRa:VERSion?
// Response: "ETSI EN 300 392-2 V3.2.1."

SOURce1:BB:TETRa:TMODe T1
SOURce1:BB:TETRa:LDIRection DOWN
SOURce1:BB:TETRa:CTYPe CH0
// setting parameters for user and T2 test modes
// SOURce1:BB:TETRa:TMODe USER
// SOURce1:BB:TETRa:MTYPe PHASe
// SOURce1:BB:TETRa:DBTYpe CONT
SOURce1:BB:TETRa:SLENgth 1

// Save the configuraton in a waveform file
SOURCe1:BB:TETRa:WAVeform:CREate 'tetra_waveform_t1_dl'

// activate signal generation
SOURCE1:BB:TETRa:STATe 1
```

**Example: Saving current configuration**

```
SOURce1:BB:TETRa:SETTing:STORe '/var/user/tetra_t1_dl'
*RST
SOURce1:BB:TETRa:SETTing:CATalog?
// Response: tetra_t1_dl, tetra_user_dl
SOURce1:BB:TETRa:SETTing:LOAD '/var/user/tetra_t1_dl'
SOURce1:BB:TETRa:SETTing:DELete 'tetra_user_dl'
```



---

**[:SOURce<hw>]:BB:TETRa:CTYPe** <CType>

(for "Test Model" set to T1 or T4)

Determines the channel type.

**Parameters:**

<CType> CH0 | CH1 | CH2 | CH3 | CH4 | CH7 | CH8 | CH9 | CH10 | CH11 | CH21 | CH22 | CH23 | CH24 | CH25 | CH26 | CH27

*RST: CH0

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "Channel Type" on page 15

---

**[:SOURce<hw>]:BB:TETRa:DBTYpe** <DBType>

(in Downlink "Link Direction" and for "Test Model" set to T2 or User Defined)

Determines the downlink burst type.

**Parameters:**

<DBType> CONTinuous | DCONtinuous

*RST: CONTinuous

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "Downlink Burst Type" on page 15

---

**[:SOURce<hw>]:BB:TETRa:LDIRection** <LDirection>

Selects the transmission direction.

This parameter determines the available "Channel Types".

**Parameters:**

<LDirection> DOWN | UP

**DOWN**
The transmission direction selected is from the base station (BS) to the terminal (MS). The signal corresponds to that of a BS.

**UP**
The transmission direction selected is from MS to the BS. The signal corresponds to that of a terminal.

*RST: DOWN

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "Link Direction" on page 14

---

**[:SOURce<hw>]:BB:TETRa:MTYPe** <MType>

(for "Test Model" set to User Defined)

Determines the modulation type, "Phase" or "QAM."

**Parameters:**

<MType> PHASe | QAM

**PHASe**
The T2 test signal is a pi/4-DQPSK modulated continuous radio signal.

**QAM**
The T2 test signal is 4-QAM, 16-QAM or 64-QAM modulated and spans a bandwidth of 25kHz, 50kHz, 100kHz or 150kHz.

*RST: PHASe

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "Modulation Type" on page 15
See "Modulation Type" on page 40

---

**[:SOURce<hw>]:BB:TETRa:PRESet**

Sets the parameters of the digital standard to their (`*RST` values specified for the commands).

Not affected is the state set with the command `[:SOURce<hw>]:BB:TETRa:STATe`.

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Usage:** Event

**Manual operation:** See "Set to Default" on page 12

---

**[:SOURce<hw>]:BB:TETRa:SETTing:CATalog?**

Queries the files with settings in the default directory. Listed are files with the file extension `*.tetra`.

**Return values:**

<Catalog> <filename1>,<filename2>,...
Returns a string of file names separated by commas.

**Example:** See Example"Saving current configuration" on page 48.

**Usage:** Query only

**Manual operation:** See "Save/Recall" on page 13

---

**[:SOURce<hw>]:BB:TETRa:SETTing:DELete** <Filename>

Deletes the selected file in the specified directory. Deleted are files with the file extension `*.tetra`.

**Setting parameters:**

<Filename> <file name>
file name or complete file path

**Example:** See Example"Saving current configuration" on page 48

**Usage:** Setting only

**Manual operation:** See "Save/Recall" on page 13

---

**[:SOURce<hw>]:BB:TETRa:SETTing:LOAD** <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.tetra`.

**Setting parameters:**

<Filename> string
file name or complete file path

**Example:** See Example"Saving current configuration" on page 48

**Usage:** Setting only

**Manual operation:** See "Save/Recall" on page 13

**[:SOURce<hw>]:BB:TETRa:SETTing:STORe** <Filename>

Stores the current settings into the selected file; the file extension (`*.tetra`) is assigned automatically.

**Setting parameters:**

<Filename> string
file name or complete file path

**Example:** See Example"Saving current configuration" on page 48

**Usage:** Setting only

**Manual operation:** See "Save/Recall" on page 13

**[:SOURce<hw>]:BB:TETRa:SLENgth** <SLength>

Selects the sequence length of the arbitrary waveform file in the number of multi-frames. One multiframe is the minimum sequence length for a T1 signal.

**Parameters:**

<SLength> integer
Range: 1 to depends on carrier bandwidth
*RST: 1

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "Sequence Length" on page 15

**[:SOURce<hw>]:BB:TETRa:SRATe:VARiation** <Variation>

Sets the symbol rate of the signal. A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged.

**Parameters:**

<Variation> float
Range: 400 to 15E6
Increment: 0.001
*RST: 18000

**Example:** `BB:TETR:SRAT:VAR?`
queries the symbol rate of the signal.

**[:SOURce<hw>]:BB:TETRa: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"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "State" on page 12

---

**[:SOURce<hw>]:BB:TETRa:TMODe** <Tmode>

Selects the test mode.

Several settings depend on the selected test mode.

**Parameters:**

<Tmode> T1 | T4 | USER | T2 | T3

*RST: T1

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Manual operation:** See "Test Mode" on page 13

---

**[:SOURce<hw>]:BB:TETRa:VERSion?**

Queries the tetra standard version.

**Return values:**

<Version> string

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Usage:** Query only

---

**[:SOURce<hw>]:BB:TETRa:WAVeform:CREate** <Filename>

Saves the current settings as an ARB signal in a waveform file (`*.wv`).

**Setting parameters:**

<Filename> string

file name or complete file path; file extension is assigned automatically

**Example:** See Example"Selecting test mode, link direction and channel type" on page 47

**Usage:** Setting only

**Manual operation:** See "Generate Waveform" on page 13

## 4.2 Power ramp commands



**[:SOURce<hw>]:BB:TETRa:PRAMping:FOFFset** <FOffset>

Sets the offset in the falling edge of the envelope at the end of a frame. A positive value gives rise to a delay and a negative value causes an advance. The setting is expressed in symbols.

**Parameters:**

<FOffset> integer

Range: 0 to 4
*RST: 0

**Example:** `BB:TETR:PRAM:FOFF 10`

**Manual operation:** See "Fall Offset" on page 44

**[:SOURce<hw>]:BB:TETRa:PRAMping:RFUNction** <RFunction>

Enters the form of the transmitted power during the switching operation, i.e. the shape of the rising and falling edges of the envelope.

**Parameters:**

<RFunction> LINear | COSine

**LINear**
The transmitted power rises and falls linear fashion.

**COSine**
The transmitted power rises and falls with a cosine-shaped edge. This gives rise to a more favorable spectrum than the "Linear" setting.

*RST: COSine

**Example:** `BB:TETR:PRAM:RFUN LIN`

**Manual operation:** See "Ramp Function" on page 43

**[:SOURce<hw>]:BB:TETRa:PRAMping:ROFFset** <ROffset>

Sets the offset in the rising edge of the envelope at the start of a frame. A positive value gives rise to a delay and a negative value causes an advance. The setting is expressed in symbols.

**Parameters:**

<ROffset> integer

Range: -4 to 0
*RST: 0

**Example:** `BB:TETR:PRAM:ROFF 6`

**Manual operation:** See "Rise Offset" on page 44

---

**[:SOURce<hw>]:BB:TETRa:PRAMping:RTIMe** <Rtime>

Enters the power ramping rise time and fall time for a frame. The setting is expressed in symbols.

The transmitted power must not be switched abruptly at the start and end of a frame, because the switching operation would otherwise generate excessively strong non-harmonics; the switching operation is therefore stretched over several symbol clocks.

**Parameters:**

<Rtime> integer

Range: 1 to 13|16, depends on test mode
*RST: 2

**Example:** `BB:TETR:PRAM:RTIM 25`

**Manual operation:** See "Ramp Time" on page 44

---

**[:SOURce<hw>]:BB:TETRa:SATTenuation<ch>** <Sattenuation>

Enters four different values for level attenuation.

The frame editor can be used to set the level attenuation for the four slots to one of these predefined values independently of one another.

The entered value determines the slot output power (slot power = RF power - attenuation). 0 dB attenuation corresponds to "Slot Level" = Full.

This feature is provided to set a sequence of slots to different levels in order to measure transmission stability.

The frame editor is likewise used to assign the "Slot Level" attribute Attenuated to individual slots.

**Parameters:**

<Sattenuation> float

Range: 0 to 50
Increment: 0.1
*RST: 0

**Example:** `BB:TETR:SATT1 30`

**Manual operation:** See "Slot Attenuation A1 to A4" on page 45

## 4.3 Slot configuration commands



---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:LDIRection<ch>:TBTYpe**
<TbType>

Selects the burst type for "Test Mode T2".

**Parameters:**

<TbType> NCDB | SCDB | NDDB | SDDB | ND4 | ND16 | ND64 | NUB | CUB | NU4 | NU16 | NU64 | CU4 | CU16 | CU64 | RAB

*RST: NCDB

**Example:** `BB:TETR:SCON:SLOT3:LDIR1:TBTY NCDB`

**Manual operation:** See "T2 Burst Type" on page 27

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:UBBNch** <Ubbnch>

Enables/disables auto coding of the data.

If enabled, the selection of the data source is disabled.

**Parameters:**

<Ubbnch> 1 | ON | 0 | OFF

*RST: 0

**Example:**
```
SOURce:BB:TETRa:TMODe USER
SOURce:BB:TETRa:LDIRection DOWN
SOURce:BB:TETRa:SCONfiguration:SLOT1:UBBNch ON
```

**Manual operation:** See "Use Coded T1/T4 Data" on page 27

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:AMODe** <AMode>

(enabled for Frame 1- 17)

Sets the AACH-Q Mode element that indicates whether the Access-Assign PDU follows in the AACH-Q.

The AACH-Q (Access Assignment Channel, QAM) channel is present on all transmitted downlink slots (except slots containing BLCH-Q) and is used to indicate on each QAM physical channel the assignment of the uplink and downlink slots.

**Parameters:**

<AMode> AAPDu | RELement

**AAPDu**
The value of the AACH-Q Mode element is set to 0, i.e. contents of Access-Assign PDU are present.
The Access-Assign PDU is used to convey information about the downlink slot in which it appears and also the access rights for the corresponding (same-numbered) uplink slot.
The fields of the "Access-Assign PDU" are defined with the corresponding parameters.

**RELement**
The value shall be set to all zeros.

*RST: AAPDu

**Example:**
```
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:AMOD REL
```

**Manual operation:** See "AACH-Q Mode" on page 28

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF1** <Apf1>

Sets the value for the information element Field 1 of the Access-Assign PDU.

**Parameters:**

<Apf1> 8 bits

**Example:** `BB:TETR:SCON:TMOD2:SLOT3:LDIR1:APF1 #B000000,6`

**Manual operation:** See "Access-Assign PDU" on page 28

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF2** <Apf2>

Sets the value for the information element Field 2 of the Access-Assign PDU.

**Parameters:**
<Apf2> 8 bits

**Example:** `BB:TETR:SCON:TMOD2:SLOT3:LDIR1:APF2 #B000000,6`

**Manual operation:** See "Access-Assign PDU" on page 28

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APHeader** <ApHeader>

Sets the value for the information element Header 0f the Access-Assign PDU.

**Parameters:**
<ApHeader> 8 bits

**Example:** `BB:TETR:SCON:TMOD3:SLOT5:LDIR1:APH #B01,2`

**Manual operation:** See "Access-Assign PDU" on page 28

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:BSATtenuation** <BsAttenuation>

Selects the level attenuation for the "Slot Level" Attenuated setting.

**Parameters:**
<BsAttenuation> A1 | A2 | A3 | A4
*RST: A1

**Example:** `BB:TETR:SCON:TMOD1:SLOT3:LDIR1:BSAT A1`

**Manual operation:** See "(Sub-) Slot Attenuation" on page 27

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSATtenuation** <SSATtenuation>

Sets the attenuation for the second sub-slot in a control burst.

**Parameters:**
<SSATtenuation> A1 | A2 | A3 | A4
*RST: A1

**Example:** `BB:TETR:SCON:TMOD1:SLOT3:LDIR2:SSAT A1`

**Example:**
```
BB:TETR:LDIR UP
BB:TETR:CTYP CH11
```
Selects a control burst.
```
BB:TETR:SCON:TMOD1:SLOT3:LDIR2:BSAT A1
BB:TETR:SCON:TMOD1:SLOT3:LDIR2:SSAT A1
```
Sets the attenuation of the first and second sub-slot.

**Manual operation:** See "(Sub-) Slot Attenuation" on page 27

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA** <Data>

Defines the data source for the DATA fields in the burst.

**Parameters:**

<Data> PATTern | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | ALL0 | ALL1 | PN09

**ALL0|ALL1|**
Internal 0 or 1 data is used.

**PATT**
Internal data is used. The bit pattern for the data is defined with the aid of command `[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DPATtern` on page 58.

**PNxx**
The pseudo-random sequence generator is used as the data source. There is a choice of different lengths of random sequence.

**DLISt**
A data list is used. The data list is selected with the aid of command `[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection` on page 59.

*RST: PN09

**Example:**
```
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:DATA PN23
```

**Manual operation:** See "Data Source" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DPATtern** <DPattern>, <BitCount>

Selects the data pattern for data source pattern (`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA` on page 58).

**Parameters:**

<DPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

**Example:**
```
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:DATA PATT
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:DATA:DPAT #H3F,8
```

**Manual operation:** See "Data Source" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection** <DSelection>

Selects a data list. This command is only valid for bursts with DATA fields. This data list is only used if it is set as the data source with the aid of command `[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA` on page 58.

**Parameters:**

<DSelection> <data list name>

**Example:**
```
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:DATA DLIS
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:DATA:DSEL
'dl_tetra_t2_ul'
```

**Manual operation:** See "Data Source" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:LCTYpe** <LcType>

Selects the logical channel type.

The available channels depend on the selected test mode and link direction.

**Parameters:**

<LcType> T72 | T48 | T24 | TCHF | TCHH | STCH | SSTCh | SCHF | T108 | SP8F | SSHD | BSHD | SBNCh | BBNCh | S8HD | D4H | D16H | D64H | D64M | D16U | D64U | B4H | B16H | B64H | B64M | B16U | B64U | SSHU | S8HU | S4S8 | S8S4 | U4H | U16H | U64H | U64M | U16U | U64U | H4H | H16H | H64H | H64M | H16U | H64U | SQRA | D4U | U4U

*RST: T72|D4H

**Example:**
```
BB:TETR:SCON:TMOD2:SLOT3:LDIR1:LCTY T72
```

**Manual operation:** See "Logical Channel Type" on page 28

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SCRambling** <Scrambling>

Enables/disables auto scrambling.

**Parameters:**

<Scrambling> 1 | ON | 0 | OFF

*RST: 1

**Example:** `BB:TETR:SCON:TMOD2:SLOT3:LDIR1:SCR ON`

**Manual operation:** See "Scrambling" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa** <SData>

Defines the data source for the DATA fields in the burst.

**Parameters:**

<SData> PATTern | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | ALL0 | ALL1 | PN09

**ALL0|ALL1|**
Internal 0 or 1 data is used.

**PATT**
Internal data is used. The bit pattern for the data is defined with the aid of command `[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDPattern` on page 60.

**PNxx**
The pseudo-random sequence generator is used as the data source. There is a choice of different lengths of random sequence.

**DLISt**
A data list is used. The data list is selected with the aid of command `[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDSelection` on page 61.

*RST: PN09

**Example:** `BB:TETR:SCON:TMOD4:SLOT2:LDIR2:SDAT PN23`

**Manual operation:** See "Data Source" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDPattern** <SdPattern>, <BitCount>

Selects the data pattern for data source pattern (`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa` on page 60).

**Parameters:**

<SdPattern> numeric

*RST: #H0

<BitCount> integer

Range: 1 to 64
*RST: 1

**Example:**
```
BB:TETR:SCON:TMOD4:SLOT2:LDIR2:SDAT PATT
BB:TETR:SCON:TMOD4:SLOT2:LDIR2:SDAT:SDP #H3F,8
```

**Manual operation:** See "Data Source" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDSelection** <SdSelection>

Selects a data list. This command is only valid for bursts with DATA fields. This data list is only used if it is set as the data source with the aid of command `[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa` on page 60.

**Parameters:**

<SdSelection> <data list name>

**Example:**
```
BB:TETR:SCON:TMOD4:SLOT2:LDIR2:SDAT DLIS
BB:TETR:SCON:TMOD4:SLOT2:LDIR2:SDAT:SDS
'dl_tetra_t4_ul_2'
```

**Manual operation:** See "Data Source" on page 29

---

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SLEVel** <SLevel>

Sets the level for the selected slot.

**Parameters:**

<SLevel> OFF | ATTenuated | FULL

**OFF**
Attenuation is maximum. The slot is inactive.

**ATT**
Level is reduced by the level attenuation set in "Slot Attenuation".

**FULL**
The level corresponds to the level indicated in the display.

*RST: FULL

**Example:**
```
BB:TETR:SCON:TMOD1:SLOT3:LDIR1:SLEV FULL
```

**Manual operation:** See "(Sub-) Slot Level" on page 27

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSLevel** <SSLevel>

Sets the level for the second sub-slot.

**Parameters:**

<SSLevel> OFF | ATTenuated | FULL

**OFF**
Attenuation is maximum. The slot is inactive.

**ATT**
Level is reduced by the level attenuation set in "Slot Attenuation".

**FULL**
The level corresponds to the level indicated in the display.

*RST: FULL

**Example:**

```
BB:TETR:LDIR UP
BB:TETR:CTYP CH11
```

Selects a control burst.

```
BB:TETR:SCON:TMOD1:SLOT3:LDIR2:SLEV FULL
BB:TETR:SCON:TMOD1:SLOT3:LDIR2:SSLevel FULL
```

Sets the level of the first and second sub-slot.

**Manual operation:** See "(Sub-) Slot Level" on page 27

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:TPATtern** <TPattern>, <BitCount>

Enters a user-defined TSC. The length of the training sequences depends on the burst type. The first user bit is equivalent to the first bit of the training sequence. All further will be inserted successively.

**Parameters:**

<TPattern> numeric

*RST: #H000000000000000000000000

<BitCount> integer

Range: 1 to 96
*RST: 96

**Example:**

```
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:TPAT
#H000000000000000000000000,96
```

**Manual operation:** See "TSC User Defined" on page 30

**[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:TSOurce** <TSource>

Determines whether the default or a user-defined training sequence (TSC) is used.

A user-defined training sequence can be created in the field "TSC User Defined".

**Parameters:**
<TSource> DEFault | UDEFined
*RST: DEFault

**Example:** `BB:TETR:SCON:TMOD1:SLOT2:LDIR1:TSO DEF`

**Manual operation:** See "Training Sequence" on page 30

## 4.4 BSCH / BNCH/T commands



---

**[:SOURce<hw>]:BB:TETRa:BBNCht:APARameter** <AParameter>

Sets the value of the ACCESS_PARAMETER information field. This parameter is used for subsequent power adjustments for the mobile station.

This protocol information field can takes values from -53 dBm to -23 dBm in 2 dB steps.

**Parameters:**
<AParameter> AP53 | AP51 | AP49 | AP47 | AP45 | AP43 | AP41 | AP39 | AP37 | AP35 | AP33 | AP31 | AP29 | AP27 | AP25 | AP23
*RST: AP53

**Example:** `BB:TETR:BBNC:APAR AP31`

**Manual operation:** See "ACCESS_PARAMETER" on page 35

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:BCCode** <Bccode>

Sets the colour code.

The base color code is the number of subscriber group in a network.

See Table 3-2 for information on how the scrambling code is calculated.

**Parameters:**

<Bccode> integer

Range: 1 to 63
*RST: 1

**Example:** `BB:TETR:BBNC:BCC 55`

**Manual operation:** See "Base Colour Code" on page 37

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:CBANdwidth** <CBandwidth>

Selects the carrier bandwidth, i.e. determines the carrier spacing.

The default value for all standard test modes is 25kHz; carrier spacing of 50, 100 and 150 kHz is enabled for "Test Mode" set to User Defined or T4.

**Parameters:**

<CBandwidth> C25 | C50 | C100 | C150

*RST: C25

**Example:** `BB:TETR:BBNC:CBAN C25`

**Manual operation:** See "Carrier Bandwidth" on page 31

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:CRFRequency?**

Displays the resulting RF frequency, calculated from the previous settings. The frequency is calculated from the "Frequency Band", "Main Carrier Number", "Offset", "Duplex Spacing" and "Reverse Operation" and transmitted in message channel BNCH/T when Downlink MS V+D Testing is selected.

The "Coded RF Frequency" is calculated as described in Table 3-1.

**Return values:**

<CrFrequency> float

Range: 0 to 1000

**Example:** `BB:TETR:BBNC:CRFR?`

**Usage:** Query only

**Manual operation:** See "Coded RF Frequency" on page 32

**[:SOURce<hw>]:BB:TETRa:BBNCht:CSLevel** <CSLevel>

Sets the cell service level information element, i.e. define the level of service a MS may receive in a cell. It may relate to the traffic loading in a cell.

**Parameters:**

<CSLevel> CLUNknown | LCLoad | MCLoad | HCLoad

**CLUNknown**
Cell load unknown

**LCLoad**
Low cell load

**MCLoad**
Medium cell load

**HCLoad**
High cell load

*RST: CLUNknown

**Example:** `BB:TETR:BBNC:CSL LCL`

**Manual operation:** See "Cell service level" on page 34

**[:SOURce<hw>]:BB:TETRa:BBNCht:DNBBroadcast** <DnbBroadcast>

Enables/disables support of the D-NWRK-BROADCAST PDU.

**Parameters:**

<DnbBroadcast> 1 | ON | 0 | OFF

*RST: OFF

**Example:** `BB:TETR:BBNC:DNBB ON`

**Manual operation:** See "D-NWRK-BROADCAST broadcast" on page 34

**[:SOURce<hw>]:BB:TETRa:BBNCht:DNBenquiry** <DnbEnquiry>

Enables/disables support of the D-NWRK-BROADCAST enquiry.

**Parameters:**

<DnbEnquiry> 1 | ON | 0 | OFF

*RST: OFF

**Example:** `BB:TETR:BBNC:DNB ON`

**Manual operation:** See "D-NWRK-BROADCAST enquiry" on page 34

**[:SOURce<hw>]:BB:TETRa:BBNCht:DSPacing** <DSpacing>

(for Uplink direction only)

The "Duplex Spacing" and "Reverse Operation" parameters in the BNCH/T indicate the required uplink frequency with respect to the indicated downlink frequency. These parameters are defined in ETSI 300 392-2.

**Parameters:**
<DSpacing> DS0 | DS1 | DS2 | DS3 | DS4 | DS5 | DS6 | DS7
*RST: DS0

**Example:** `BB:TETR:BBNC:DSP DS2`

**Manual operation:** See "Duplex Spacing" on page 32

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:ECORrection** <ECorrection>

Enables/disables error correction.

**Parameters:**
<ECorrection> 1 | ON | 0 | OFF
*RST: ON

**Example:** `BB:TETR:BBNC:ECOR ON`

**Manual operation:** See "Error Correction" on page 35

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:FBANd** <FBand>

Sets the Frequency Band.

This setting has an effect on the calculation of the transmission frequency. The Frequency Band Information is inserted only in the TETRA BSCH protocol channel.

**Parameters:**
<FBand> F100 | F200 | F300 | F400 | F500 | F600 | F700 | F800 | F900
*RST: F100

**Example:** `BB:TETR:BBNC:FBAN F700`

**Manual operation:** See "Frequency Band" on page 31

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:FEEXtension** <FeExtension>

Enables/disables the frame 18 extension element, i.e. indicates whether an MS is allowed to receive downlink information on all slots of the frame 18. If extension is allowed, only MSs which are capable of receiving consecutive slots are able to perform this function.

**Parameters:**
<FeExtension> 1 | ON | 0 | OFF
*RST: OFF

**Example:** `BB:TETR:BBNC:FEEX ON`

**Manual operation:** See "Frame 18 extension" on page 34

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:LBACk** <LBack>

Enables/disables loop back for test purposes.

If enabled, the mobile station should set up a loop and return the data when requested by the Tx_burst_type.

**Parameters:**
<LBack> 1 | ON | 0 | OFF
*RST: OFF

**Example:** `BB:TETR:BBNC:LBAC ON`

**Manual operation:** See "Loop Back" on page 36

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:LENTry** <LEntry>

Sets the value of the late entry supported information element, used to indicate to the MS whether or not late entry can be supported by the cell.

**Parameters:**
<LEntry> 1 | ON | 0 | OFF
*RST: OFF

**Example:** `BB:TETR:BBNC:LENT ON`

**Manual operation:** See "Late Entry" on page 35

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:MCCode** <Mccode>

Sets the Mobile Country Code.

The MCC is the number of the country in which the unit is operated.

See Table 3-2 for information on how the scrambling code is calculated.

**Parameters:**
<Mccode> integer
Range: 0 to 1023
*RST: 262

**Example:** `BB:TETR:BBNC:MCC 900`

**Manual operation:** See "Mobile Country Code" on page 37

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:MCNumber** <Mcnumber>

The "Main Carrier Number" divides the TETRA band into carriers with a spacing as set with the parameter "Carrier Bandwidth". The range is 0 to 4095 (12 bits).

The Main Carrier Frequency is calculated as follow:

Main Carrier Frequency, kHz = "Main Carrier Number" * "Carrier Bandwidth"

**Parameters:**
<Mcnumber> integer
Range: 0 to 4095
*RST: 0

**Example:** `BB:TETR:BBNC:MCN 2300`

**Manual operation:** See "Main Carrier Number" on page 31

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:MNCode** <Mncode>

Sets the Mobile Network Code (MNC).

The MNC is the number of the TETRA network operator.

See Table 3-2 for information on how the scrambling code is calculated.

**Parameters:**

<Mncode> integer

Range: 0 to 16383
*RST: 5519

**Example:** `BB:TETR:BBNC:MNC 230`

**Manual operation:** See "Mobile Network Code" on page 37

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:MTMCell** <MtmCell>

Sets the protocol information on the maximum transmission power for the mobile station. Allowed are values from 15 dBm to 45 dBm in 5 dB steps.

The MS_TXPWR_MAX_CELL paramer is used for cell selection and reselection, and for power adjustments.

**Parameters:**

<MtmCell> M15 | M20 | M25 | M30 | M35 | M40 | M45

*RST: M15

**Example:** `BB:TETR:BBNC:MTMC M25`

**Manual operation:** See "MS_TXPWR_MAX_CELL" on page 35

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:OFFSet** <Offset>

Set the "Offset" to shifft the center frequency in the channel spacing. The allowed offsets are +6.25, 0,–6.25 and +12.50 kHz.

**Parameters:**

<Offset> ZERO | P625 | M625 | P125

*RST: ZERO

**Example:** `BB:TETR:BBNC:OFFS P125`

**Manual operation:** See "Offset" on page 32

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:ROPeration** <ROperation>

(for Uplink direction only)

Enables/disables reverse operation.

Reverse operation is used to fix the uplink frequency relative to the downlink frequency. In normal operation, the uplink frequency is lower than the downlink frequency and in reverse operation, the uplink frequency is higher than the downlink frequency.

**Parameters:**
<ROperation> 1 | ON | 0 | OFF
*RST: OFF

**Example:** `BB:TETR:BBNC:ROP ON`

**Manual operation:** See "Reverse Operation" on page 32

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:SCODe** <SCode>

Indicate whether the system is a TETRA V+D system or whether this is a Direct Mode transmission.

**Parameters:**
<SCode> S0 | S1 | S2 | S3 | S4 | S5 | S6 | S7
*RST: S4

**Example:** `BB:TETR:BBNC:SCOD S3`

**Manual operation:** See "System Code" on page 33

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:SMODe** <SMode>

The sharing mode field indicates whether the BS is using continuous transmission, carrier sharing, MCCH sharing or traffic carrier sharing.

**Parameters:**
<SMode> CTRansmission | CSHaring | MSHaring | TCSHaring
*RST: CTRansmission

**Example:** `BB:TETR:BBNC:SMOD CSHaring`

**Manual operation:** See "Sharing Mode" on page 34

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:TBTYpe** <TbType>

Sets the parameter Tx_burst_type and determines whether the MS under test transmit either a normal uplink burst or control uplink burst.

**Parameters:**
<TbType> NUB | CUB

**NUB**
The mobile station should transmit using normal uplink burst.

**CUB**
The mobile station should transmit using control uplink burst.

*RST: NUB

**Example:** `BB:TETR:BBNC:TBTY NUB`

**Manual operation:** See "Tx_burst_type" on page 36

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:TRFRames** <TrFrames>

Determines the number of frames reserved over two multiframes period.

The way this field is processed, depends on the selected `[:SOURce<hw>]:BB:TETRa:BBNCht:SMODe`. If MCCH sharing is indicated, the TS reserved frames field shall indicate which frames are reserved in this mode of operation. For the other values of sharing mode, the contents of the TS reserved frames field shall be ignored.

**Parameters:**

<TrFrames> F1 | F2 | F3 | F4 | F6 | F9 | F12 | F18

*RST: F1

**Example:** `BB:TETR:BBNC:TRFR F2`

**Manual operation:** See "TS reserved frames" on page 34

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:TTBType** <TtbType>

Sets the value of the special parameter T1_T4_Burst_Type, i.e. determines the logical channel the BS is expecting to receive.

**Parameters:**

<TtbType> T72F | T72S | SFD | BSHD | T24D | RSV1 | RSV2 | T72U | SFU | SSTCh | T24U | SSCH | RSV3 | RSBurst | RSSBurst | TPTD | TPTU | T48D | T48U | TSCD | TSCU | T108 | SPHD | SPHU | SPF | SQHU | SQU | SQD | SQRA

*RST: T72F

**Example:** `BB:TETR:BBNC:TTBT T48D`

**Manual operation:** See "T1_T4_Burst_Type" on page 35

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:TXON** <TxOn>

Determines the value of the Tx_on parameter, i.e. selects the test mode the MS operates in, "Reception ON" or "Transmission ON".

This parameter is neccessary for the generation of test signal T1 or T4 transmitted by the test system.

**Parameters:**

<TxOn> RON | TON

**RON**
The mobile station is requested to recept.

**TON**
The mobile station is requested to transmit.

*RST: RON

**Example:** `BB:TETR:BBNC:TXON RON`

**Manual operation:** See "Tx_on" on page 35

---

**[:SOURce<hw>]:BB:TETRa:BBNCht:UPDTx** <UpDtx>

The "U-plane DTX" element indicates whether or not the BS supports discontinuous traffic transmission by the MS.

**Parameters:**

<UpDtx> 1 | ON | 0 | OFF

*RST: OFF

**Example:** `BB:TETR:BBNC:UPDT ON`

**Manual operation:** See "U-plane DTX" on page 34

## 4.5 Filter/clipping commands



---

**[:SOURce<hw>]:BB:TETRa:CLIPping:LEVel** <Level>

Sets the limit for clipping.

**Parameters:**

<Level> integer

Range: 1 to 100
*RST: 100
Default unit: PCT

**Example:** `BB:TETR:CLIP:LEV 25`

**Manual operation:** See "Clipping Level" on page 42

**[:SOURce<hw>]:BB:TETRa:CLIPping:MODE** <Mode>

Selects the clipping method.

**Parameters:**

<Mode> VECTor | SCALar
*RST: VECTor

**Example:** `BB:TETR:CLIP:MODE SCAL`

**Manual operation:** See "Clipping Mode" on page 42

**[:SOURce<hw>]:BB:TETRa:CLIPping:STATe** <State>

Switches baseband clipping on and off.

**Parameters:**

<State> 1 | ON | 0 | OFF
*RST: OFF

**Example:** `BB:TETR:CLIP:STAT ON`

**Manual operation:** See "Clipping State" on page 41

**[:SOURce<hw>]:BB:TETRa:FILTer:ILENgth** <ILength>

Sets the impulse length (number of filter tabs).

**Parameters:**

<ILength> integer
Range: 2 to 100
*RST: 40

**Example:** `BB:TETR:FILT:ILEN 20`

**Manual operation:** See "Impulse Length" on page 39

**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine** <Cosine>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:GAUSs** <Gauss>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASs** <LPass>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASSEVM** <LPassEvm>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:PGAuss** <PGauss>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:RCOSine** <RCosine>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:SPHase** <SPhase>
**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:APCO25** <Apco25>

Sets the filter parameter.

**Parameters:**

<Apco25> float
Range: 0.05 to 0.99
Increment: 0.01
*RST: 0.2

**Example:**
```
BB:TETR:FILT:TYPE APCO25
BB:TETR:FILT:PAR:APCO25 0.1
```

**Manual operation:** See "Roll Off Factor or BxT" on page 39

---

**[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine:COFS** <Cofs>

Sets the value for the cut off frequency shift. The cut off frequency of the cosine filter can be adjusted to reach spectrum mask requirements.

**Parameters:**

<Cofs> float

Range: -1 to 1
Increment: 0.01
*RST: -0.1

**Example:**
```
BB:TETR:FILT:TYPE COS
BB:TETR:FILT:PAR:COS:COFS 0.5
```

**Manual operation:** See "Cut Off Frequency Shift" on page 39

---

**[:SOURce<hw>]:BB:TETRa:FILTer:TYPE** <Type>

Sets the baseband filter.

**Parameters:**

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | DIRac | ENPShape | EWPShape

*RST: RCOSine

**Example:**
```
SOURce1:BB:TETRa:FILTer:TYPE GAUS
```

**Manual operation:** See "Filter" on page 39

## 4.6 Trigger commands

**Example: Configuring trigger signals**

```
SOURce1:BB:TETRa:TRIGger:SEQuence ARETrigger
SOURce1:BB:TETRa:TRIGger:SOURce EGT1
SOURce1:BB:TETRa:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:TETRa:TRIGger:EXTernal:INHibit 100
SOURce1:BB:TETRa:TRIGger:EXTernal:DELay 10


SOURce1:BB:TETRa:TRIGger:SEQuence SING
SOURce1:BB:TETRa:TRIGger:SLUNit SEQ
```

```
// SOURce1:BB:TETRa:TRIGger:SLUNit MFR
SOURce1:BB:TETRa:TRIGger:SLENgth 2


SOURce1:BB:TETRa:TRIGger:SOURce INTernal
SOURce1:BB:TETRa:TRIGger:SEQuence ARETrigger
SOURce1:BB:TETRa:STATe ON
SOURce1:BB:TETRa:TRIGger:EXECute
// executes a trigger, signal generation starts
SOURce1:BB:TETRa:TRIGger:ARM:EXECute
// signal generation stops
SOURce1:BB:TETRa:TRIGger:EXECute
// executes a trigger, signal generation starts again
SOURce1:BB:TETRa:TRIGger:RMODe?
// queries the current signal generation status
// 1 (running)

BB:TETRa:TRIG:SOUR OBAS
// sets triggering by the other path
BB:TETRa:TRIG:INH 200
// sets a restart inhibit for 200 chips following a trigger event
BB:TETRa:TRIG:OBAS:DEL 50
// sets a delay of 50 symbols for the trigger
```

**Commands:**



### [:SOURce<hw>]:BB:TETRa:TRIGger:ARM:EXECute

Stops signal generation; a subsequent trigger event restarts signal generation.

**Example:** See Example"Configuring trigger signals" on page 73

**Usage:** Event

**Manual operation:** See "Arm" on page 18

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:EXECute**

Executes a trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

**Example:** See Example"Configuring trigger signals" on page 73

**Usage:** Event

**Manual operation:** See "Execute Trigger" on page 19

---

**[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:SYNChronize:OUTPut** <Output>

Enables signal output synchronous to the trigger event.

**Parameters:**

<Output> 1 | ON | 0 | OFF

*RST: 1

**Example:** See Example"Configuring trigger signals" on page 73

**Manual operation:** See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 19

---

**[:SOURce<hw>]:BB:TETRa: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"Configuring trigger signals" on page 73

**Manual operation:** See "External Delay/Trigger Delay" on page 20

---

**[:SOURce<hw>]:BB:TETRa: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 65535
Increment: 0.01
*RST: 0

**[:SOURce<hw>]:BB:TETRa: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"Configuring trigger signals" on page 73

**Manual operation:** See "External Inhibit/Trigger Inhibit" on page 20

**[:SOURce<hw>]:BB:TETRa:TRIGger:RMODe** <RMode>

Queries the status of signal generation for all trigger modes.

**Parameters:**

<RMode> STOP | RUN

*RST: STOP

**Example:** See Example"Configuring trigger signals" on page 73

**Manual operation:** See "Running/Stopped" on page 18

**[:SOURce<hw>]:BB:TETRa: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"Configuring trigger signals" on page 73

**Manual operation:** See "Signal Duration" on page 18

**[:SOURce<hw>]:BB:TETRa:TRIGger:SLUNit** <SlUnit>

Defines the unit of the signal sequence length that is output in the `SINGle` trigger mode.

**Parameters:**

<SlUnit> SEQuence | MFRame

*RST: SEQuence

**Example:** See Example"Configuring trigger signals" on page 73

**Manual operation:** See "Signal Duration Unit" on page 17

**[:SOURce<hw>]:BB:TETRa:TRIGger:SOURce** <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the local or global connectors
  - `EGT1|EGT2`: External global trigger
  - `EGC1|EGC2`: External global clock
  - `ELTRigger`: External local trigger
  - `ELCLock`: External local clock
- Internal triggering by a signal from the other basebands (`INTA|INTB`)
- `OBASeband|BEXTernal|EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators.
  The R&S SMW accepts these values and maps them automatically as follows:
  `EXTernal = EGT1, BEXTernal = EGT2, OBASeband = INTA or INTB`
  (depending on the current baseband)

**Parameters:**

<Source> INTB|INTernal|OBASeband|EGT1|EGT2|EGC1|EGC2|ELTRigger|INTA|ELCLock|BEXTernal|EXTernal

*RST: INTernal

**Example:** See Example"Configuring trigger signals" on page 73

**Manual operation:** See "Source" on page 19

**[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:DELay** <Delay>

Sets the trigger delay.

**Parameters:**

<Delay> float

Range: 0.0 to 65535
Increment: 0.01
*RST: 0.0

**[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal]:DELay** <Delay>

Sets the trigger delay.

**Parameters:**

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0
Default unit: samples

**Example:** See Example"Configuring trigger signals" on page 73

**Manual operation:** See "External Delay/Trigger Delay" on page 20

---

**[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:INHibit** <Inhibit>

Specifies the duration by which a restart is inhibited.

**Parameters:**

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

---

**[:SOURce<hw>]:BB:TETRa: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*symRate(=18E3)
*RST: 0

**Example:** See Example"Configuring trigger signals" on page 73

**Manual operation:** See "External Inhibit/Trigger Inhibit" on page 20

---

**[:SOURce<hw>]:BB:TETRa: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"Configuring trigger signals" on page 73

**Manual operation:** See "Mode" on page 17

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:TIME:DATE** <Year>, <Month>, <Day>

Sets the date for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this date via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

**Parameters:**

<Year> integer
Range: 1980 to 9999

<Month> integer
Range: 1 to 12

<Day> integer
Range: 1 to 31

**Example:** See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

**Manual operation:** See "Trigger Time" on page 18

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:TIME:TIME** <Hour>, <Minute>, <Second>

Sets the time for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this time via the following command:

SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

**Parameters:**

<Hour> integer
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 00 to 59

**Example:** See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

**Manual operation:** See "Trigger Time" on page 18

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:TIME[:STATe]** <State>

Activates time-based triggering with a fixed time reference. If activated, the R&S SMW triggers signal generation when its operating system time matches a specified time.

Specify the trigger date and trigger time with the following commands:

SOURce<hw>:BB:<DigStd>:TRIGger:TIME:DATE

SOURce<hw>:BB:<DigStd>:TRIGger:TIME:TIME

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

**Parameters:**

<State> 1 | ON | 0 | OFF
*RST: 0

**Example:** See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMW user manual.

**Manual operation:** See "Time Based Trigger" on page 18

## 4.7 Marker commands

### Example: Configuring marker signals

```
SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE RESTart
// sets a marker at ARB sequence start
// SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE SSTart
// SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE FSTart
// SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE MFSTart
// SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE HFSTart

SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE PULSe
// sets a pulse marker
SOURce1:BB:TETRa:TRIGger:OUTPut1:PULSe:DIVider 2
SOURce1:BB:TETRa:TRIGger:OUTPut1:PULSe:FREQuency?
// 500000

SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE PATTern
// sets a bit pattern marker
SOURce1:BB:TETRa:TRIGger:OUTPut1:PATTern #H2,2

SOURce1:BB:TETRa:TRIGger:OUTPut1:MODE RAT
SOURce1:BB:TETRa:TRIGger:OUTPut1:ONTime 40
SOURce1:BB:TETRa:TRIGger:OUTPut1:OFFTime 20
// defines the on/off ratio
```

### Example: Configuring marker delay

```
SOURce1:BB:TETRa:TRIGger:OUTPut2:DELay 1600
// delays the marker signal output
```

### Commands:

**[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay** <Delay>

Defines the delay between the signal at the marker outputs and the start of the signals.

**Parameters:**

<Delay> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

**Example:** See Example"Configuring marker delay" on page 80.

**Manual operation:** See "Delay" on page 23

**[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE** <Mode>

Defines the signal for the selected marker output.

**Parameters:**

<Mode> RESTart | SSTart | FSTart | MFSTart | HFSTart | PULSe | PATTern | RATio

**RESTart**
A marker signal is generated at the start of each ARB sequence.

**SSTart**
A marker signal is generated at the start of each slot.

**FSTart**
A marker signal is generated at the start of each frame.

**MFSTart**
A marker signal is generated at the start of each multiframe.

**HFSTart**
A marker signal is generated at the start of each hyperframe.

**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.

**PATTern**
A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 64 bits and is defined with the command `[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PATTern` on page 82.

**RATio**
A marker signal corresponding to the Time Off / Time On specifications in the commands `[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:ONTime` on page 82 and `[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime` on page 82 is generated.
*RST: RESTart

**Example:** See Example"Configuring marker signals" on page 80.

**Manual operation:** See "Mode" on page 22

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:ONTime** <Ontime>
**[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime** <Offtime>

Sets the duration during which the marker output is on or off.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/ symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

**Parameters:**
<Offtime> integer
Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 16777215
*RST: 1

**Example:** See Example"Configuring marker signals" on page 80

**Manual operation:** See "Mode" on page 22

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PATTern** <Pattern>, <BitCount>

Sets a data pattern.

**Parameters:**
<Pattern> numeric
*RST: #H2

<BitCount> integer
Range: 1 to 64
*RST: 2

**Example:** See Example"Configuring marker signals" on page 80.

**Manual operation:** See "Mode" on page 22

---

**[:SOURce<hw>]:BB:TETRa: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 SMW user manual.

**Parameters:**

<Divider> integer

Range: 2 (R&S SMW-B10) / 2* (R&S SMW-B9) to 1024
*RST: 2

**Example:** See Example"Configuring marker signals" on page 80.

**Manual operation:** See "Mode" on page 22

---

**[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:FREQuency?**

Queries the marker pulse frequency.

**Return values:**

<Frequency> float

Increment: 0.001

**Example:** See Example"Configuring marker signals" on page 80.

**Usage:** Query only

**Manual operation:** See "Mode" on page 22

## 4.8 Clock commands

This section lists the remote control commands to configure the clock.

**Example: Configuring the clock**

```
SOURce:BB:TETRa:CLOCk:SOURce INTernal
// selects internal clock

SOURce1:BB:TETRa:CLOCk:SOURce ELCL
// selects and configure the external clock signal
SOURce1:BB:TETRa:CLOCk:MODe SAMP
```



---

**[:SOURce<hw>]:BB:TETRa:CLOCk:MODE** <Mode>

Sets the type of externally supplied clock.

**Parameters:**

<Mode> SAMPle

*RST: SAMPle

**Example:** `SOURce1:BB:TETRa:CLOCk:MODE SAMPle`

**Options:** R&S SMW-B10

**Manual operation:** See "Clock Mode" on page 24

---

**[:SOURce<hw>]:BB:TETRa:CLOCk:SOURce** <Source>

Selects the clock source.

**Parameters:**

<Source> INTernal | ELCLock | EXTernal

**INTernal**
The instrument uses its internal clock reference

**ELCLock**
External local clock

**EXTernal**
`EXTernal = EGC1`
Setting only; provided for backward compatibility with other Rohde & Schwarz signal generators.

*RST: INTernal

**Example:** `BB:TETR:CLOC:SOUR INT`
selects the nternal clock reference.

**Options:** ELCLock requires R&S SMW-B10

**Manual operation:** See "Clock Source" on page 24

# List of commands

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