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

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMW-K68
  1413.4439.xx

This manual describes firmware version FW 3.20.324.xx and later of the R&S®SMW200A.

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

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1 Preface

1.1 Documentation Overview

The user documentation for the R&S SMW consists of the following parts:

- Getting Started printed manual
- Online Help system on the instrument, incl. Tutorials
- Documentation CD-ROM with:
  - Getting Started
  - Online help system (Web Help and `*.chm`) as a standalone help
  - User Manuals for base unit and options
  - Service manual
  - Data sheet and product brochure
  - Links to useful sites on the Rohde & Schwarz internet

Online Help

The Online Help is embedded in the software. It offers quick, context-sensitive access to the complete information needed for operation and programming. The online help contains help on operating the R&S SMW and all available options.

Getting Started

The Getting Started is delivered with the instrument in printed form and in PDF format on the documentation CD. It provides the information needed to set up and start working with the instrument. Basic operations and typical signal generation examples are described. Safety information is also included.

This manual is available in several languages. You can download these documents from the Rohde & Schwarz website, on the R&S SMW product page at http://www.rohde-schwarz.com/product/SMW200A.html > Downloads > Manuals.

User Manual

User manuals are provided for the base unit and each additional (software) option.

The User Manual for the base unit is a supplement to the Getting Started manual and provides basic information on operating the R&S SMW in general. In this manual, all instrument functions are described in detail. Furthermore, it provides a complete description of the remote control commands with programming examples. An introduction to remote control is provided, as well as information on maintenance, instrument interfaces and troubleshooting.

In the user manuals for the individual software options, the specific instrument functions of this option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S SMW is not included in these user manuals.

The user manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument.

All user manuals are also available for download from the Rohde & Schwarz website, on the R&S SMW product page at http://www.rohde-schwarz.com/product/SMW200A.html > Downloads > Manuals.

Service Manual

The service manual is available in PDF format on the CD delivered with the instrument. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S SMW by replacing modules.

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes.

The latest versions are available for download from the R&S SMW product page, at http://www.rohde-schwarz.com/product/SMW200A.html > Downloads > Firmware.

Web Help

The web help provides online access to the complete information on operating the R&S SMW and all available options, without downloading. The content of the Web Help corresponds to the user manuals for the latest product version.

The web help is available from the R&S SMW product page, at http://www.rohde-schwarz.com/product/SMW200A.html > Downloads > Web Help.

Tutorials

A set of tutorials is embedded in the software. The tutorials offer guided examples and demonstrations on operating the R&S SMW.

Application Notes

Application notes, application cards, white papers and educational notes are further publications that provide more comprehensive descriptions and background information.

A subset of application notes is provided on the documentation CD-ROM delivered with the instrument.

The latest versions are available for download from the Rohde & Schwarz website, at http://www.rohde-schwarz.com/appnotes.

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

1.2.3 Notes on Screenshots

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

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 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 is 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 specifiction.
- Additionaly, 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 for download at the product homepage.

Installation

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

2.1 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".

2.2 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, this includes:

- Managing settings and data lists, i.e. storing and loading settings, creating and accessing data lists, accessing files in a particular directory, etc.
- Information on regular trigger, marker and clock signals as well as 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.

3 TETRA2 Configuration and Settings

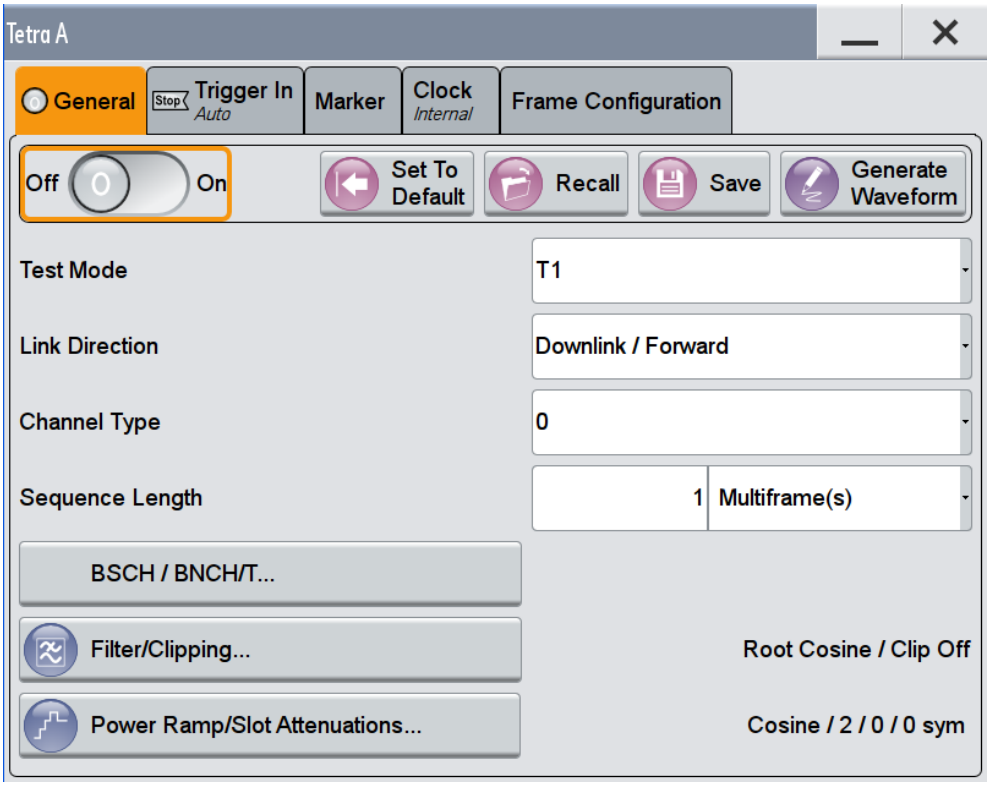
► To access the TETRA2 settings, select "Baseband > TETRA".

The remote commands required to define these settings are described in chapter 4, "Remote Control Commands", on page 41.

3.1 General Settings

This dialog provides access to the default, the "Save/Recall" settings and to the settings for selection of a test mode, channel type and link direction.

► To access this dialog select "Baseband > TETRA > General".



This dialog comprises the standard general settings, valid for the signal in both transmission directions.

State....11
Set to Default....11
Save/Recall....11
Generate Waveform....12
Test Mode....12
Link Direction....13
Channel Type....13

Modulation Type....13
Downlink Burst Type....13
Sequence Length....13
BSCH / BNCH/T....14
Filter / Clipping....14
Power Ramp/Slot Attenuations....14

State
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 46

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
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 43

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

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

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:SETTing:LOAD` on page 44
`[:SOURce<hw>]:BB:TETRa:SETTing:STORe` on page 45
`[:SOURce<hw>]:BB:TETRa:SETTing:STORe:FAST` on page 45
`[:SOURce<hw>]:BB:TETRa:SETTing:CATalog?` on page 44
`[:SOURce<hw>]:BB:TETRa:SETTing:DELete` on page 44

Generate Waveform
With enabled signal generation, triggers the instrument to store the current settings as an ARB signal in a waveform file. Waveform files can be further processed by the ARB and/or as a multi carrier or a multi segment signal.

The file name and the directory it is stored in are user-definable; the predefined file extension for waveform files is `*.wv`.

Remote command:
`[:SOURce<hw>]:BB:TETRa:WAVeform:CREate` on page 46

Test Mode
Selects the test mode.

Several settings depends on the selected test model.

"T1" Test signal T1 (TETRA wanted signal, phase modulated)
This test mode enables the generation of test signal 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 interfer)
The T2 test signal is phase or QAM modulated, depending on the selected Modulation Type.

"T3" Test sugnal 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 46

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 43

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

Determines the channel type.

Remote command:
[:SOURce<hw>]:BB:TETRa:CTYPe on page 42

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 43

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 42

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 45

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 28.

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 35.

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 39).

The currently selected ramp function and ramp time are displayed.

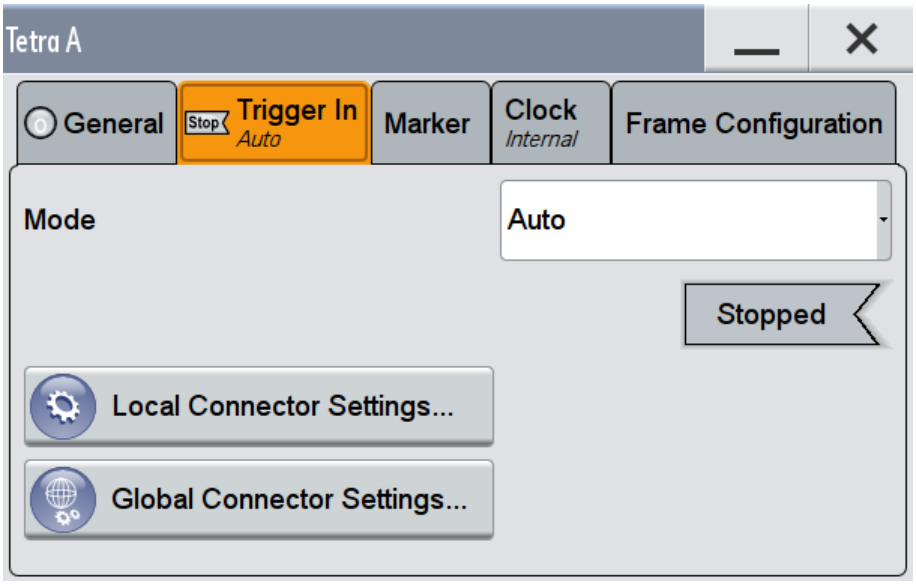
3.2 Trigger Settings

This tab provides access to the settings necessary to select and configure the trigger, like trigger source, mode, trigger delay, trigger suppression, as well as to arm or trigger an internal trigger manually. The current signal generation status is displayed in the header of the tab together with information on the enabled trigger mode. As in the "Marker" and "Clock" tabs, this tab provides also an access to the settings of the related connectors.

This section focuses on the available settings.

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

► To access this dialog, select "Baseband > TETRA > Trigger In".



This dialog comprises the settings required for configuring the trigger signal.

Routing and Enabling a Trigger

The provided trigger signals are not dedicated to a particular connector but can be mapped to one or more globally shared USER or local T/M/(C) connectors.

Use the Local and Global Connector Settings to configure the signal mapping as well as the polarity, the trigger threshold and the input impedance of the input connectors.

To route and enable a trigger signal, perform the following *general steps*:

- Define the signal source and the effect of a trigger event, i.e. select the "Trigger In > Mode" and "Trigger In > Source"
- Define the connector, USER or T/M/(C), the selected signal is provided at, i.e. configure the Local and Global Connector 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 (e.g. MIMO configuration, routing and summing of basebands and/or streams).

The icon indicates that common trigger settings are applied.

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

Trigger Mode ← Trigger Settings Common to All Basebands

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 with 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 with 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 71

Signal Duration Unit ← Trigger Settings Common to All Basebands
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 70

Trigger Signal Duration ← Trigger Settings Common to All Basebands
Enters the length of the signal sequence to be output in the "Single" trigger mode.

Use this parameter to deliberately output part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:SLENgth` on page 69

Running/Stopped ← Trigger Settings Common to All Basebands
For 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 69

Arm ← Trigger Settings Common to All Basebands
Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:ARM:EXECute on page 67

Execute Trigger ← Trigger Settings Common to All Basebands
For internal trigger source, executes trigger manually.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:EXECute on page 67

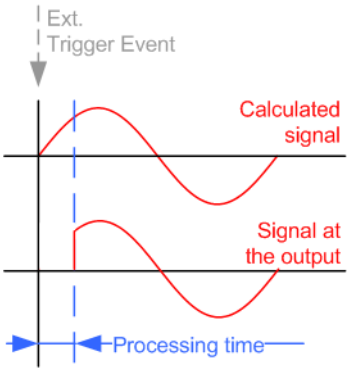
Trigger Source ← Trigger Settings Common to All Basebands
The following sources of the trigger signal are available:

- "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 1 / 2"
  The trigger event is the active edge of an external trigger signal provided and configured at the global USER connectors.
- "External Global Clock 1 / 2"
  The trigger event is the active edge of an external global clock signal provided and configured at the global USER 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/C 1/2/3 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/C 1 connector.

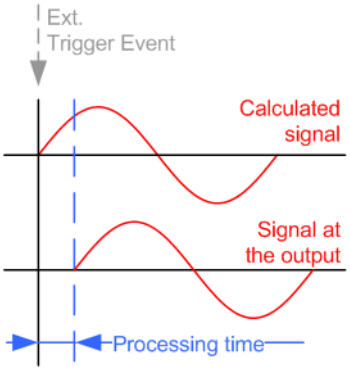
Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:SOURce on page 70

Sync. Output to External Trigger ← Trigger Settings Common to All Basebands
For an external trigger signal, enables/disables the output of a signal synchronous to the external trigger event.

"On" Corresponds to the default state of this parameter.
The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time 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 and starts with sample 0, i.e. the complete signal is output.
This mode is recommended for triggering of short signal 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 67

External Trigger Inhibit ← Trigger Settings Common to All Basebands
For external trigger signal or trigger signal from the other path, sets the duration a new trigger event subsequent to triggering is suppressed. In "Retrigger" mode for example, a new trigger event will 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 71
`[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:INHibit` on page 68

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.

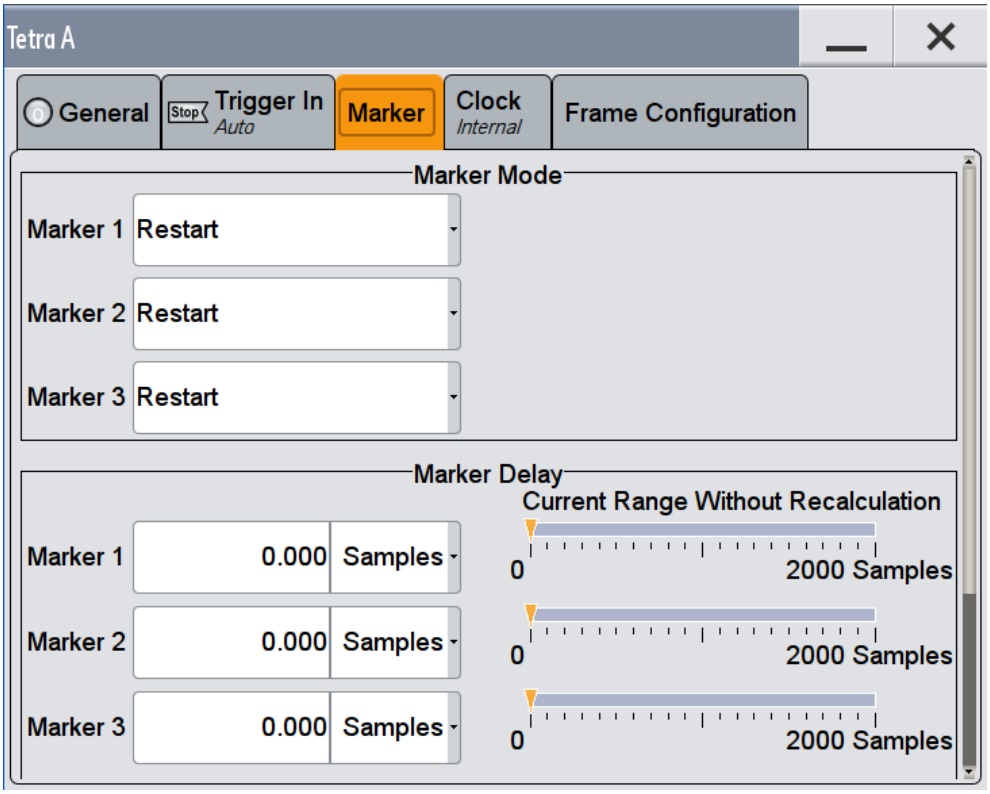
Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal]:DELay` on page 71
`[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:DELay` on page 67

3.3 Marker Settings

This tab provides an access to the settings necessary to select and configure the marker output signal, like the marker mode or marker delay settings.

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.

► To access this dialog, select "Baseband > TETRA > Marker".



This dialog comprises the settings required for configuring the marker mode and the marker delay.

Routing and Enabling a Marker

The provided marker signals are not dedicated to a particular connector but can be mapped to one or more globally shared USER or local T/M/(C) connectors.

To route and enable a marker signal, perform the following *general steps*:

- Define the shape of the generated marker, i.e. select the "Marker > Mode"
- Define the connector, USER or T/M/(C), the selected signal is output at, i.e. configure the Local and Global Connector Settings.

Marker Mode

Marker configuration for up to 3 marker channels. 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; the settings are self-explanatory.

"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 74
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:FREQuency? on page 74

"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 74

"ON/OFF Period" 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 a number of 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 73
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime on page 73

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE on page 72

Marker x Delay
Defines the delay between the marker signal at the marker outputs relative to the signal generation start.

"Marker x" For the corresponding marker, sets the delay as a number of symbols.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay on page 68

"Current Range without Recalculation"
Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and the signal.
Move the setting mark to define the delay.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MINimum? on page 69
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MAXimum? on page 69

"Fix marker delay to current range"
Restricts the marker delay setting range to the dynamic range.

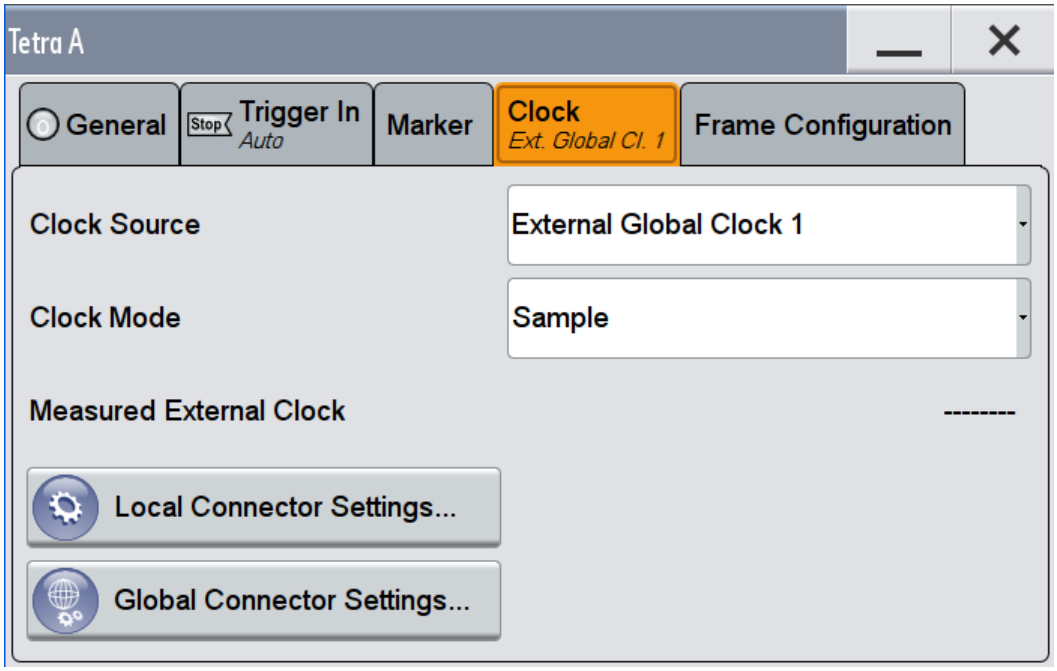
Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut:DELay:FIXed` on page 68

3.4 Clock Settings

This tab provides an access to the settings necessary to select and configure the clock signal, like the clock source and clock mode.

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

► To access this dialog, select "Baseband >TETRA > Clock".



This dialog comprises the settings required for configuring the clock signal.

Defining the Clock

The provided clock signals are not dedicated to a particular connector but can be mapped to one or more globally shared USER and the two local T/M/C connectors.

Use the Local and Global Connector Settings to configure the signal mapping as well as the polarity, the trigger threshold and the input impedance of the input connectors.

To route and enable a trigger signal, perform the following *general steps*:

- Define the signal source, i.e. select the "Clock > Source"
- Define the connector, USER or T/M/C, the selected signal is provided at, i.e. configure the Local and Global Connector Settings.

Clock Source

Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.
- "External Global Clock 1/2"
  The instrument expects an external clock reference at the global USER connector, as configured in the "Global Connector Settings" dialog.
- "External Local Clock"
  The instrument expects an external clock reference at the local T/M/C connector.

Remote command:

`[:SOURce<hw>]:BB:TETRa:CLOCk:SOURce` on page 66

Clock Mode

Enters the type of externally supplied clock.

Remote command:

`[:SOURce<hw>]:BB:TETRa:CLOCk:MODE` on page 65

Clock Multiplier

Enters the multiplication factor for clock type "Multiple".

Remote command:

`[:SOURce<hw>]:BB:TETRa:CLOCk:MULTiplier` on page 65

Measured External Clock

Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:

`CLOCk:INPut:FREQuency?`

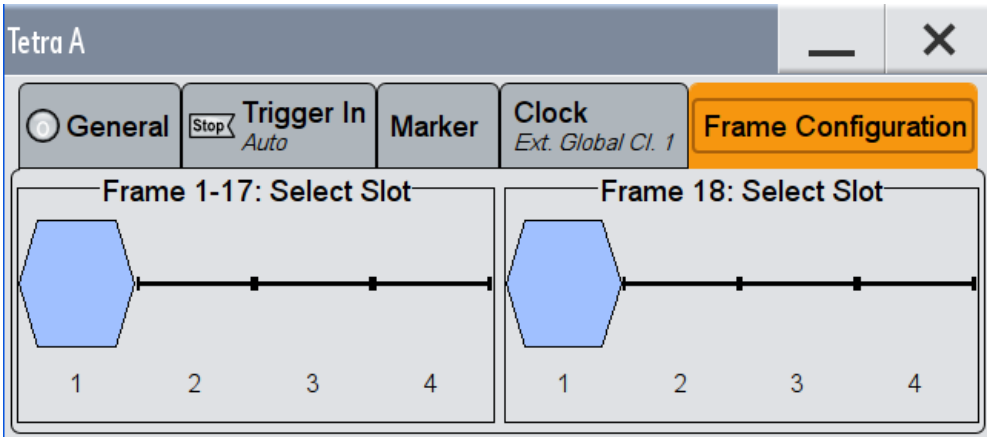
3.5 Local and Global Connector Settings

Each of the "Trigger In", "Marker" and "Clock" dialogs as well as the "Trigger Marker Clock" dialog provides a quick access to the related local and global connector settings.

For more information, refer to the description R&S SMW User Manual, section "Local and Global Connectors".

3.6 Frame Configuration Settings

1. To access this dialog select "Baseband > TETRA > Frame Configuration".



   The dialog displays the frames slots graphically.

2. Select a slot to be configured.

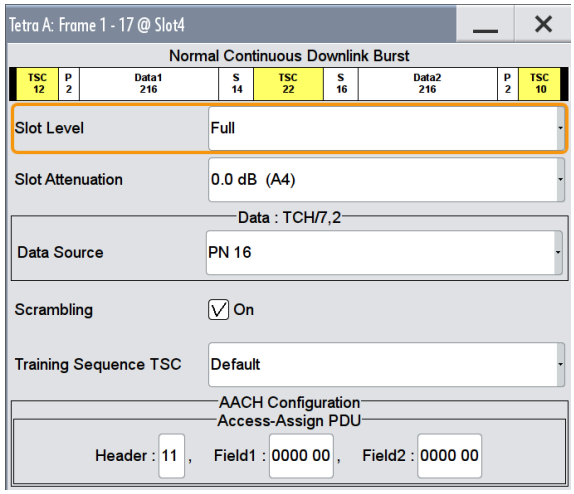
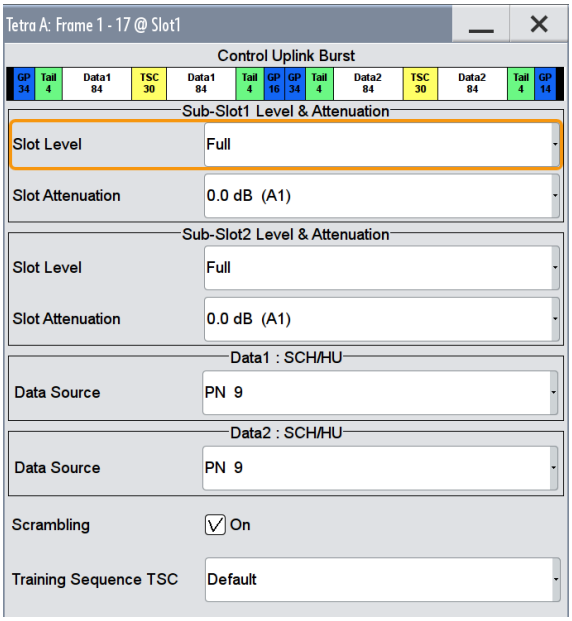
   The corresponding burst editor dialog opens, see chapter 3.7, "Burst Editor", on page 24.

3.7 Burst Editor

► To access this dialog, 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, this is mentioned for the parameter concerned.

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:LDIRection<ch>:TBTYpe` on page 49

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

Sub-slots 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 55 for "Slot Level"
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSLevel` on page 55 for "Sub-Slot Level".

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

Sub-slots are used by control bursts only.

Use the Power Ramp Control 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 51 for "Slot-Attenuation".
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSATtenuation` on page 52 for "Sub-Slot Attenuation".

Use Coded T1/T4 Data
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 50

Data Source
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, these are treated as a continuous field, and 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 52
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa on page 54
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection on page 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDSelection on page 55
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DPATtern on page 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDPattern on page 54

Logical Channel Type
Selects the logical channel type.

Tha 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 53

Scrambling
Enables/disables auto scrambling.

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SCRambling on page 54

Training Sequence
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 56

TSC User Defined
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.

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

AACH-Q Mode
(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.

"Access-Assign PDU" 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.

"Reserved Element" The value shall be set to all zeros.

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:AMODe` on page 50

Access-Assign PDU
(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 51

"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 51

"Field2" Sets the value for the information element Fieled 2.

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF2` on page 51

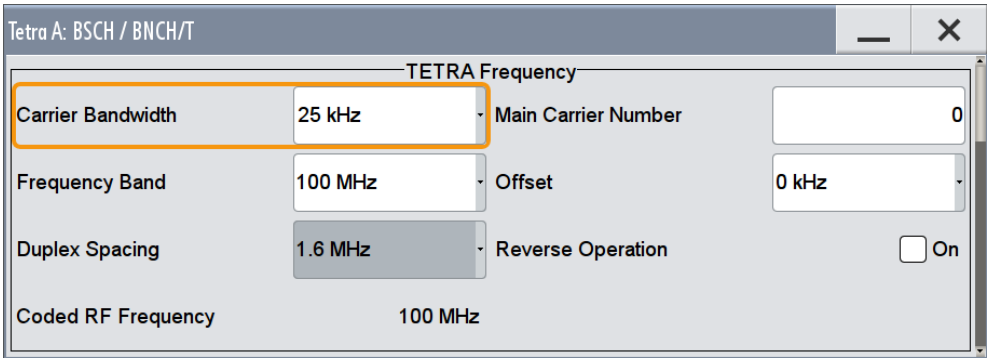
3.8 BSCH / BNCH/T

► To access this dialog 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.

3.8.1 TETRA Frequency

► To access this dialog select "General > BSCH/BNCH/T > TETRA Frequeuncy"



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

Provided are the following settings:

Carrier Bandwidth
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:CBANdwidth` on page 58

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 follow:

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:MCNumber` on page 61

Frequency Band
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:FBANd` on page 60

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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:OFFSet` on page 62

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 59

Reverse Operation
(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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:ROPeration` on page 62

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.

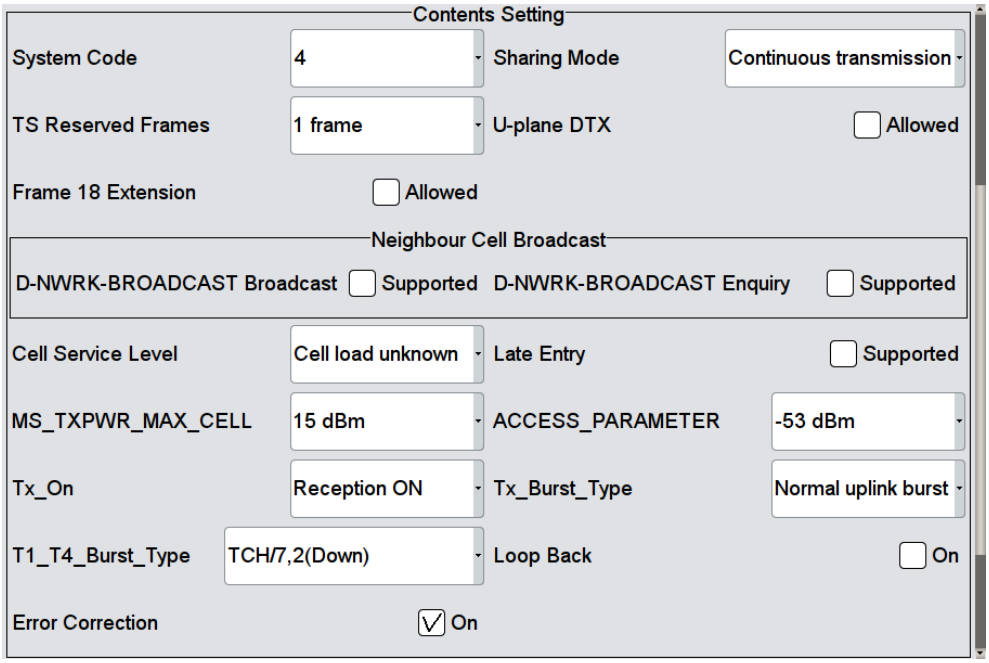
Table 3-1: Calculation of Coded RF Frequency

"Link Direction"	"Reverse Operation"	"Coded RF Frequency", MHz
Downlink	-	Downlink Coded RF Frequency = "Frequency Band" + ("Main Carrier Number"* "Carrier Bandwidth") + "Offset"
Uplink	Off (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 58

3.8.2 Contents Settings

1. To access this dialog 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.

Provided are the following settings.

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

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

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 32. 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.

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

Frame 18 extension
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:FEEXtension` on page 60

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 63

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

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

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:DNBBroadcast` on page 59

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:BBNCht:DNBenquiry` on page 59

Cell service level
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.

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 58

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

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:MTMCell on page 62

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 neccessary 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 recept.

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

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 64

Error Correction
Enables/disables error correction.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:ECORrection on page 60

Late Entry
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.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:LENTry on page 61

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 takes values from -53 dBm to -23 dBm in 2 dB steps.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:APARameter on page 57

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 should transmit using normal uplink burst.

"Control uplink burst" The mobile station should transmit using control uplink burst.

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

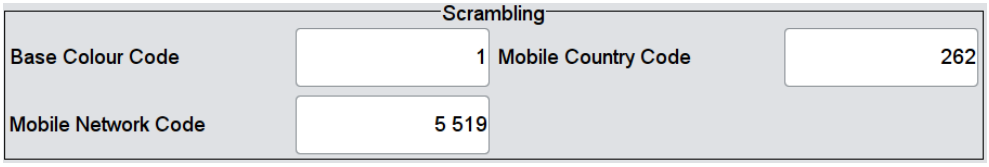
Loop Back
Enables/disables loop back for test purposes.

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

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:LBACk on page 60

3.8.3 Scrambling

► To access this dialog select "General > BSCH/BNCH/T > Scrambling".



The "Srcambling" section comprises 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 to this 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 scarmbling 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		

Base Colour Code
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.

Remote command:
[:SOURce<hw>]:BB:TETRa:BBNCht:BCCode on page 57

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 62

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 61

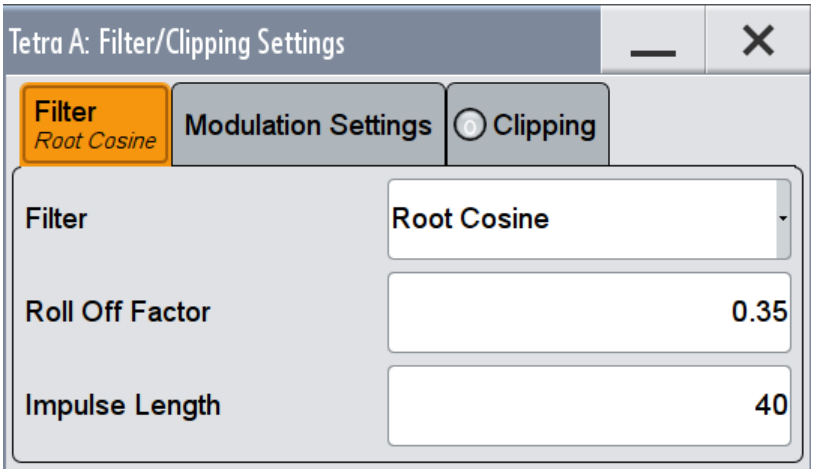
3.9 Filter / Clipping Settings

► To access this dialog, select "General > Filter/Clipping/ARB/IQ Settings".

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

3.9.1 Filter Settings

► To access this dialog select "General > Filter/Clipping".



Provided are the following settings for configuring the baseband filter:

Filter
Selects the baseband filter.

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

Roll Off Factor or BxT
Sets the filter parameter.

The filter parameter offered ("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 76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:RCOSine on page 76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:PGAuss on page 76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:GAUSs on page 76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:SPHase on page 76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:APCO25 on page 76

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 77

Cut Off Frequency Factor
Sets the value for the cut off frequency factor. The cut off frequency of the filter can be adjusted to reach spectrum mask requirements.

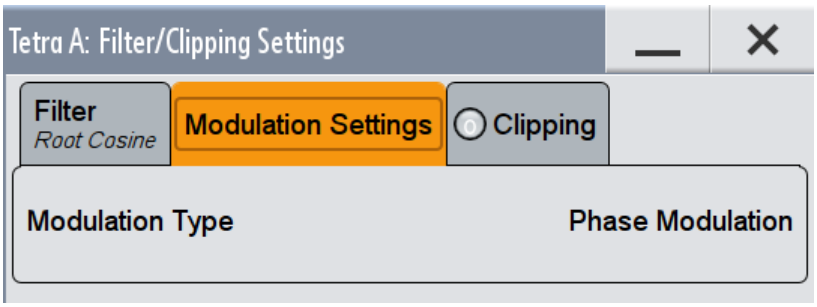
Remote command:
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASs on page 76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASSEVM on page 76

Impulse Length
Sets the number of filter tabs.

Remote command:
[:SOURce<hw>]:BB:TETRa:FILTer:ILENgth on page 76

3.9.2 Modulation Settings

► To access this dialog select "General > Filter/Clipping > Modulation".



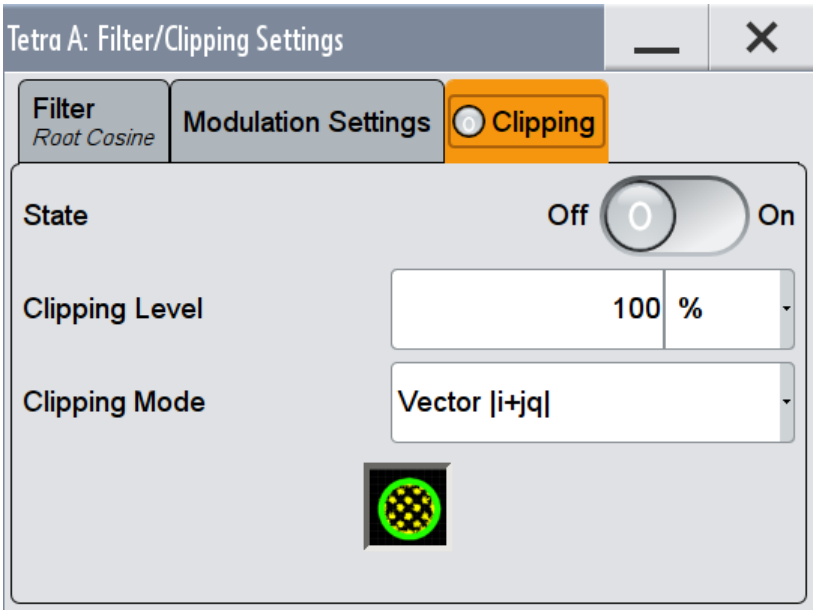
Provided are the following settings:

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

Remote command:
[:SOURce<hw>]:BB:TETRa:MTYPe on page 43

3.9.3 Clipping Settings

► To access this dialog select "General > Filter/Clipping > Clipping".



Provided are the following settings:

Clipping State
Switches baseband clipping on and off.

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLIPping:STATe` on page 75

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 75

Clipping Mode
Selects the clipping method. A graphic illustration of the way in which these two methods work is given in the dialog.

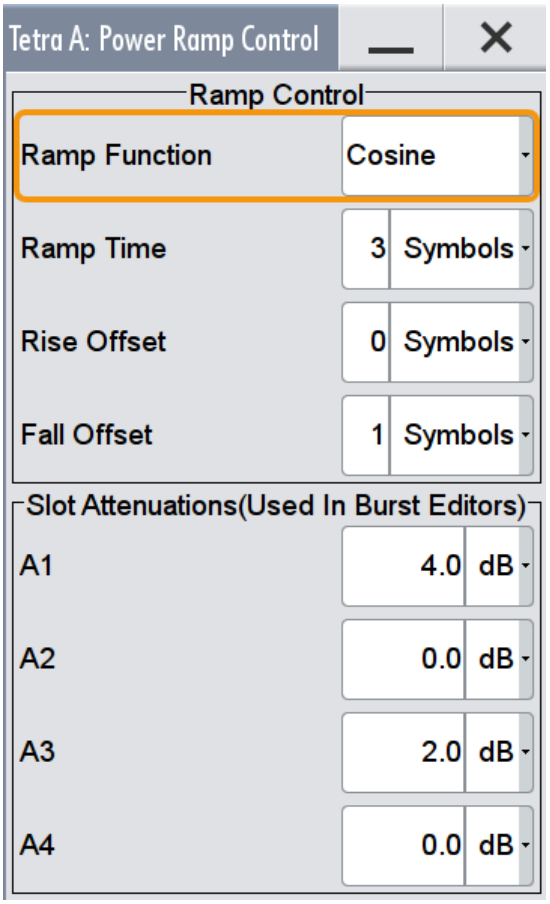
- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the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

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLIPping:MODE` on page 75

3.10 Power Ramp Control

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

► To access this dialog 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.

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

Provided are the following settings:

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

"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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:RFUNction` on page 47

Ramp Time
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

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:RTIMe` on page 48

Rise Offset
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:ROFFset` on page 48

Fall Offset
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:PRAMping:FOFFset` on page 47

Slot Attenuation A1 to A4
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:SATTenuation<ch>` on page 48

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

The following commands specific to the TETRA are described here:

4.1 Primary Settings

[:SOURce<hw>]:BB:TETRa:CTYPe 42
[:SOURce<hw>]:BB:TETRa:DBTYpe 42
[:SOURce<hw>]:BB:TETRa:LDIRection 43
[:SOURce<hw>]:BB:TETRa:MTYPe 43
[:SOURce<hw>]:BB:TETRa:PRESet 43
[:SOURce<hw>]:BB:TETRa:SETTing:CATalog? 44
[:SOURce<hw>]:BB:TETRa:SETTing:DELete 44
[:SOURce<hw>]:BB:TETRa:SETTing:LOAD 44
[:SOURce<hw>]:BB:TETRa:SETTing:STORe 45
[:SOURce<hw>]:BB:TETRa:SETTing:STORe:FAST 45
[:SOURce<hw>]:BB:TETRa:SLENgth 45
[:SOURce<hw>]:BB:TETRa:SRATe:VARiation 46
[:SOURce<hw>]:BB:TETRa:STATe 46
[:SOURce<hw>]:BB:TETRa:TMODe 46
[:SOURce<hw>]:BB:TETRa:WAVeform:CREate 46

[: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: `BB:TETR:CTYP CH2`

Manual operation: See "Channel Type" on page 13

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

(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.

Parameters:

<DBType> CONTinuous | DCONtinuous

*RST: CONTinuous

Example: `BB:TETR:DBTY CONT`

Manual operation: See "Downlink Burst Type" on page 13

[: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: `BB:TETR:LDIR UP`

Manual operation: See "Link Direction" on page 13

[: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: `BB:TETR:MTYP QAM`

Manual operation: See "Modulation Type" on page 13

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

Calls the default settings.

Example: `BB:TETR:PRES`

Usage: Event

Manual operation: See "Set to Default" on page 11

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

Reads out the files with TETRA settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.tetra` will be listed.

Return values:
<Catalog> string

Example: `MMEM:CDIR '/var/user/temp/tetra'`
sets the default directory to /var/user/temp/tetra.
`BB:TETR:SETT:CAT?`
reads out all the files with TETRA settings in the default directory.
`Response: 'tetra_t1_dl'`
the file "`tetra_t1_dl`" is available.

Usage: Query only

Manual operation: See "Save/Recall" on page 11

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

This command deletes the selected file with TETRA settings in the specified directory. The file extension may be omitted. Only files with the file extension `*.tetra` will be deleted.

Setting parameters:
<Filename> <file name>

Example: `BB:TETR:SETT:DEL '/var/user/temp/tetra_t1_dl'`

Usage: Setting only

Manual operation: See "Save/Recall" on page 11

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

Loads the selected file with TETRA settings in the specified directory. The file extension may be omitted. Only files with the file extension `*.tetra` will be loaded.

Setting parameters:
<Filename> <file name>

Example: `MMEM:CDIR '/var/user/temp/tetra'`
sets the default directory to /var/user/temp/tetra.
`BB:TETR:SETT:CAT?`
reads out all the files with TETRA settings in the default directory.
`Response: 'tetra_t1_dl'`
the file `tetra_t1_dl` is available.
`BB:TETR:SETT:LOAD '/var/user/temp/tetra_t1_dl'`

Usage: Setting only

Manual operation: See "Save/Recall" on page 11

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

Stores the current TETRA settings into the selected file in the specified directory. The file extension may be omitted. TETRA settings are stored as files with the specific file extensions `*.tetra`.

Setting parameters:

<Filename> <file name>

Example:
```
BB:TETR:SETT:STOR '/var/user/temp/tetra_t1_dl'
MMEM:CDIR '/var/user/temp/tetra'
```
sets the default directory to /var/user/temp/tetra.
```
BB:TETR:SETT:CAT?
```
reads out all the files with TETRA settings in the default directory.
```
Response: 'tetra_t1_dl'
```
the file "`tetra_t1_dl`" is available.

Usage: Setting only

Manual operation: See "Save/Recall" on page 11

[:SOURce<hw>]:BB:TETRa:SETTing:STORe:FAST <Fast>

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

Note: This function is not affected by the "Preset" function.

Parameters:

<Fast> 0 | 1 | OFF | ON

*RST: ON

Manual operation: See "Save/Recall" on page 11

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

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.

Parameters:

<SLength> integer

Range: 1 to depends on carrier bandwidth

*RST: 1

Example:
```
BB:TETR:SLEN 51500
```

Manual operation: See "Sequence Length" on page 13

[: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> 0 | 1 | OFF | ON

*RST: 0

Example: `SOURce1:BB:TETRa:STATe ON`

Manual operation: See "State" on page 11

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

Selects the test mode.

Several settings depends on the selected test mode.

Parameters:

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

*RST: T1

Example: `BB:TETR:TMOD T3`

Manual operation: See "Test Mode" on page 12

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

Opens the submenu for storing the current TETRA signal as ARB signal in a waveform file. This file can be loaded in the "ARB" dialog and processed as multicarrier or multisegment signal.

The file name is entered in the submenu. The file is stored with the predefined file extension `*.wv`. The file name and the directory it is stored in are user-definable.

Setting parameters:

<Filename> string

Example: `BB:TETR:WAV:CRE "/var/user/temp/tetra_waveform"`

Usage: Setting only

Manual operation: See "Generate Waveform" on page 12

4.2 Power Ramp Settings

[:SOURce<hw>]:BB:TETRa:PRAMping:FOFFset 47
[:SOURce<hw>]:BB:TETRa:PRAMping:RFUNction 47
[:SOURce<hw>]:BB:TETRa:PRAMping:ROFFset 48
[:SOURce<hw>]:BB:TETRa:PRAMping:RTIMe 48
[:SOURce<hw>]:BB:TETRa:SATTenuation<ch> 48

[: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 40

[: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 39

[: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 40

[: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 40

[: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 40

4.3 Slot Configuration Settings

[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:LDIRection<ch>:TBTYpe 49
[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:UBBNch 50
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:AMODe 50
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF1 51
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF2 51
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APHeader 51
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:BSATtenuation 51
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSATtenuation 52
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA 52
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DPATtern 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:LCTYpe 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SCRambling 54
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa 54
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDPattern 54
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDSelection 55
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SLEVel 55
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSLevel 55
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:TPATtern 56
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:TSOurce 56

[: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 25

[: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> 0 | 1 | OFF | ON

*RST: OFF

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 26

[: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 27

[: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 26

[: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 26

[: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 53.

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 53.

*RST: PN09

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

Manual operation: See "Data Source" on page 26

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

Selects the data pattern with a maximum length of 64 bits for the internal data when PATTern is selected as the data source (`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA` on page 52).

Parameters:

<DPattern> 64 bits

*RST: #H0,1

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 26

[: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 52.

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 26

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

Selects the logical channel type.

Tha 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 27

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

Enables/disables auto scrambling.

Parameters:

<Scrambling> 0 | 1 | OFF | ON

*RST: ON

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

Manual operation: See "Scrambling" on page 27

[: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 54.

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 55.

*RST: PN09

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

Manual operation: See "Data Source" on page 26

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

Selects the data pattern with a maximum length of 64 bits for the internal data when PATTern is selected as the data source (`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa` on page 54).

Parameters:

<SdPattern> 64 bits

*RST: #H0,1

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 26

[: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 54.

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 26

[: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 25

[: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 25

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

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> 96 bits

*RST: #H000000000000000000000000,96

Example:
```
BB:TETR:SCON:TMOD1:SLOT2:LDIR1:TPAT
```

Manual operation: See "TSC User Defined" on page 27

[: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 27

4.4 BSCH / BNCH/T Settings

[:SOURce<hw>]:BB:TETRa:BBNCht:APARameter....57
[:SOURce<hw>]:BB:TETRa:BBNCht:BCCode....57
[:SOURce<hw>]:BB:TETRa:BBNCht:CBANdwidth....58
[:SOURce<hw>]:BB:TETRa:BBNCht:CRFRequency?....58
[:SOURce<hw>]:BB:TETRa:BBNCht:CSLevel....58
[:SOURce<hw>]:BB:TETRa:BBNCht:DNBBroadcast....59
[:SOURce<hw>]:BB:TETRa:BBNCht:DNBenquiry....59
[:SOURce<hw>]:BB:TETRa:BBNCht:DSPacing....59
[:SOURce<hw>]:BB:TETRa:BBNCht:ECORrection....60
[:SOURce<hw>]:BB:TETRa:BBNCht:FBANd....60
[:SOURce<hw>]:BB:TETRa:BBNCht:FEEXtension....60
[:SOURce<hw>]:BB:TETRa:BBNCht:LBACk....60
[:SOURce<hw>]:BB:TETRa:BBNCht:LENTry....61
[:SOURce<hw>]:BB:TETRa:BBNCht:MCCode....61
[:SOURce<hw>]:BB:TETRa:BBNCht:MCNumber....61
[:SOURce<hw>]:BB:TETRa:BBNCht:MNCode....62
[:SOURce<hw>]:BB:TETRa:BBNCht:MTMCell....62
[:SOURce<hw>]:BB:TETRa:BBNCht:OFFSet....62
[:SOURce<hw>]:BB:TETRa:BBNCht:ROPeration....62
[:SOURce<hw>]:BB:TETRa:BBNCht:SCODe....63
[:SOURce<hw>]:BB:TETRa:BBNCht:SMODe....63
[:SOURce<hw>]:BB:TETRa:BBNCht:TBTYpe....63
[:SOURce<hw>]:BB:TETRa:BBNCht:TRFRames....64
[:SOURce<hw>]:BB:TETRa:BBNCht:TTBType....64
[:SOURce<hw>]:BB:TETRa:BBNCht:TXON....64
[:SOURce<hw>]:BB:TETRa:BBNCht:UPDTx....65

[: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 33

[: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 34

[: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 29

[: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 30

[: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 32

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

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

Parameters:

<DnbBroadcast> 0 | 1 | OFF | ON

*RST: OFF

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

Manual operation: See "D-NWRK-BROADCAST broadcast" on page 32

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

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

Parameters:

<DnbEnquiry> 0 | 1 | OFF | ON

*RST: OFF

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

Manual operation: See "D-NWRK-BROADCAST enquiry" on page 32

[: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 30

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

Enables/disables error correction.

Parameters:

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

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

Manual operation: See "Error Correction" on page 33

[: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 29

[: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> 0 | 1 | OFF | ON
*RST: OFF

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

Manual operation: See "Frame 18 extension" on page 32

[: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> 0 | 1 | OFF | ON

*RST: OFF

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

Manual operation: See "Loop Back" on page 34

[: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> 0 | 1 | OFF | ON

*RST: OFF

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

Manual operation: See "Late Entry" on page 33

[: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 35

[: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 29

[: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 35

[: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 32

[: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 30

[: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> 0 | 1 | OFF | ON

*RST: OFF

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

Manual operation: See "Reverse Operation" on page 30

[: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 31

[: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 32

[: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 33

[: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 31

[: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 33

[: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 33

[: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> 0 | 1 | OFF | ON
*RST: OFF

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

Manual operation: See "U-plane DTX" on page 32

4.5 Trigger/Marker/Clock Settings

This section lists the relevant remote control commands.

4.5.1 Clock Settings

[:SOURce<hw>]:BB:TETRa:CLOCk:MODE 65
[:SOURce<hw>]:BB:TETRa:CLOCk:MULTiplier 65
[:SOURce<hw>]:BB:TETRa:CLOCk:SOURce 66

[:SOURce<hw>]:BB:TETRa:CLOCk:MODE <Mode>

Sets the type of externally supplied clock.

Parameters:

<Mode> SAMPle | MSAMple
*RST: SAMPle

Example: `SOURce1:BB:TETRa:CLOCk:MODE SAMple`

Manual operation: See "Clock Mode" on page 23

[:SOURce<hw>]:BB:TETRa:CLOCk:MULTiplier <Multiplier>

Sets the multiplier for clock type Multiplied (`[:SOURce<hw>]:BB:TETRa:CLOCk:MODE` on page 65).

Parameters:

<Multiplier> integer
Range: 1 to 64
*RST: 4

Example: `SOURce1:BB:TETRa:CLOCk:SOURce EGC1`
selects the external clock source.
`SOURce1:BB:TETRa:CLOCk:MODE MULTiplied`
selects clock type multiplied, i.e. the supplied clock has a rate which is a multiple of the chip rate.
`SOURce1:BB:TETRa:CLOCk:MULTiplier 12`
the multiplier for the external clock rate is 12.

Manual operation: See "Clock Multiplier" on page 23

[:SOURce<hw>]:BB:TETRa:CLOCk:SOURce <Source>

Selects the clock source.

Parameters:

<Source> INTernal | EGC1 | EGC2 | ELCLock | EXTernal

INTernal
The instrument uses its internal clock reference

EGC1|EGC2
External global clock

ELCLock
External local clock

EXTernal
`EXTernal = EGC1`
Setting only; provided for backward compatibility with other R&S signal generators.

*RST: INTernal

Example: `BB:TETR:CLOC:MODE INT`
selects an internal clock reference.

Manual operation: See "Clock Source" on page 23

4.5.2 Trigger Settings

The numeric suffix to `OUTPut` distinguishes between the available markers.

[:SOURce<hw>]:BB:TETRa:TRIGger:ARM:EXECute....67
[:SOURce<hw>]:BB:TETRa:TRIGger:EXECute....67
[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:SYNChronize:OUTPut....67
[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:DELay....67
[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:INHibit....68
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut:DELay:FIXed....68
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay....68
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MINimum?....69
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MAXimum?....69
[:SOURce<hw>]:BB:TETRa:TRIGger:RMODe....69
[:SOURce<hw>]:BB:TETRa:TRIGger:SLENgth....69
[:SOURce<hw>]:BB:TETRa:TRIGger:SLUNit....70
[:SOURce<hw>]:BB:TETRa:TRIGger:SOURce....70

[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal]:DELay 71
[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal]:INHibit 71
[:SOURce<hw>]:BB:TETRa:TRIGger:SEQuence 71

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

(for Armed_Auto nd Armed_Retrigger trigger modes)

Stops signal generation. Signal generation can be restarted by a new trigger (internally or externally).

Example: `BB:TETR:TRIG:ARM:EXEC`

Usage: Event

Manual operation: See "Arm" on page 17

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

Executes 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: `BB:TETR:TRIG:EXEC`

Usage: Event

Manual operation: See "Execute Trigger" on page 17

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

(enabled for Trigger Source External)

Enables/disables output of the signal synchronous to the external trigger event.

Parameters:

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

Example: `BB:TETR:TRIG:SYNC:OUTP ON`

Manual operation: See "Sync. Output to External Trigger" on page 17

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

Specifies 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 16777215
Increment: 0.01
*RST: 0

Example: `BB:TETR:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:TETR:TRIG:OBAS:DEL 50`
sets a delay of 50 symbols for the trigger.

Manual operation: See "Trigger Delay" on page 19

[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:INHibit <Inhibit>

This command applies only for triggering by the second path.

Specifies the number of samples by which a restart is to be inhibited following a trigger event.

Parameters:
<Inhibit> integer
Range: 0 to 67108863
*RST: 0

Example:
```
BB:TETR:TRIG:SOUR OBAS
BB:TETR:TRIG:OBAS:INH 50
```

Manual operation: See "External Trigger Inhibit" on page 18

[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut:DELay:FIXed <Fixed>

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

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

Example: `BB:TETR:TRIG:OUTP:DEL:FIX ON`

Manual operation: See "Marker x Delay" on page 21

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

Enters the delay between the marker signal at the marker outputs and the start of the frame or slot.

Parameters:
<Delay> float
Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: `BB:TETR:TRIG:OUTP1:DEL 1600`

Manual operation: See "Marker x Delay" on page 21

[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MINimum?
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MAXimum?

Queries the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

Return values:

<Maximum> float

Range: 0 to 16777215
Increment: 0.001
*RST: 2000

Example:

```
BB:TETR:TRIG:OUTP:DEL:FIX ON
BB:TETR:TRIG:OUTP:DEL:MAX?
```

Response: 2000

```
BB:TETR:TRIG:OUTP:DEL:MIN?
```

Usage: Query only

Manual operation: See "Marker x Delay" on page 21

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

Queries the status of signal generation for all trigger modes.

Parameters:

<RMode> STOP | RUN

*RST: STOP

Example: BB:TETR:TRIG:RMOD?

Manual operation: See "Running/Stopped" on page 16

[:SOURce<hw>]:BB:TETRa:TRIGger:SLENgth <Slength>

Defines the length of the signal sequence to be output in the "Single" trigger mode. The unit of the entry is defined with the command `[:SOURce<hw>]:BB:TETRa:TRIGger:SLUNit` on page 70. It is then possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Parameters:

<Slength> integer

Range: 1 to 7000
*RST: 1

Example:

```
BB:TETR:TRIG:SLEN 100
```

Manual operation: See "Trigger Signal Duration" on page 16

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

Defines the unit for the entry of the length of the signal sequence to be output in the "Single" trigger mode.

Available units are sequence length (SL) and multiframe.

Parameters:

<SlUnit> SEQuence | MFRame

*RST: SEQuence

Example: `BB:TETR:TRIG:SLUN MFRame`

Manual operation: See "Signal Duration Unit" on page 16

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

Selects trigger source. This setting is effective only when a trigger mode other than "Auto" has been selected.

Parameters:

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

INTernal
Internal

INTA | INTB
Internal trigger from the other baseband

EGT1 | EGT2
External global trigger

EGC1 | EGC2
External global clock

ELTRigger
External local trigger

ELCLock
External local clock

OBASeband|BEXTernal|EXTernal
Provided only for backward compatibility with other R&S signal generators.
The R&S SMW accepts these values und maps them automatically as follow:
EXTernal = EGT1, BEXTernal = EGT2, OBASeband = INTA or INTB (depending on the current baseband)

*RST: INTernal

Example: `BB:TETR:TRIG:SOUR INT`
selects an internal trigger source.

Manual operation: See "Trigger Source" on page 17

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

Sets the trigger delay.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 0.01
*RST: 0
Default unit: samples

Example: `BB:TETR:TRIG:SOUR EXT`
selects an external trigger.
`BB:TETR:TRIG:EXT:DEL 50`
sets a delay of 50 symbols for the trigger.

Manual operation: See "Trigger Delay" on page 19

[: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: `BB:TETR:TRIG:SOUR EXT`
selects an external trigger.
`BB:TETR:TRIG:EXT:INH 200`
sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "External Trigger Inhibit" on page 18

[:SOURce<hw>]:BB:TETRa:TRIGger:SEQuence <Sequence>

Selects trigger mode.

The trigger mode determines the effect of a trigger on the signal generation.

Parameters:

<Sequence> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

AUTO
The signal is generated continuously.

RETRigger
The signal is generated continuously. A trigger event (internal or external) causes a restart.

AAUTo
The signal is generated only when a trigger event occurs. Then the signal is generated continuously.
Command `[:SOURce<hw>]:BB:TETRa:TRIGger:ARM:EXECute` stops signal generation. A subsequent trigger event (internal or external) causes a restart.

ARETrigger
The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

ARETrigger
The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

*RST: AUTO

Example: `BB:TETR:TRIG:SEQ AUTO`

Manual operation: See "Trigger Mode" on page 15

4.5.3 Marker Settings

[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE....72
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:ONTime....73
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime....73
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PATTern....74
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:DIVider....74
[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:FREQuency?....74

[: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 74.

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 73 and `[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime` on page 73 is generated.

*RST: RESTart

Example:
```
BB:TETR:TRIG:OUTP2:MODE SST
```

Manual operation: See "Marker Mode" on page 20

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

Sets the number of symbols in a period (ON time + OFF time) during which the marker signal On/Off Ratio on the marker outputs is OFF.

Parameters:

<Offtime> integer

Range: 1 to 16777215
*RST: 1

Example:
```
BB:TETR:TRIG:OUTP2:MODE RAT
BB:TETR:TRIG:OUTP2:ONT 20
BB:TETR:TRIG:OUTP2:OFF 20
```

Manual operation: See "Marker Mode" on page 20

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

Defines the bit pattern used to generate the marker signal ([:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE on page 72). 0 is marker off, 1 is marker on.

Parameters:

<Pattern> 64 bits

*RST: #H2,2

Example:
```
BB:TETR:TRIG:OUTP2:MODE PATT
BB:TETR:TRIG:OUTP2:PATT #H1,4
```

Manual operation: See "Marker Mode" on page 20

[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

Sets the divider for the pulsed marker signal ([:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE on page 72).

Parameters:

<Divider> integer

Range: 2 to 1024
*RST: 2

Example:
```
BB:TETR:TRIG:OUTP2:PULS:DIV 2
```

Manual operation: See "Marker Mode" on page 20

[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:FREQuency?

Queries the pulse frequency of the pulsed marker signal ([:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:MODE on page 72).

Return values:

<Frequency> float

Increment: 0.001

Example:
```
BB:TETR:TRIG:OUTP2:MODE PULS
BB:TETR:TRIG:OUTP2:PULS:DIV 4
BB:TETR:TRIG:OUTP2:PULS:FREQ?
```
Response: 600.000 Hz

Usage: Query only

Manual operation: See "Marker Mode" on page 20

4.6 Filter/Clipping Settings

[:SOURce<hw>]:BB:TETRa:CLIPping:LEVel....75
[:SOURce<hw>]:BB:TETRa:CLIPping:MODE....75
[:SOURce<hw>]:BB:TETRa:CLIPping:STATe....75
[:SOURce<hw>]:BB:TETRa:FILTer:ILENgth....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:GAUSs....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASs....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASSEVM....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:PGAuss....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:RCOSine....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:SPHase....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:APCO25....76
[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine:COFS....77
[:SOURce<hw>]:BB:TETRa:FILTer:TYPE....77

[: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 38

[: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 38

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

Switches baseband clipping on and off.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

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

Manual operation: See "Clipping State" on page 38

[: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 37

[: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

<Cosine> float

Range: 0.0 to 1.0
Increment: 0.01
*RST: 0.1

<Gauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

<LPass> float

Range: 0.05 to 2.0
Increment: 0.01
*RST: 0.5

<PGauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

<RCosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.35

<SPhase> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 2

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

Manual operation: See "Roll Off Factor or BxT" on page 36

[: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 36

[: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 36

List of Commands

[:SOURce<hw>]:BB:TETRa:BBNCht:APARameter....57
[:SOURce<hw>]:BB:TETRa:BBNCht:BCCode....57
[:SOURce<hw>]:BB:TETRa:BBNCht:CBANdwidth....58
[:SOURce<hw>]:BB:TETRa:BBNCht:CRFRequency?....58
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[:SOURce<hw>]:BB:TETRa:BBNCht:DNBBroadcast....59
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[:SOURce<hw>]:BB:TETRa:CLIPping:STATe....75
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[:SOURce<hw>]:BB:TETRa:FILTer:ILENgth....76
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[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:LDIRection<ch>:TBTYpe 49
[:SOURce<hw>]:BB:TETRa:SCONfiguration:SLOT<st>:UBBNch 50
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:AMODe 50
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF1 51
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF2 51
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