TETRA Release 2 Digital Standard for R&S®Signal Generators

Operating Manual

1173.0843.12 ─ 12

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMBV-K68
  1415.8490.xx
- R&S®SMU-K68
  1408.8217.02
- R&S®AMU-K68
  1403.0601.02
- R&S®SMATE-K68
  1404.8664.02
- R&S®SMJ-K68
  1409.3102.02

This manual version corresponds to firmware version:
FW 3.20.281.xx and later of the R&S®SMBV100A
FW 3.20.286.xx and later of the R&S®SMU200A, R&S®SMATE200A, R&S®SMJ100A and R&S®AMU200A

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The following abbreviations are used throughout this manual: R&S®SMBV100A is abbreviated as R&S SMBV, R&S®SMU200A is abbreviated as R&S SMU, R&S®AMU200A is abbreviated as R&S AMU, R&S®SMATE200A is abbreviated as R&S SMATE, R&S®SMJ100A is abbreviated as R&S SMJ, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

Contents

1 Preface

1.1 Documentation Overview

This section provides an overview of the R&S Signal Generator user documentation. You find it on the product page at:

http://www.rohde-schwarz.com/product/SMBV100A.html > "Downloads"

Quick start guide

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

Online help

Offers quick, context-sensitive access to the complete information for the base unit and the software options directly on the instrument.

Operating manual

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

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

The **online version** of the operating manual provides the complete contents for immediate display on the Internet.

Service manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS, https://gloris.rohde-schwarz.com).

Instrument security procedures manual

Deals with security issues when working with the R&S Signal Generator in secure areas.

Basic safety instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

Data sheet and brochure

The data sheet contains the technical specifications of the software options, see "Digital Standards for Signal Generators - Data sheet" on the web site. It also lists the options and their order numbers.

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

Release notes and open source acknowledgment (OSA)

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

The open source acknowledgment document provides verbatim license texts of the used open source software. See the product page of the base unit, e.g. at:

http://www.rohde-schwarz.com/product/SMBV100A.html > "Downloads" > "Firmware"

Application Notes, Application Cards, White Papers, etc.

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

Convention	Description
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 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.

1.2.3 Naming of Software Options

In this operating manual, we explicitly refer to options required for specific functions of the digital standard.

The name of software options for signal generators vary in the name of the instrument, but the option name is identical. Therefore we use in this manual the placeholder R&S SMx/AMU.

Example:

Naming for an option of the vector signal generator R&S SMBV100A, e.g:

- R&S SMx/AMU-K99, stands for R&S SMBV-K99

The particular software options available for the corresponding instruments are listed on the back of the title page.

2 Introduction

The R&S SMx/AMU-K68 enables you to generate signals in accordance with the standard Terrestrial Trunked Radio Release 2 (TETRA2).

To play back a signal from a waveform file created by the simulation software R&S WinIQSIM2, the corresponding R&S WinIQSIM2 digital standard option must be installed.

The following list gives an overview of the main options provided by the R&S Signal Generator for generating a TETRA signal in accordance with ETSI EN 300 392-2.

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

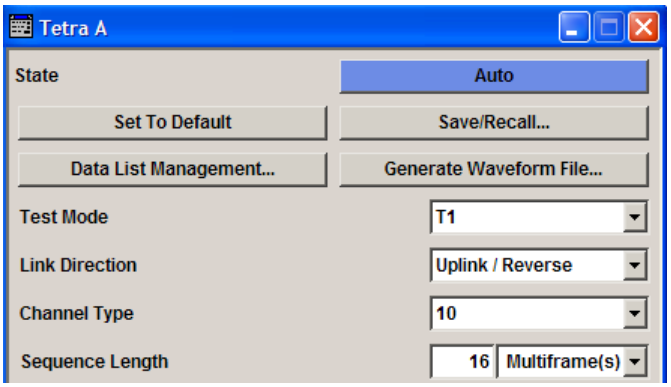
3 User Interface

Access:

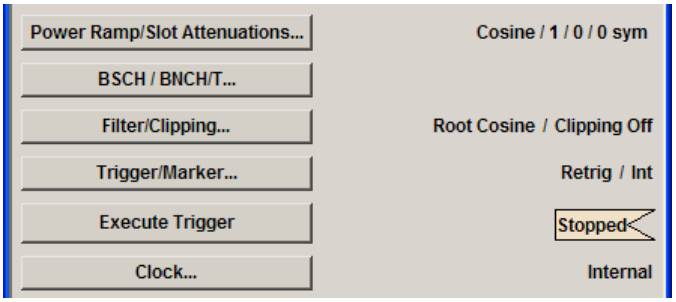
► Select "Baseband Block > Config > TETRA".

The dialog is split into three sections for configuring the standard.

In the upper section of the dialog, the TETRA digital standard is enabled. It provides access to the default and "Save/Recall" settings, to the data list management and to a file select dialog for creating a waveform file. In the middle section, the transmission direction is selected the test mode is set. The transmission direction determines the available parameters.

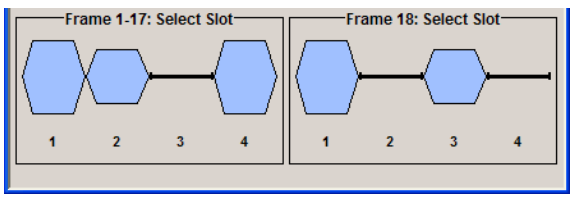


The trigger and clock parameters, data list management, saving and loading a frame, setting the power ramping and slot attenuation are available for the modes T1, T2, T4 and User.

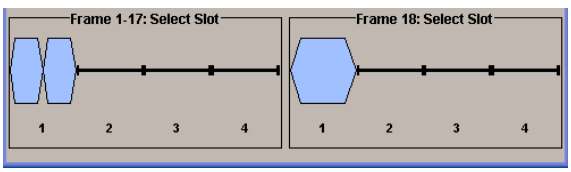


The lower part of the dialog displays the frame configuration. In this graphical display, you can select the slot that you wish to edit. The frame editor then opens. Slots for frame 1 to 17 and frame 18 can be activated and configured independently.

normal burst:



control burst:



Contents

3.1 General Settings

The upper section of the dialog provides access to the default and "Save/Recall" settings.

Settings:

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

Remote command:
`[:SOURce<hw>]:BB: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 44

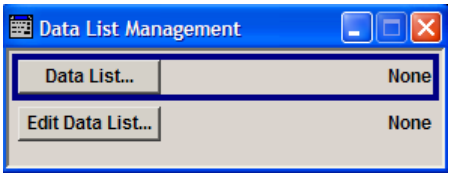
Save/Recall
Accesses the "Save/Recall" dialog, that is the standard instrument function for storing and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The filename and the directory, in which the settings are stored, are user-definable; the file extension is however predefined.

TETRA configurations are stored as files with the predefined file extension `*.tetra`. The file name and the directory they are stored in are user-definable.

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

Data List Management
Calls the "Data List Management" dialog. This dialog is used to create and edit a data list.



All data lists are stored as files with the predefined file extension `*.dm_iqd`. The file name and the directory they are stored in are user-definable.

The data lists must be selected as a data source from the submenus under the individual function.

Example: Creating and editing the data list

```
SOUR:BB:DM:DLIS:SEL "TETRA"
SOUR:BB:DM:DLIS:DATA 1,1,0,1,0,1,0,1,1,1,1,0,0,0
SOUR:BB:DM:DLIS:DATA:APP 1,1,0,1,0,1,0,1,1,1,1,0,0,0
```

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA on page 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection on page 54

Generate Waveform File
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 filename 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 47

Test Mode
Selects the test mode.

Several settings depend on the selected test model.

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

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

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

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

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

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

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

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 44

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 43

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 46

Power Ramp/Slot Attenuations
Accesses 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 3.2, "Power Ramp Control", on page 15).

The currently selected ramp function and ramp time are displayed.

BSCH / BNCH/T
Accesses the "BSCH / BNCH/T" dialog. This dialog is 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 3.3, "BSCH / BNCH/T", on page 17).

Filter/Clipping
Accesses the dialog for setting baseband filtering, clipping and modulation settings (seeChapter 3.5, "Filter / Clipping Settings", on page 28).

The current settings are displayed.

Trigger/Marker/Clock
(Trigger and clock settings for R&S SMx and R&S AMU instruments only)

Acesses the dialog for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal, and for selecting the clock source. This dialog is described in Chapter 3.6, "Trigger/Marker/Clock Settings", on page 31.

The current settings are displayed.

Execute Trigger
For R&S SMx and R&S AMU instruments only

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.

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

Clock
The clock functions are available for R&S SMx and R&S AMU instruments only.

Slot Selection Graph for Frame 1-17 and Frame 18
Accesses the Burst Editor dialog.

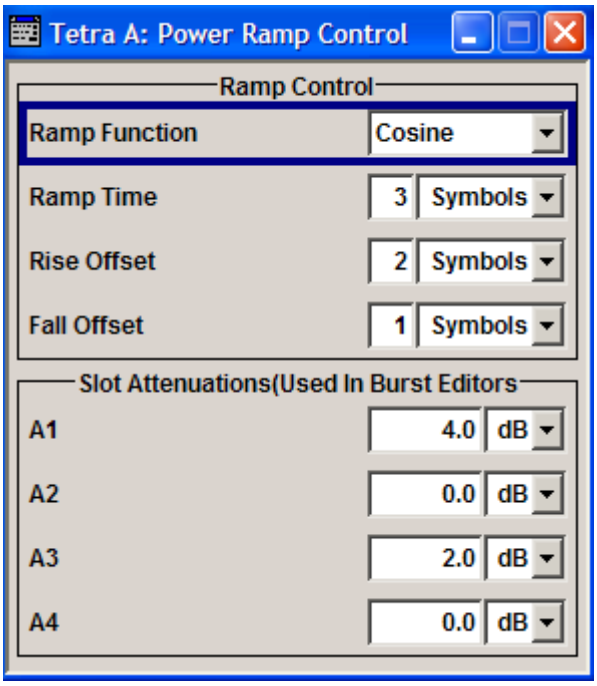
3.2 Power Ramp Control

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

Access:

► Select "Baseband > TETRA... > Power Ramp/Slot Attenuations...".

This dialog is used to enter the settings for power ramping and level attenuation. The "Slot Attenuations" (used in "Frame Editor") section is used to define four possible values for level attenuation. These values can be selected from the frame editor for the slot currently being edited.



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

Settings:

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

"Linear" The transmitted power rises and falls linear fashion.

"Cosine" The transmitted power rises and falls with a cosine-shaped edge. This setting causes a more favorable spectrum than the "Linear" setting.

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

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

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

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

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

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

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

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

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

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

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

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

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

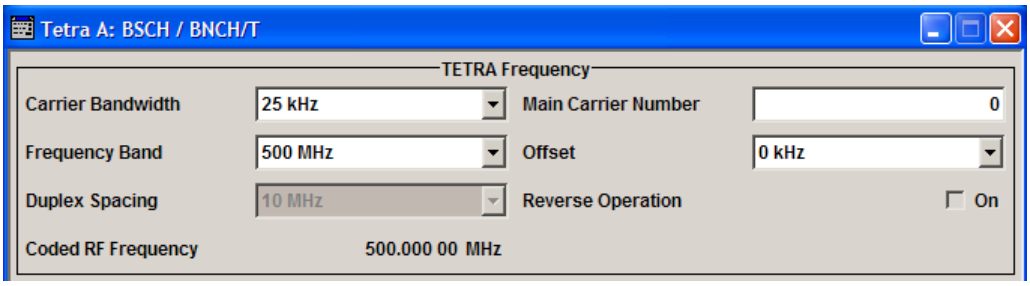
Remote command:
[:SOURce<hw>]:BB:TETRa:SATTenuation<ch> on page 49

3.3 BSCH / BNCH/T

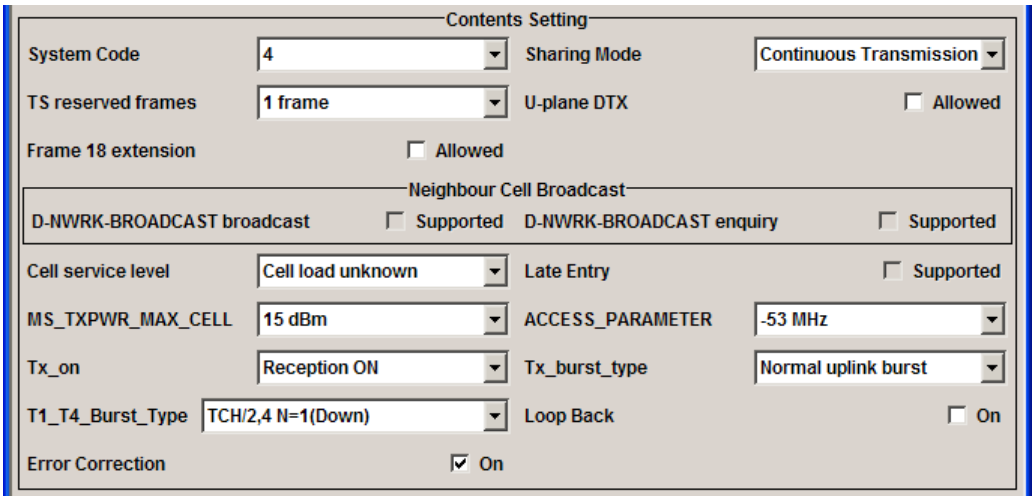
Access:

► Select "Main dialog > BSCH / BNCH/T".

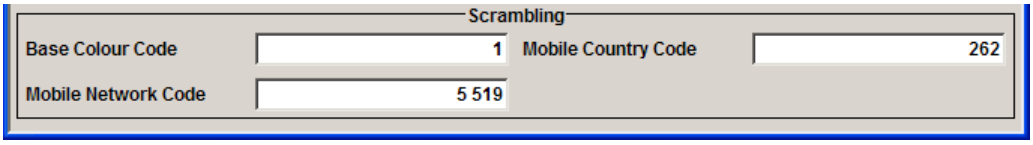
In the "BSCH / BNCH/T" dialog, the contents of the broadcast synchronization channel (BSCH) and the broadcast network channel (BNCH/T) are configured. The BSCH and the BNCH are the two possible broadcast control channels (BCCH) that are transmitted in downlink direction only. Hence, the parameters in this dialog provided to configure the content of the channels are enabled only for "Link Direction" set to "Downlink/Forward". The "BSCH / BNCH/T" dialog is divided into several sections. The "TETRA Frequency" section comprises of the parameters necessary to set the carrier bandwidth and the frequency band. The section is enabled in both link directions.



The "Contents Setting" section is enabled in 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.



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



Contents

3.3.1 TETRA Frequency

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

Settings:

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

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

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

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

The main carrier frequency is calculated as follows:

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

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

Frequency Band
Sets the "Frequency Band".

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

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

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

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

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 60

Reverse Operation
(for Uplink direction only)

Enables reverse operation.

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

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

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 59

3.3.2 Contents Settings

The "Contents Setting" section is enabled in downlink direction only.

Settings:

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

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

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 20. If MCCH sharing is indicated, the TS reserved frames field indicates which frames are reserved in this mode of operation. For the other values of sharing mode, the contents of the TS reserved frames field are ignored.

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

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

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

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 64

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 65

Error Correction
Enables error correction.

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

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

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

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

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

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

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

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

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

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

Loop Back
Enables the loop back for test purposes.

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

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

3.3.3 Scrambling

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

The scrambling code is a 24-bit field composed of the "Mobile Country Code" (MCC) and "Mobile Network Code" (MNC) and is calculated as defined in EN 300 392. The MCC and MNC is a part of the MLE information contained within the SYNC PDU broadcast by the BS on the BSCH. The upper MAC adds a 6-bit color code which is contained in the SYNC PDU. The combination of MCC, MNC and color code make up the scrambling code which the upper MAC passes to the lower MAC via the TMV-SAP. This scrambling code corresponds to the extended color code used for scrambling and descrambling in the lower MAC. The scrambling code corresponds to the 30-bit extended color code e(1), e(2),..., e(30).

Table 3-2: Building of scrambling code

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

Settings:

Base Colour Code
Sets the colour code.

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

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

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

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 63

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 62

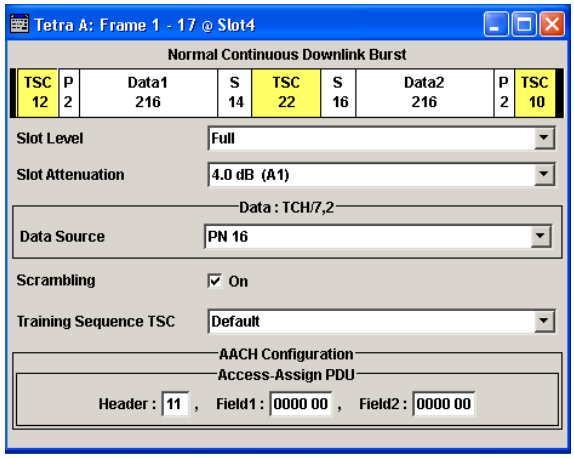
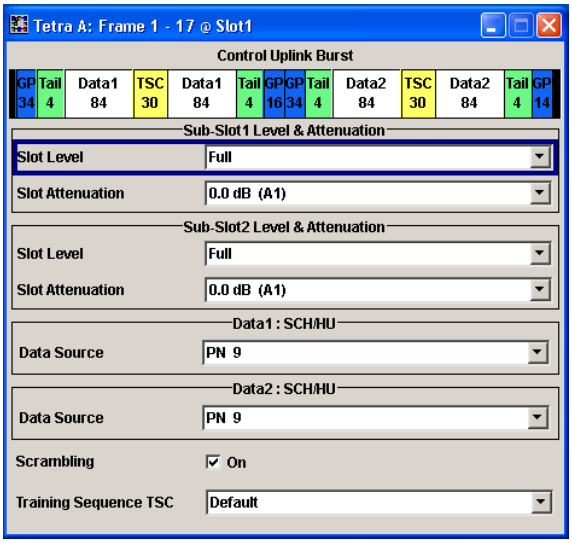
3.4 Burst Editor

Access:

► Select a slot from the graphical display in the TETRA main dialog.

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

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

normal burst:	control burst:
	

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

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

Settings:

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 50

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

Subslots are used by control bursts only.

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SLEVel` on page 56 for "Slot Level"
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SSLevel` on page 56 for "Sub-Slot Level".

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

Subslots 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 52 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, they are treated as a continuous field. For instance, a pseudo-random sequence is continued without interruption from one "Data" field to the next.

The following standard data sources are available:

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

  See also "Main Dialog > Data List Management".

Remote command:
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA on page 53
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa on page 55
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:DATA:DSELection on page 54
[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:SDATa:SDSelection on page 56
[: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 55

Logical Channel Type
Selects the logical channel type.

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

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

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 57

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 sequences are inserted successively.

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

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). It is used to indicate on each QAM physical channel the assignment of the uplink and downlink slots.

"Access-Assign PDU"	The value of the AACH-Q mode element is set to 0, i.e. contents of "Access-Assign PDU" are present. 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 must be set to all zeros.

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

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 52

"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

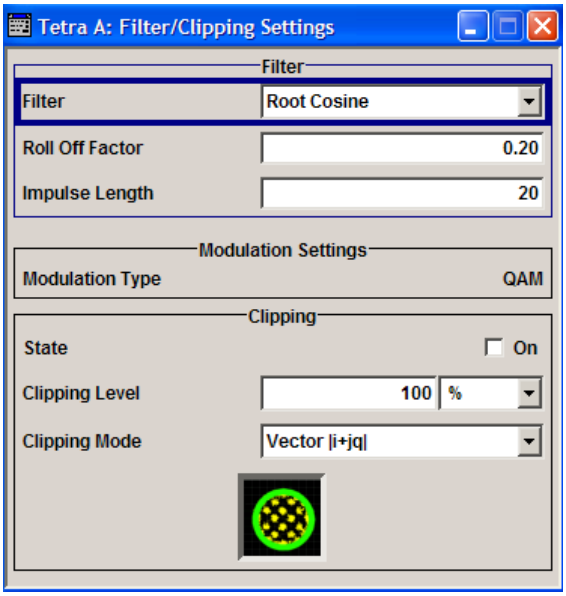
"Field2" Sets the value for the information element "Field2".

Remote command:
`[:SOURce<hw>]:BB:TETRa:SCONfiguration:TMODe<di>:SLOT<st>:LDIRection<ch>:APF2` on page 52

3.5 Filter / Clipping Settings

Access:

► Select "Main dialog > Filter/Clipping/ARB Settings".



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

Contents

3.5.1 Filter Settings

The "Filter" section contains the parameters necessary to configure the baseband filter.

Settings:

Filter
Selects the baseband filter.

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:TYPE` on page 68

Roll Off Factor or BxT
Sets the filter parameter.

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:COSine` on page 67
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:RCOSine` on page 67
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:PGAuss` on page 67
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:GAUSs` on page 67
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:SPHase` on page 67
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:APCO25` on page 67

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 68

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASs` on page 67
`[:SOURce<hw>]:BB:TETRa:FILTer:PARameter:LPASSEVM` on page 67

3.5.2 Modulation Settings

The "Modulation" section displays the used modulation type.

Settings:

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

Remote command:
[:SOURce<hw>]:BB:TETRa:MTYPe on page 44

3.5.3 Clipping Settings

This section contains the settings necessary ro configure the clipping.

Settings:

Clipping State
Switches baseband clipping on and off.

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

Remote command:
[:SOURce<hw>]:BB:TETRa:CLIPping:STATe on page 67

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 66

Clipping Mode
Selects the clipping method. A graphic illustration of the way in which this 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.

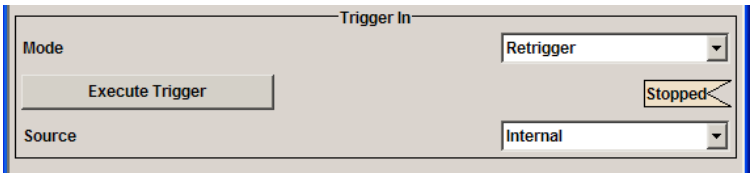
Remote command:
[:SOURce<hw>]:BB:TETRa:CLIPping:MODE on page 66

3.6 Trigger/Marker/Clock Settings

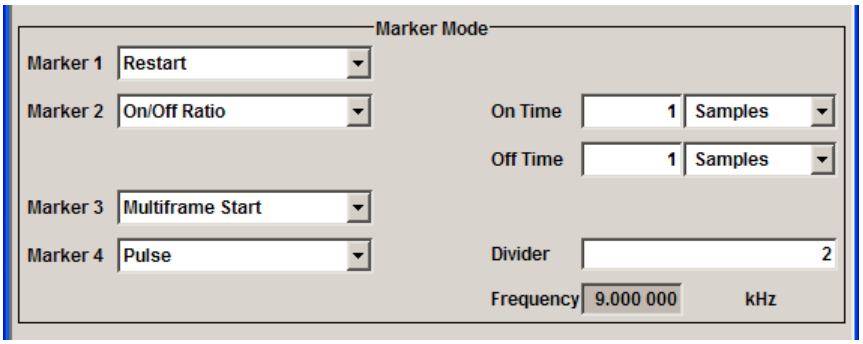
Access:

► Select "Main Menu > Trigger/Marker".

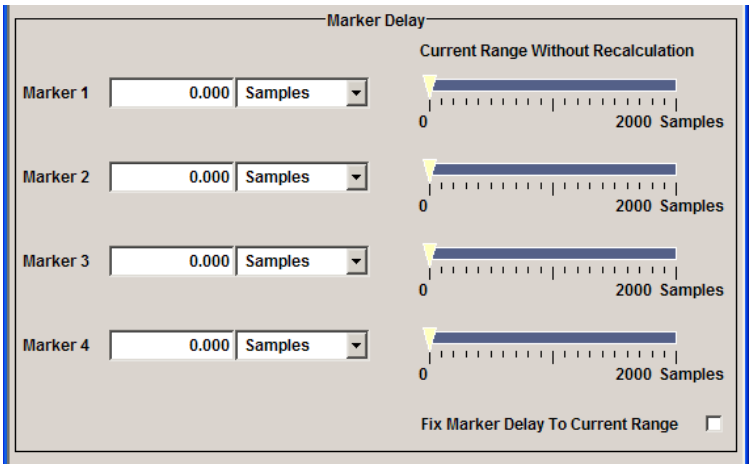
The "Trigger In" section is where the trigger for the signal is set. Depending on the selected trigger source, the parameters vary. The status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



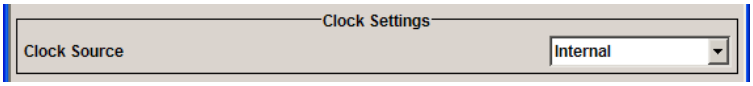
In the "Marker Mode" section, the marker signals at the "Marker" output connectors are configured.



In the "Marker Delay" section, a marker signal delay can be defined, either without restriction or restricted to the dynamic section. I.e. you can set parameters without restarting signal and marker generation.



In the "Clock Settings" section, the clock source is selected and - in the case of an external source - the clock type.



The buttons in the last section lead to submenu for general trigger, clock and mapping settings.

Settings:

3.6.1 Trigger Settings

In the "Trigger In" section, the trigger for the signal is set. Depending on the trigger source (internal or external), the available parameters vary. The status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.

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

- "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 72

Signal Duration Unit
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.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:SLUNit` on page 71

Signal Duration
Enters the length of the signal sequence to be output in the "Single" trigger mode.

Use this parameter to output part of the signal deliberately, 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 71

Running/Stopped
With enabled modulation, displays the status of signal generation for all trigger modes.

- "Running"
  The signal is generated; a trigger was (internally or externally) initiated in triggered mode.
- "Stopped"
  The signal is not generated and the instrument waits for a trigger event.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:RMODe` on page 71

Arm
Stops the signal generation until subsequent trigger event occurs.

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

Execute Trigger
For R&S SMx and R&S AMU instruments only

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.

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

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

- "Internal"
  The trigger event is executed by "Execute Trigger".
- "Internal (Baseband A/B)"
  (two-path instruments)
  The trigger event is the trigger signal from the second path
- "External (Trigger 1/2)"

The trigger event is the active edge of an external trigger signal, supplied at the TRIGGER 1/2 connector.
Use the "Global Trigger/Clock Settings" dialog to define the polarity, the trigger threshold and the input impedance of the trigger signal.

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

Sync. Output to External Trigger
(enabled for "Trigger Source External")

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

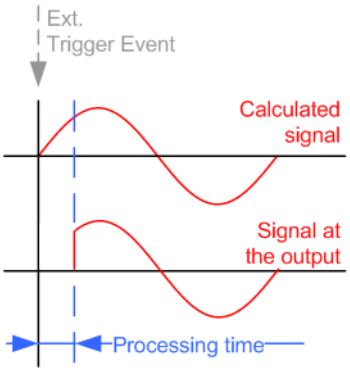
For R&S SMBV instruments:

If two or more R&S SMBVs are set up to work in a master-slave mode for synchronous signal generation, configure this parameter depending on the provided system trigger event and the properties of the output signal. See Table 3-3 for an overview of the required settings.

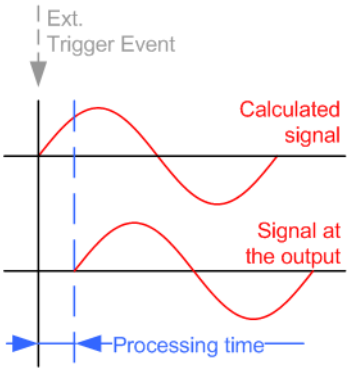
Table 3-3: Typical applications

System Trigger	Application	"Sync. Output to External Trigger"
Common External Trigger event for the master and the slave instruments	All instruments are synchronous to the external trigger event	ON
	All instruments are synchronous among themselves but starting the signal from first symbol is more important than synchronicity with external trigger event	OFF
Internal trigger signal of the master R&S SMBV for the slave instruments	All instruments are synchronous among themselves	OFF

"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 outputted. 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 outputted.
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 70

Trigger Delay
Delays the trigger event of the signal from:
- The external trigger source
- The other path

Use this setting to:
- Synchronize the instrument with the device under test (DUT) or other external devices

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:DELay on page 72
[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:DELay on page 70

Trigger Inhibit
Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in samples.

In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of samples.

This parameter is only available on external triggering or on internal triggering via the second path.

For two-path instruments, the trigger inhibit can be set separately for each of the two paths.

Remote command:
[:SOURce<hw>]:BB:TETRa:TRIGger[:EXTernal<ch>]:INHibit on page 72
[:SOURce<hw>]:BB:TETRa:TRIGger:OBASeband:INHibit on page 71

3.6.2 Marker Mode Settings

The marker output signal for synchronizing external instruments is configured in the "Marker Settings" section "Marker Mode".

The R&S SMBV supports only two markers.

Settings:

Marker Mode
Selects a marker signal for the associated "MARKER" output.

"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 77
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 77

"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 77

"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 76
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime` on page 76

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

3.6.3 Marker Delay Settings

The delay of the signals on the MARKER outputs is set in the"Marker Delay" section.

The R&S SMBV supports only two markers.

Settings:

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

The input is expressed as a number of symbols. If the setting "Fix marker delay to dynamic range" is enabled, the setting range is restricted to the dynamic range. In this range, the delay of the marker signals can be set without restarting the marker and signal.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay` on page 74

Current Range without Recalculation
Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MINimum?`
on page 74
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:DELay:MAXimum?`
on page 74

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

Remote command:
`[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut:DELay:FIXed` on page 74

3.6.4 Clock Settings

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

Settings:

Sync. Mode
(for R&S SMBV only)

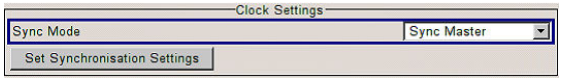
Selects the synchronization mode.

This parameter enables you to generate precise synchronous signals of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.
Avoid unnecessary cable length and branching points.

"None" The instrument is working in stand-alone mode.

"Sync. Master" The instrument provides all connected instrument with its synchronization (including the trigger signal) and reference clock signal.



"Sync. Slave" The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLOCk:SYNChronization:MODE` on page 79

Set Synchronization Settings
(for R&S SMBV only)

Automatically adjusts the instrument's settings required for the synchronization mode, selected with the parameter "Synchronization Mode".

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLOCk:SYNChronization:EXECute` on page 79

Clock Source
Selects the clock source.

"Internal" The instrument uses its internal clock reference.

"External" The external clock reference is fed in as the symbol clock or multiple thereof via the CLOCK connector.
The symbol rate must be correctly set with the accuracy of +/-2 % (see data sheet).
The polarity of the clock input can be changed in the "Global Trigger/Clock Settings".
In the case of two-path instruments, this selection applies to path A.

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

Clock Mode
Sets the type of externally supplied clock.

"Sample"	A sample clock is supplied via the CLOCK connector.
"Multiple Sample"	A multiple of the sample clock is supplied via the CLOCK connector; the sample clock is derived internally from this clock signal.

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLOCk:MODE` on page 77

Clock Multiplier
Sets the multiplication factor for clock type "Multiple".

Remote command:
`[:SOURce<hw>]:BB:TETRa:CLOCk:MULTiplier` on page 78

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

Remote command:
`CLOCk:INPut:FREQuency?`

3.7 Global Settings

This section provides access general trigger, clock and mapping settings.

Global Trigger/Clock Settings
Accesses the "Global Trigger/Clock/Input Settings" dialog.

This dialog is to set the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

The parameters in this dialog affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the operating manual.

User Marker / AUX I/O Settings
Accesses the "User Marker AUX I/O Settings" dialog, used to map the connector on the rear of the instruments.

See also "User Marker / AUX I/O Settings" in the operating manual.

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 Signal Generator has already been set up for remote operation in a network as described in the R&S Signal Generator 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 Signal Generator operating manual.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
SOURce<hw>	[1]|2	available baseband signals
OUTPut<ch>	1 .. 4	available markers R&S SMBV supports two markers
EXTernal<ch>	1|2	external trigger connectors
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 to Slot#4 in Frame 1..17 • SLOT<5..8> = Slots#1 to Slot#4 in Frame 18
LDIRection<ch>	1...2	The numeric suffix to LDIRection distinguishes between the link directions: • LDIRection1 = Downlink • LDIRection2 = Uplink

Placeholder <root>

For commands that read out or save files in the default directory, the default directory is set using command MMEM:CDIRectory. The examples in this description use the place holder <root> in the syntax of the command.

- D:\ - for selecting the internal hard disk of a Windows instrument
- E:\ - for selecting the memory stick which is inserted at the USB interface of a Windows instrument
- /var/user/ - for selecting the internal flash card of a Linux instrument
- /usb/ - for selecting the memory stick which is inserted at the USB interface of a Linux instrument.

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 configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S Signal Generator operating manual.

Programming examples

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

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

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

The following commands specific to the TETRA are described here:

4.1 General Commands

Example: Selecting test mode, link direction and channel type

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

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

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

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

Example: Storing current configuration

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

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

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

Determines the channel type.

Parameters:

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

*RST: CH0

Example: See Example "Selecting test mode, link direction and channel type" on page 42

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 the downlink burst type.

Parameters:

<DBType> CONTinuous | DCONtinuous

*RST: CONTinuous

Example: See Example "Selecting test mode, link direction and channel type" on page 42

Manual operation: See "Downlink Burst Type" on page 14

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

Selects the transmission direction.

This parameter determines the available "Channel Types".

Parameters:

<LDirection> DOWN | UP

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

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

*RST: DOWN

Example: See Example "Selecting test mode, link direction and channel type" on page 42

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: See Example "Selecting test mode, link direction and channel type" on page 42

Manual operation: See "Modulation Type" on page 13

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

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

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

Example: See Example "Selecting test mode, link direction and channel type" on page 42

Usage: Event

Manual operation: See "Set to Default" on page 10

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

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

Return values:

<Catalog> <filename1>,<filename2>,...

Returns a string of file names separated by commas.

Example: See Example "Storing current configuration" on page 42

Usage: Query only

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

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

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

Setting parameters:

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

Example: See Example "Storing current configuration" on page 42

Usage: Setting only

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

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

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

Setting parameters:

<Filename> string
file name or complete file path

Example: See Example "Storing current configuration" on page 42

Usage: Setting only

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

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

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

Setting parameters:

<Filename> string
file name or complete file path

Example: See Example "Storing current configuration" on page 42

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: 1

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: See Example "Selecting test mode, link direction and channel type" on page 42

Manual operation: See "Sequence Length" on page 14

[: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: See Example "Selecting test mode, link direction and channel type" on page 42

Manual operation: See "State" on page 10

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

Selects the test mode.

Several settings depend on the selected test mode.

Parameters:

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

*RST: T1

Example: See Example "Selecting test mode, link direction and channel type" on page 42

Manual operation: See "Test Mode" on page 12

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

Queries the tetra standard version.

Return values:

<Version> string

Example: See Example "Selecting test mode, link direction and channel type" on page 42

Usage: Query only

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

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

Setting parameters:

<Filename> string

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

Example: See Example "Selecting test mode, link direction and channel type" on page 42

Usage: Setting only

Manual operation: See "Generate Waveform File" on page 12

4.2 Power Ramp Commands

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

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

Parameters:

<FOffset> integer

Range: 0 to 4
*RST: 0

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

Manual operation: See "Fall Offset" on page 16

[: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 15

[: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 16

[: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 16

[: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 16

4.3 Slot Configuration Commands

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

Selects the burst type for "Test Mode T2".

Parameters:

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

*RST: NCDB

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

Manual operation: See "T2 Burst Type" on page 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: 0

Example:

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

Manual operation: See "Use Coded T1/T4 Data" on page 25

[: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 27

[: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 27

[: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 27

[: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 25

[: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 25

[: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 54.

*RST: PN09

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

Manual operation: See "Data List Management" on page 11

[: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 53).

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 53.

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 List Management" on page 11

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

Selects the logical channel type.

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

Parameters:

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

*RST: T72|D4H

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

Manual operation: See "Logical Channel Type" on page 26

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

Enables/disables auto scrambling.

Parameters:

<Scrambling> 0 | 1 | OFF | ON

*RST: 1

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 55.

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 56.

*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 55).

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 55.

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 Commands

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

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

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

Parameters:

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

*RST: AP53

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

Manual operation: See "ACCESS_PARAMETER" on page 22

[: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 23

[: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 18

[: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 19

[: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 21

[: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 21

[: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 21

[: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 19

[: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 22

[: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 18

[: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 20

[: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 22

[: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 22

[: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 23

[: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 18

[: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 23

[: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 21

[: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 19

[: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 19

[: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 20

[: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 20

[: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 22

[: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 20

[: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 22

[: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 21

[: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 21

4.5 Filter/Clipping Commands

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

Sets the limit for clipping.

Parameters:

<Level> integer
Range: 1 to 100
*RST: 100
Default unit: PCT

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

Manual operation: See "Clipping Level" on page 30

[: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 30

[: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 30

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

Sets the impulse length (number of filter tabs).

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

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

Sets the filter parameter.

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

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

Manual operation: See "Roll Off Factor or BxT" on page 29

[: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 29

[: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 29

4.6 Trigger Commands

Programming example

Example: Trigger configuration

```
SOURce1:BB:TETRa:TRIGger:SEQuence AAUT
SOURce1:BB:TETRa:TRIGger:SOURce EXT
SOURce1:BB:TETRa:TRIGger:EXTernal1:SYNChronize:OUTPut 1
SOURce1:BB:TETRa:TRIGger:EXTernal1:INHibit 100
SOURce1:BB:TETRa:TRIGger:EXTernal:DELay 10


SOURce1:BB:TETRa:TRIGger:SEQuence SING
SOURce1:BB:TETRa:TRIGger:SLUNit SEQ
// SOURce1:BB:TETRa:TRIGger:SLUNit MFR
SOURce1:BB:TETRa:TRIGger:SLENgth 2


SOURce1:BB:TETRa:TRIGger:SOURce INT
SOURce1:BB:TETRa:TRIGger:SEQuence ARETrigger
SOURce1:BB:TETRa:STATe ON
SOURce1:BB:TETRa:TRIGger:EXEcute
// executes a trigger, signal generation starts
SOURce1:BB:TETRa:TRIGger:ARM:EXECute
// signal generation stops
SOURce1:BB:TETRa:TRIGger:EXEcute
// executes a trigger, signal generation starts again

SOURce1:BB:TETRa:TRIGger:RMODe?
// queries the current signal generation status
// 1 (running)

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

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

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

Example: See Example "Trigger configuration" on page 69

Usage: Event

Manual operation: See "Arm " on page 33

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

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

Example: See Example "Trigger configuration" on page 69

Usage: Event

Manual operation: See "Execute Trigger" on page 14

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

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

Parameters:

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

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Sync. Output to External Trigger" on page 34

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

Sets the trigger delay (expressed as a number of samples) for triggering by the trigger signal from the second path.

Parameters:

<Delay> float
Range: 0 to 65535
Increment: 0.01
*RST: 0

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Trigger Delay" on page 35

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

For triggering via the other path, specifies the duration by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Trigger Inhibit" on page 35

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

Queries the status of signal generation for all trigger modes.

Parameters:

<RMode> STOP | RUN

*RST: STOP

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Running/Stopped" on page 33

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

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

Parameters:

<Slength> integer

Range: 1 to 7000
*RST: 1

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Signal Duration " on page 33

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

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

Parameters:

<SlUnit> SEQuence | MFRame

*RST: SEQuence

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Signal Duration Unit" on page 33

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

Selects the trigger source:

- `INTernal`: manual trigger or `*TRG`.
- `EXTernal|BEXTernal`: trigger signal on the TRIGGER 1/2 connector.
- `OBASeband`: trigger signal from the other path

Parameters:

<Source> INTernal|OBASeband|BEXTernal|EXTernal

*RST: INTernal

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Trigger Source" on page 33

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

Sets the trigger delay.

Parameters:

<Delay> float

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

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Trigger Delay" on page 35

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

Specifies the duration by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Trigger Inhibit" on page 35

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

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

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

*RST: AUTO

Example: See Example "Trigger configuration" on page 69

Manual operation: See "Trigger Mode" on page 32

4.7 Marker Commands

Programming Examples

Example: Marker configuration

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

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

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

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

// Marker delay
SOURce1:BB:TETRa:TRIGger:OUTPut:DELay:FIXed 1
// restricts the marker signal delay
SOURce1:BB:TETRa:TRIGger:OUTPut:DELay:MINimum?
// 0
SOURce1:BB:TETRa:TRIGger:OUTPut:DELay:MAXimum?
// 2000
SOURce1:BB:TETRa:TRIGger:OUTPut2:DELay 1600
// delays the marker signal output
```

[: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: 0

Example: See Example "Marker configuration" on page 73

Manual operation: See "Fix marker delay to current range " on page 37

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

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

Parameters:

<Delay> float

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

Example: See Example "Marker configuration" on page 73

Manual operation: See "Marker x Delay" on page 37

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

Queries the min/max marker delay.

Return values:

<Maximum> float

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

Example: See Example "Marker configuration" on page 73

Usage: Query only

Manual operation: See "Current Range without Recalculation" on page 37

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

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

Parameters:

<Delay> float

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

Example: See Example "Marker configuration" on page 73

Manual operation: See "Marker x Delay" on page 37

[: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 | TRIGger

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 77.

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 76 and `[:SOURce<hw>]:BB:TETRa:TRIGger:OUTPut<ch>:OFFTime` on page 76 is generated.

TRIGger
A received internal or external trigger signal is output at the marker connector.

*RST: RESTart

Example: See Example "Marker configuration" on page 73

Manual operation: See "Marker Mode" on page 36

[: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

Manual operation: See "Marker Mode" on page 36

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

Selects the data for a pattern.

Parameters:

<Pattern> 64 bits

*RST: #H2,2

Example: See Example "Marker configuration" on page 73

Manual operation: See "Marker Mode" on page 36

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

Sets the divider for the clock frequency.

Parameters:

<Divider> integer

Range: 2 to 1024

*RST: 2

Example: See Example "Marker configuration" on page 73

Manual operation: See "Marker Mode" on page 36

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

Queries the marker pulse frequency.

Return values:

<Frequency> float

Increment: 0.001

Example: See Example "Marker configuration" on page 73

Usage: Query only

Manual operation: See "Marker Mode" on page 36

4.8 Clock Commands

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

Sets the type of externally supplied clock.

For two-path instruments, the only numerical suffix allowed for SOURce is 1, since the external clock source is permanently allocated to path A.

Parameters:

<Mode> SAMPle | MSAMple

*RST: SAMPle

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

Manual operation: See "Clock Mode" on page 38

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

Sets the multiplier for clock type Multiplied (`[:SOURce<hw>]:BB:TETRa:CLOCk:MODE` on page 77).

For two-path instruments, the only numerical suffix allowed for `SOURce` is 1, since the external clock source is permanently allocated to path A.

Parameters:

<Multiplier> integer

Range: 1 to 64

*RST: 4

Example: `SOURce1:BB:TETRa:CLOCk:SOURce EXTernal`
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 39

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

Selects the clock source.

For two-path instruments, selecting `EXTernal` is only possible for path A, since the external clock source is permanently allocated to path A. Selection `AINternal` is only possible for path B.

Parameters:

<Source> INTernal | EXTernal | AINTernal

INTernal
The internal clock reference is used to generate the symbol clock.

EXTernal
The external clock reference is supplied to the CLOCK connector.

AINTernal
The clock source of path A is used for path B.

*RST: INTernal

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

Manual operation: See "Clock Source " on page 38

[:SOURce<hw>]:BB:TETRa:CLOCk:SYNChronization:EXECute

(for R&S SMBV only)

Performs automatically adjustment of the instrument's settings required for the synchronization mode (`[:SOURce<hw>]:BB:TETRa:CLOCk:SYNChronization:MODE` on page 79).

Example:
```
BB:TETR:CLOC:SYNC:MODE SLAV
BB:TETR:CLOC:SYNC:EXEC
```

Usage: Event

Manual operation: See "Set Synchronization Settings " on page 38

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

(for R&S SMBV only)

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type. Avoid unnecessary cable length and branching points.

Parameters:

<Mode> NONE | MASTer | SLAVe

NONE
The instrument is working in stand-alone mode.

MASTer
The instrument provides all connected instrument with its synchronisation (including the trigger signal) and reference clock signal.

SLAVe
The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

*RST: NONE

Example: `BB:TETR:CLOC:SYNC:MODE MAST`

Manual operation: See "Sync. Mode" on page 38

List of Commands

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