

XM Radio

Digital Standard for

R&S[®]Signal Generators

Operating Manual



1171.5183.52 – 14

This document describes the following software options:

- R&S®AMU-K56
1402.9905.02
- R&S®SMATE-K56
1404.7751.02
- R&S®SMBV-K56
1415.8183.02
- R&S®SMJ-K56
1404.1806.02
- R&S®SMU-K56
1161.1162.02

This manual version corresponds to firmware version:

FW 3.20.281.xx and later of the R&S®SMBV100A

FW 2.20.360.142 and later of the R&S®SMU200A, R&S®SMATE200A, R&S®SMJ100A and R&S®AMU200A

Customer Information Regarding Recording in the Sirius XM Band

Sirius XM does not support recording of Sirius XM broadcast. If a customer purchases equipment from Rohde & Schwarz with the intention of recording the Sirius XM broadcast, this customer does so at its own risk. Sirius XM will not provide any support or assistance to this customer. Rohde & Schwarz decline to assist customers in recording the Sirius XM broadcast.

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The following abbreviations are used throughout this manual: R&S®AMU200A is abbreviated as R&S AMU, R&S®AFQ100A is abbreviated as R&S AFQ, R&S®SMATE200A is abbreviated as R&S SMATE, R&S®SMBV100A is abbreviated as R&S SMBV, R&S®SMJ100A is abbreviated as R&S SMJ, R&S®SMU200A is abbreviated as R&S SMU, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2

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1 Preface

1.1 Documentation Overview

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

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
 - Online help system (*.chm) as a standalone help,
 - Software Manual and User Manuals for the options,
 - Operating Manuals for base unit and options,
 - Service Manual,
 - Data sheet and specifications,
 - Links to useful sites on the R&S internet.

Online Help

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

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

Quick Start Guide

The Quick Start Guide is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

Operating Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

These manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual for the base unit, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given.

In the individual option manuals, the specific functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S Signal Generator is not included in the option manuals.

User Manuals

The operating manual is delivered with the software in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the software, as well as a detailed description of all instrument functions. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Basic operations and an example of setup are described.

Additional operating manuals are provided for each supported Digital Standard, containing the specific functions of the corresponding digital standard. Basic information on operating R&S Signal Generator is not included in these manuals.

Service Manual

The Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be ordered in printed form (see ordering information in the data sheet).

Release Notes

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

Web Help

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

The Web Help provides online access to the complete information on operating the R&S Signal Generator and all supported digital standards, without downloading.

The web help is available on the R&S Signal Generator product page at the Downloads > Web Help area.

Application Notes

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

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

1.2 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.
<i>Input</i>	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3 Notes on Screenshots

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

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

2 Introduction

The R&S Signal Generator enables you to generate signals in accordance with the XM-Radio standard.

The equipment layout of R&S SMUx/AMU for generating XM-Radio signals includes the options Baseband Main Module (R&S SMx/AMU-B13), Baseband Generator (R&S SMx/AMU-B9/B10/B11) and XM-Radio (R&S SMx/AMU-K56).

The equipment layout of R&S SMBV instrument for generating XM-Radio signals includes one of the options Baseband Generator (R&S SMx/AMU-B10/B51) and option XM-Radio (R&S SMx/AMU-K56).

Per baseband, one satellite signal or one terrestrial signal can be generated.

In the case of two-path instruments, at least one further option R&S SMx/AMU-B9/B10/B11 (Baseband Generator) is needed for generating a XM-Radio signal in the second path.

2.1 Modulation System XM-RADIO

The XM-Radio signal consists of ensemble A and ensemble B.

Within an ensemble, the XM-Radio signal is transmitted via two satellites (QPSK-modulation) and additionally via one terrestrial repeater (COFDM-modulation).

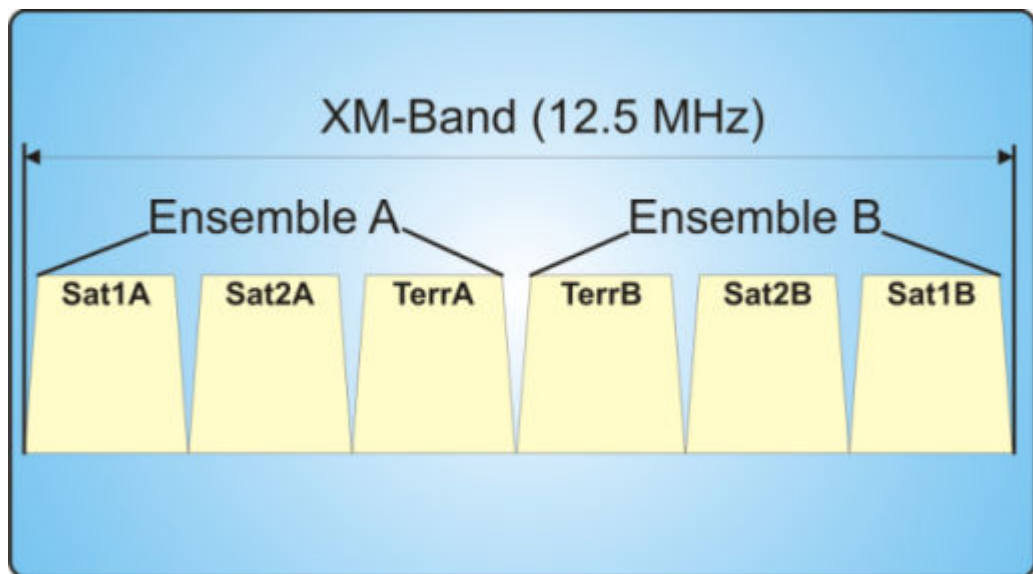


Fig. 2-1: XM-Radio Frequency Band

The following table shows the carrier frequencies for the corresponding channels:

Table 2-1: Carrier frequencies

Ensemble	Channel	Frequency [MHz]	Polarization
A	Satellite 1 (Sat1A)	2333.465	LHCP
	Satellite 2 (Sat2A)	2335.305	LHCP
	Terrestrial (TerrA)	2337.490	vertically
B	Terrestrial (TerrB)	2340.020	vertically
	Satellite 2 (Sat2B)	2342.205	LHCP
	Satellite 1 (Sat1B)	2344.045	LHCP

3 XM-RADIO User interface

The menu for setting the XM-RADIO digital standard is either called from the baseband block or from the menu tree under "Baseband".



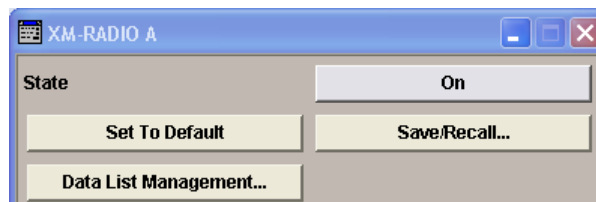
The screenshots provided in this description show parameter values that have been selected to illustrate as much as possible of the provided functions and possible inter-dependencies between them.

These values are not necessarily representative of realistic test situations.

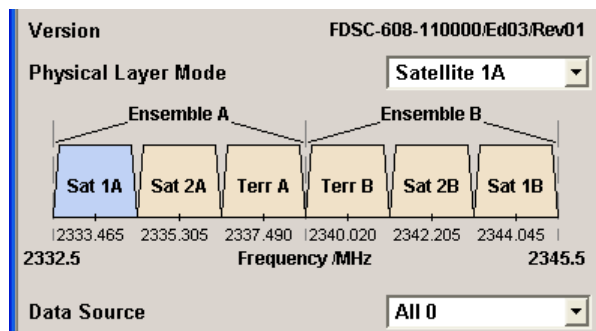
3.1 Main Menu for XM-RADIO Signals

The menu is split into several sections for configuring the standard.

The upper menu section is where the XM-RADIO digital standard is activated and deactivated. Configuration settings can be stored and already stored configuration settings can be loaded.



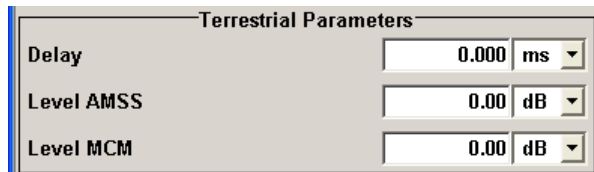
In the next section, the physical layer mode and the data source are selected.



In the "Satellite Parameters" section, the parameter for the delay is set.



In the "Terrestrial Parameters" section, the parameters for the terrestrial transponder are set.



The buttons in the lower menu section lead to submenus for setting the filter, trigger, and clock parameters.



State

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

Remote command:

```
[ :SOURce<hw> ] :BB:XMRadio:STATe on page 34
```

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"
Physical Layer Mode	Satellite 1A
Data Source	PN9
Delay	0.000 ms
Filter	Root Cosine
Roll Off Factor	0.15
Symbol Rate Variation	1.64 Msym/s

Remote command:

```
[ :SOURce<hw> ] :BB:XMRadio:PRESet on page 32
```

Save/Recall...

Calls the "Save/Recall" menu.

From the "Save/Recall" menu, the "File Select" windows for saving and recalling XM-RADIO configurations and the "File Manager" is called.



XM-RADIO configurations are stored as files with the predefined file extension *.xmradio. The file name and the directory they are stored in are user-definable.

The complete settings in the "XM-RADIO" menu are saved and recalled.

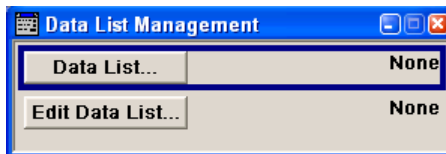
- "Recall XM-RADIO Setting" Opens the "File Select" window for loading a saved XM-RADIO configuration. The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.
- "Save XM-RADIO Setting" Opens the "File Select" window for saving the current XM-RADIO signal configuration. The name of the file is specified in the "File Name" entry field. The file is saved by pressing the "Save" button. The "Fast Save" checkbox 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. "Fast Save" is not affected by the "Preset" function.
- "File Manager" Calls the "File Manager". The "File Manager" is used to copy, delete, and rename files and to create new directories.

Remote command:

- [\[:SOURce<hw>\]:BB:XMRadio:SETTING:CATalog? on page 33](#)
- [\[:SOURce<hw>\]:BB:XMRadio:SETTING:LOAD on page 33](#)
- [\[:SOURce<hw>\]:BB:XMRadio:SETTING:STORe on page 34](#)
- [\[:SOURce<hw>\]:BB:XMRadio:SETTING:STORe:FAST on page 34](#)
- [\[:SOURce<hw>\]:BB:XMRadio:SETTING:DELeTe on page 33](#)

Data List Management

Calls the "Data List Management" menu. This menu 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, e.g. in the channel table of the base stations.

Note: All data lists are generated and edited by means of the `SOURce:BB:DM` subsystem commands. Files containing data lists usually end with *.dm_iqd. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

Example: Creating and editing the data list

```
SOUR:BB:DM:DLIS:SEL "xm_radio"
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
```

Remote command:

[\[:SOURce<hw>\]:BB:XMRadio:DATA](#) on page 30

[\[:SOURce<hw>\]:BB:XMRadio:DATA:DSElect](#) on page 31

Version

Displays the current version of the XM-RADIO standard depending on the selected physical layer mode.

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

Remote command:

[\[:SOURce<hw>\]:BB:XMRadio:VERSion?](#) on page 35

Physical Layer Mode

Selects the physical layer mode.

"Satellite" Transmits the QPSK-modulated signal by means of a satellite.

"Terrestrial" Transmits the COFDM-modulated signal by means of a repeater.

Remote command:

[\[:SOURce<hw>\]:BB:XMRadio:LAYer](#) on page 32

Data Source

Selects the data source for the XM-Radio signal.

The following data sources are available for selection:

"ALL0, ALL1" 0 data and 1 data is generated internally.

"PNxx" PRBS data as per CCITT with period length between 2^9-1 and $2^{23}-1$ is generated internally.

"Pattern" A user-definable bit pattern with a maximum length of 64 bits is generated internally.
The bit pattern is defined in the "Pattern" entry field.

"Data List" Internal data from a programmable data list is used. The data list can be generated by the Data Editor or generated externally.
Data lists are selected in the "Select Data List" field.

Remote command:

[\[:SOURce<hw>\]:BB:XMRadio:DATA](#) on page 30

[\[:SOURce<hw>\]:BB:XMRadio:DATA:PATtern](#) on page 31

[\[:SOURce<hw>\]:BB:XMRadio:DATA:DSElect](#) on page 31

Frame Counter

The parameter is available for Data List only.

Displays the number of frames.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:FCOUNTER?` on page 31

Delay

Sets the signal delay.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATELLITE:DELAY` on page 32

`[:SOURCE<hw>] :BB:XMRadio:TERRESTRIAL:DELAY` on page 34

Level AMSS

Sets the level for the amplitude modulated synchronization symbol (AMSS).

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TERRESTRIAL:POWER:AMSS` on page 35

Level MCM

Sets the level for the multicarrier modulation (MCM).

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TERRESTRIAL:POWER:MCM` on page 35

Filter...

Calls the menu for setting baseband filtering. The current filter is displayed next to the button.

The menu is described in [chapter 3.2, "Filter Settings"](#), on page 16.

Remote command:

n.a.

Trigger /Marker

Calls the menu for selecting the trigger mode and trigger source, for configuring the marker signals, and for setting the time delay of an external trigger signal.

This menu is described in [chapter 3.3, "Trigger/Marker/Clock Settings"](#), on page 18.

The currently selected trigger mode and trigger source are displayed next to the button.

Remote command:

n.a.

Execute Trigger

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

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TRIGGER:EXECUTE` on page 41

Arm

Stops signal generation manually. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TRIGger:ARM:EXECute` on page 41

Clock

Calls the menu for selecting the clock source and for setting a delay.

This menu is described in [chapter 3.3.4, "Clock Settings"](#), on page 26.

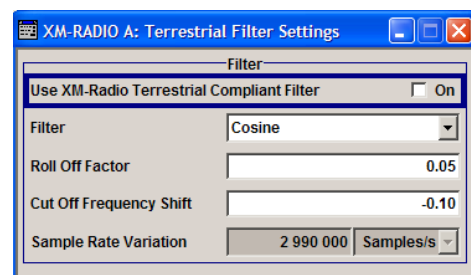
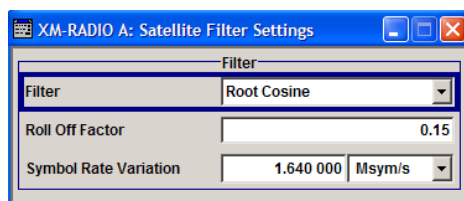
Remote command:

n.a.

3.2 Filter Settings

To access this dialog, select "Main Menu > Filter".

The baseband filter, symbol rate variation and clipping are defined in this menu.



Use XM-Radio Terrestrial Compliant Filter

Activates or deactivates the usage of the filter which is in compliance with the spectral mask of the terrestrial standard.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:TCFilter[:STATe]`

on page 36

Filter

Sets the baseband filter.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:TYPE` on page 37

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:TYPE` on page 37

Roll Off Factor / BxT

Sets the filter parameter.

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

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:APCO25`
on page 37

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:COsine`
on page 37

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:GAUSS`
on page 37

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:PGAuss`
on page 38

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:RCOSine`
on page 39

`[:SOURCE<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:SPHase`
on page 39

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:APCO25`
on page 37

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:COsine`
on page 37

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:GAUSS`
on page 37

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:PGAuss`
on page 38

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:RCOSine`
on page 39

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:SPHase`
on page 39

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.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:COsine:COFS`
on page 39

Cut Off Frequency Factor

(available for filter parameter Lowpass only)

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

Remote command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:LPASs`

on page 38

`[:SOURce<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:LPASSEVM`

on page 38

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:LPASs`

on page 38

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:LPASSEVM`

on page 38

Symbol Rate Variation

(available for physical layer mode Satellite only).

Sets the symbol rate of the signal.

Remote command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:SRATe:VARiation` on page 40

Sample Rate Variation

(available for physical layer mode Terrestrial only).

Displays the terrestrial sample rate variation.

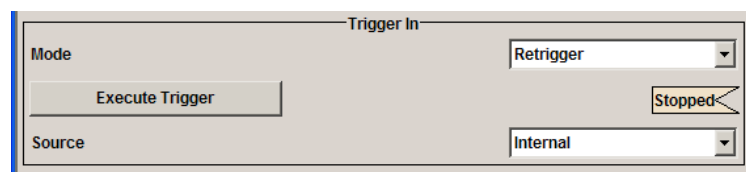
Remote command:

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:SRATe:VARiation?` on page 40

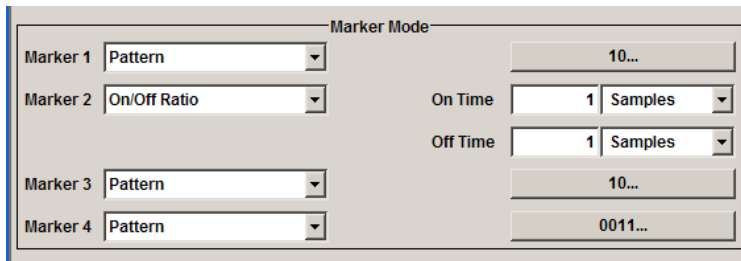
3.3 Trigger/Marker/Clock Settings

To access this dialog, select "Main Menu > Trigger/Marker".

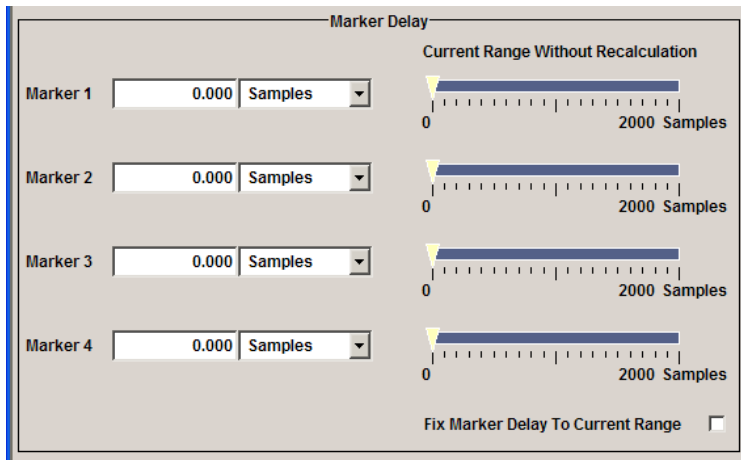
The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



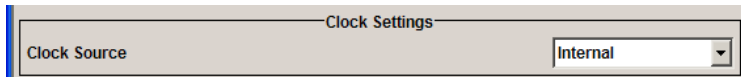
The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.



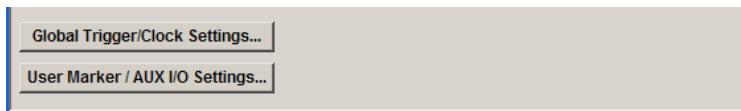
The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.



The "Clock Settings" section is where 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.



3.3.1 Trigger In

The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current 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:XMRadio:SATellite\[:TRIGGER\]:SEQUENCE](#) on page 43

[\[:SOURCE<hw>\]:BB:XMRadio:TERRESTRIAL\[:TRIGGER\]:SEQUENCE](#)

on page 43

Signal Duration Unit

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

Remote command:

[\[:SOURCE<hw>\]:BB:XMRadio:TERRESTRIAL:TRIGGER:SLUNIT](#) on page 47

Signal Duration

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

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

Remote command:

[\[:SOURCE<hw>\]:BB:XMRadio:SATellite:TRIGGER:SLLENGTH](#) on page 45

[\[:SOURCE<hw>\]:BB:XMRadio:TERRESTRIAL:TRIGGER:SLLENGTH](#) on page 47

Running/Stopped

For enabled modulation, displays the status of signal generation for all trigger modes.

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

Remote command:

[\[:SOURCE<hw>\]:BB:XMRadio:TRIGGER:RMODE?](#) on page 42

Arm

Stops signal generation manually. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TRIGger:ARM:EXECute` on page 41

Execute Trigger

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

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TRIGger:EXECute` on page 41

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:XMRadio:SATellite:TRIGger:SOURce` on page 43

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:TRIGger:SOURce` on page 43

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:

For one or two or more R&S SMBVs configured 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 the table below for an overview of the required settings.

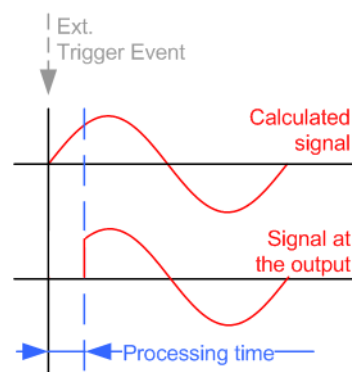
Table 3-1: Typical Applications

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"

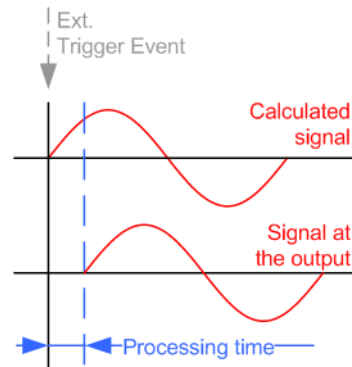
Corresponds to the default state of this parameter.

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:XMRadio:SATellite:TRIGger:EXTernal:SYNChronize:OUTPut` on page 42

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger:EXTernal:SYNChronize:OUTPut` on page 42

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:XMRadio:SATellite:TRIGger[:EXTernal<ch>]:DELay` on page 45

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger[:EXTernal<ch>]:DELay` on page 48

`[:SOURce<hw>] :BB:XMRadio:SATellite:TRIGger:OBASeband:DELay` on page 44

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger:OBASeband:DELay` on page 46

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:XMRadio:SATellite:TRIGger [:EXTernal<ch>] :`

`INHibit` on page 46

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:TRIGger [:EXTernal<ch>] :`

`INHibit` on page 48

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGger:OBASeband:INHibit`

on page 45

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:TRIGger:OBASeband:INHibit`

on page 46

3.3.2 Marker Mode

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.

Marker Mode

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

"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:XMRadio:SATellite:TRIGger:OUTPut<ch>:ONTime`

on page 53

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:ONTime`

on page 55

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:OFFTime`

on page 52

`[:SOURCE<hw>] :BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:OFFTime`

on page 55

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

"TPL Frame " (available for Physical Layer Mode Terrestrial only)

A marker signal is generated at the start of each TPL (Terrestrial Physical Layer) frame.

"MCM Symbol" (available for Physical Layer Mode Terrestrial only)

A marker signal is generated at the beginning of each MCM (Multicarrier Modulation) symbol.

"User Period" A marker signal is generated at the beginning of every user-defined period. The period is defined in "Period."

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PERIOD`

on page 53

`[:SOURCE<hw>] :BB:XMRadio:TERRESTRIAL:TRIGGER:OUTPUT<ch>:PERIOD`

on page 56

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

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PULSE:`

`DIVIDER` on page 54

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PULSE:`

`FREQUENCY?` on page 54

"Pattern " (available for Physical Layer Mode Satellite only)
A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when pattern is selected.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PATTERN`

on page 53

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:MODE`

on page 51

`[:SOURCE<hw>] :BB:XMRadio:TERRESTRIAL:TRIGGER:OUTPUT<ch>:MODE`

on page 51

MCM Position

(available for Physical Layer Mode Terrestrial only)

Sets the position of the MCM symbol.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:TERRESTRIAL:TRIGGER:OUTPUT<ch>:`

`MCMPOSITION` on page 54

3.3.3 Marker Delay

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

The R&S SMBV supports only two markers.

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/samples. 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:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay
```

on page 49

```
[ :SOURce<hw> ] :BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay
```

on page 50

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:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay:
```

MINimum? on page 50

```
[ :SOURce<hw> ] :BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:
```

MINimum? on page 51

```
[ :SOURce<hw> ] :BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay:
```

MAXimum? on page 50

```
[ :SOURce<hw> ] :BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:
```

MAXimum? on page 51

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:XMRadio:SATellite:TRIGger:OUTPut:DELay:FIXed
```

on page 49

```
[ :SOURce<hw> ] :BB:XMRadio:TERRestrial:TRIGger:OUTPut:DELay:FIXed
```

on page 49

3.3.4 Clock Settings

The Clock Settings is used to set the clock source and a delay if required.

Sync. Mode

(for R&S SMBV only)

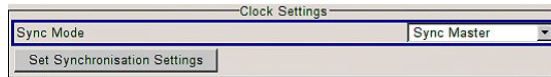
Selects the synchronization mode.

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.

- "None" The instrument is working in stand-alone mode.
- "Sync. Master" The instrument provides all connected instrument with its synchronisation (including the trigger signal) and reference clock signal.



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

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:CLOCK:SYNChronization:MODE`

on page 58

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:CLOCK:SYNChronization:MODE`

on page 59

Set Synchronization Settings

(for R&S SMBV only)

Performs automatically adjustment of the instrument's settings required for the synchronization mode, selected with the parameter "Synchronization Mode".

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:CLOCK:SYNChronization:EXECute`

on page 58

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:CLOCK:SYNChronization:`

`EXECute` on page 58

Clock Source

Selects the clock source.

- "Internal" The internal clock reference is used to generate the symbol clock.
- "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 to an accuracy of +/-2 % (see data sheet).
The polarity of the clock input can be changed with the aid of "Global Trigger/Clock Settings".
In the case of two-path instruments this selection applies to path A.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:CLOCK:SOURCE` on page 57

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:CLOCK:SOURCE` on page 57

Clock Mode

Enters the type of externally supplied clock.

- "Sample/Symbol" A sample clock (for physical layer mode Terrestrial) or a symbol clock (for physical layer mode Satellite) is supplied via the CLOCK connector.

"Multiple Sample/Symbol" A multiple of the sample clock (for physical layer mode Terrestrial) or a multiple of the symbol clock (for physical layer mode Satellite) is supplied via the CLOCK connector; the sample clock is derived internally from this.

The Clock Multiplier window provided allows the multiplication factor to be entered.

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:CLOCK:MODE` on page 56

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:CLOCK:MODE` on page 56

Clock Multiplier

Enters the multiplication factor for clock type "Multiple".

Remote command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:CLOCK:MULTIPLIER` on page 57

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:CLOCK:MULTIPLIER` on page 57

Measured External Clock

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

Remote command:

`CLOCK:INPUT:FREQUENCY?`

3.3.5 Global Settings

The buttons in this section lead to dialogs for general trigger, clock and mapping settings.

Global Trigger/Clock Settings

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

This dialog is used among other things for setting 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

Calls 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 XM-Radio option 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

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.

The following commands specific to the `SOURCE:BB:XMR` subsystem are described here:

- [Main Settings](#)..... 30
- [Filter Settings](#)..... 36
- [Trigger Settings](#)..... 40
- [Marker Settings](#)..... 48
- [Clock Settings](#)..... 56

4.1 Main Settings

- [\[:SOURCE<hw>\]:BB:XMRadio:DATA](#)..... 30
- [\[:SOURCE<hw>\]:BB:XMRadio:DATA:DSElect](#)..... 31
- [\[:SOURCE<hw>\]:BB:XMRadio:DATA:PATtern](#)..... 31
- [\[:SOURCE<hw>\]:BB:XMRadio:FCOunter?](#)..... 31
- [\[:SOURCE<hw>\]:BB:XMRadio:LAYer](#)..... 32
- [\[:SOURCE<hw>\]:BB:XMRadio:PRESet](#)..... 32
- [\[:SOURCE<hw>\]:BB:XMRadio:SATellite:DELay](#)..... 32
- [\[:SOURCE<hw>\]:BB:XMRadio:SETTing:CATalog?](#)..... 33
- [\[:SOURCE<hw>\]:BB:XMRadio:SETTing:DELete](#)..... 33
- [\[:SOURCE<hw>\]:BB:XMRadio:SETTing:LOAD](#)..... 33
- [\[:SOURCE<hw>\]:BB:XMRadio:SETTing:STORe](#)..... 34
- [\[:SOURCE<hw>\]:BB:XMRadio:SETTing:STORe:FAST](#)..... 34
- [\[:SOURCE<hw>\]:BB:XMRadio:STATe](#)..... 34
- [\[:SOURCE<hw>\]:BB:XMRadio:TERRestrial:DELay](#)..... 34
- [\[:SOURCE<hw>\]:BB:XMRadio:TERRestrial:POWer:AMSS](#)..... 35
- [\[:SOURCE<hw>\]:BB:XMRadio:TERRestrial:POWer:MCM](#)..... 35
- [\[:SOURCE<hw>\]:BB:XMRadio:VERSion?](#)..... 35

[:SOURCE<hw>]:BB:XMRadio:DATA <Data>

This command selects the data source for the XM-Radio signal.

Parameters:

<Data> ZERO | ONE | PATtern | PN9 | PN11 | PN15 | PN16 | PN20 |
 PN21 | PN23 | DLISt
 *RST: PN9

Example:

BB:XMR:DATA PN9
 PN9 is the data source for the XM-Radio signal.

Manual operation: See ["Data List Management"](#) on page 13

[:SOURce<hw>]:BB:XMRadio:DATA:DSElect <DSelect>

The command selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions *.dm_iqd in a directory of the user's choice. The directory applicable to the following commands is defined with the command MMEMory:CDIR. To access the files in this directory, you only have to give the file name without the path and the file extension.

Parameters:

<DSelect> string

Example:

BB:XMR:DATA DLIS
 selects Data Lists as data source.
 MMEM:CDIR '<root>Lists'
 selects the directory for the data lists.
 BB:XMR:DATA:DSEL 'XMRadio_list1'
 selects file XMRadio_list1 as the data source.

Manual operation: See ["Data List Management"](#) on page 13

[:SOURce<hw>]:BB:XMRadio:DATA:PATtern <Pattern>

Selects the bit pattern for the Data selection. The maximum length is 64 bits.

Parameters:

<Pattern> 64 bits

Example:

BB:XMR:DATA:PATT #B10
 defines the bit pattern.

Manual operation: See ["Data Source"](#) on page 14

[:SOURce<hw>]:BB:XMRadio:FCOUNTER?

Queries the number of frames.

Return values:

<FCOUNTER> integer
 Range: 0..max

Example:

BB:XMR:FCO?
 queries the number of frames.

Usage: Query only
Manual operation: See ["Frame Counter"](#) on page 14

[:SOURce<hw>]:BB:XMRadio:LAYer <Layer>

The command selects the physical layer mode for the transmission of the XM-Radio signal.

Parameters:

<Layer> SAT1A/SAT2A/SAT2B/SAT1B | TERRA/TERRB
SAT1A/SAT2A/SAT2B/SAT1B
 Transmits the QPSK-modulated signal via up to two satellites.
TERRA|TERRB
 Transmits the COFDM-modulated signal by means of a repeater.
 *RST: SAT1A

Example: BB:XMR:LAY SAT1A
 selects SAT1A as physical layer mode.

Manual operation: See ["Physical Layer Mode"](#) on page 14

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

The command produces a standardized default for the XM-RADIO standard. The settings correspond to the *RST values specified for the commands.

All XM-RADIO settings are preset.

Example: BB:XMR:PRES
 resets all the XM-RADIO settings to default values.

Usage: Event

Manual operation: See ["Set To Default"](#) on page 12

[:SOURce<hw>]:BB:XMRadio:SATellite:DELay <Delay>

Sets the signal delay in physical layer mode satellite.

Parameters:

<Delay> float
 Range: 0 to 0.063
 Increment: 1E-6
 *RST: 0

Example: BB:XMR:SAT:DEL 5.0MS
 sets a signal delay of 5 ms.

Manual operation: See ["Delay"](#) on page 15

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

This command reads out the files with XM-RADIO settings in the default directory. The default directory is set using command `M MEM:CDIRectory`. Only files with the file extension `*.xmradio` will be listed.

Return values:

<Catalog> string

Example:

```
M MEM:CDIR '

```

Usage: Query only

Manual operation: See "[Save/Recall...](#)" on page 12

[:SOURce<hw>]:BB:XMRadio:SETTing:DELeTe <Filename>

This command deletes the selected file with "XM-RADIO" settings. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.xmradio` will be deleted.

Setting parameters:

<Filename> string

Example:

```
BB:XMR:SETT:DEL 'xmradio_1'
deletes file 'xmradio_1'.
```

Usage: Setting only

Manual operation: See "[Save/Recall...](#)" on page 12

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

This command loads the selected file with "XM-RADIO" settings. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.xmradio` will be loaded.

Setting parameters:

<Filename> string

Example:

```
BB:XMR:SETT:LOAD 'xmradio_1'
loads file 'xmradio_1'.
```

Usage: Setting only

Manual operation: See "[Save/Recall...](#)" on page 12

[:SOURce<hw>]:BB:XMRadio:SETTING:STORE <Filename>

This command stores the current "XM-RADIO" settings into the selected file. The directory is set using command `MMEM:CDIRECTORY`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. XM-RADIO settings are stored as files with the specific file extensions `*.xmradio`.

Setting parameters:

<Filename> string

Example: `BB:XMR:SETT:STOR 'xmradio_1'`
stores the current settings into file 'xmradio_1'.

Usage: Setting only

Manual operation: See "[Save/Recall...](#)" on page 12

[:SOURce<hw>]:BB:XMRadio: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 12

[:SOURce<hw>]:BB:XMRadio:STATE <State>

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

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `SOURce1:BB:XMRadio:STATE ON`

Manual operation: See "[State](#)" on page 12

[:SOURce<hw>]:BB:XMRadio:TERRESTRIAL:DELAY <Delay>

Sets the signal delay in physical layer mode terrestrial.

Parameters:

<Delay> float
 Range: 0 to 0.063
 Increment: 1E-6
 *RST: 0

Example:

BB:XMR:TERR:DEL 5.0MS
 sets a signal delay of 5 ms.

Manual operation: See "[Delay](#)" on page 15

[:SOURce<hw>]:BB:XMRadio:TERRestrial:POWER:AMSS <Amss>

This command sets the level for the amplitude modulated synchronization symbol (AMSS).

Parameters:

<Amss> float
 Range: -12 to 12
 Increment: 0.01
 *RST: 0

Example:

BB:XMR:TERR:POW:AMSS 12dB
 sets the AMSS level to 12 dB.

Manual operation: See "[Level AMSS](#)" on page 15

[:SOURce<hw>]:BB:XMRadio:TERRestrial:POWER:MCM <Mcm>

This command sets the level for the multicarrier modulation(MCM).

Parameters:

<Mcm> float
 Range: -12 to 12
 Increment: 0.01
 *RST: 0

Example:

BB:XMR:TERR:POW:MCM 12dB
 sets the MCM to 12 dB.

Manual operation: See "[Level MCM](#)" on page 15

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

The command queries the version of the XM-RADIO standard underlying the definitions. The displayed version is depends on the selected physical layer mode.

Return values:

<Version> string

Example: BB:XMR:VERS?
 queries the XM-RADIO version.
Response:
 FDSC-608-110000/Ed03/Rev01

Usage: Query only

Manual operation: See "Version" on page 14

4.2 Filter Settings

[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:TCFilter[:STATe]	36
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:TYPE	37
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:TYPE	37
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:APCO25	37
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:APCO25	37
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:COSSine	37
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:COSSine	37
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:GAUSS	37
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:GAUSS	37
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:LPASS	38
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:LPASS	38
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:LPASSEVM	38
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:LPASSEVM	38
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:PGAuss	38
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:PGAuss	38
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:RCOSSine	39
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:RCOSSine	39
[:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:SPHase	39
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:SPHase	39
[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:PARAMeter:COSSine:COFS	39
[:SOURce<hw>]:BB:XMRadio:SATellite:SRATe:VARiation	40
[:SOURce<hw>]:BB:XMRadio:TERRestial:SRATe:VARiation?	40

[:SOURce<hw>]:BB:XMRadio:TERRestial:FILTer:TCFilter[:STATe] <State>

Activates or deactivates the XM-Radio filter which is in compliance with the spectral mask of the terrestrial standard.

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

Example: BB:XMR:TERR:FILT:TCF:STAT ON
 activates the XM-Radio terrestrial compliant filter.

Manual operation: See "Use XM-Radio Terrestrial Compliant Filter" on page 16

```
[ :SOURce<hw>]:BB:XMRadio:SATellite:FILTer:TYPE <Type>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:TYPE <Type>
```

The command selects the baseband filter type for the terrestrial physical layer mode.

Parameters:

```
<Type>          RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 |
                COEqualizer | COFequalizer | C2K3x | APCO25 | SPHase |
                RECTangle | PGAuss | LPASs | DIRac | ENPShape |
                EWPSshape | LPASSEVM
*RST:          COSine
```

Example:

```
BB:XMR:TERR:FILT:TYPE COS
sets the cosine filter type.
```

Manual operation: See "[Filter](#)" on page 16

```
[ :SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:APCO25 <Apco25>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAMeter:APCO25 <Apco25>
```

The command sets the roll-off factor for the APCO25 filter type.

Parameters:

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

Example:

```
BB:XMR:TERR:FILT:PAR:APCO25 0.05
the roll-off factor is set to 0.05.
```

Manual operation: See "[Roll Off Factor / BxT](#)" on page 16

```
[ :SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:COSine <Cosine>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAMeter:COSine <Cosine>
```

The command sets the roll-off factor for the cosine filter type.

Parameters:

```
<Cosine>        float
                Range:    0.05 to 1.0
                Increment: 0.05
*RST:          0.20
```

Example:

```
BB:XMR:TERR:FILT:PAR:COS 0.05
the roll-off factor is set to 0.05.
```

Manual operation: See "[Roll Off Factor / BxT](#)" on page 16

```
[ :SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:GAUSs <Gauss>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAMeter:GAUSs <Gauss>
```

The command sets the BxT for the gauss filter type.

Parameters:

<Gauss> float
 Range: 0.15 to 2.5
 Increment: 0.01
 *RST: 0.5

Example: BB:XMR:TERR:FILT:PAR:GAUS 0.15
 the BxT is set to 0.15.

Manual operation: See "[Roll Off Factor / BxT](#)" on page 16

[:SOURCE<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:LPASS <LPass>
[:SOURCE<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAmeter:LPASS <LPass>

The command sets the cut off frequency factor for the Lowpass (ACP optimization) filter type.

Parameters:

<LPass> float
 Range: 0.05 to 2
 Increment: 0.01
 *RST: 0.5

Example: BB:XMR:TERR:FILT:PAR:LPAS 0.15
 the cut of frequency factor is set to 0.15.

Manual operation: See "[Cut Off Frequency Factor](#)" on page 17

[:SOURCE<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:LPASSEVM
 <LPassEvm>

[:SOURCE<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAmeter:LPASSEVM
 <LPassEvm>

The command sets the cut off frequency factor for the Lowpass (EVM optimization) filter type.

Parameters:

<LPassEvm> float
 Range: 0.05 to 2
 Increment: 0.01
 *RST: 0.5

Example: BB:XMR:TERR:FILT:PAR:LPASSEVM 0.15
 the cut of frequency factor is set to 0.15.

Manual operation: See "[Cut Off Frequency Factor](#)" on page 17

[:SOURCE<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:PGAuss <PGauss>

[:SOURCE<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAmeter:PGAuss <PGauss>

The command sets the BxT for the pure gauss filter type.

Parameters:

<PGauss> float
 Range: 0.15 to 2.5
 Increment: 0.01
 *RST: 0.5

Example:

BB:XMR:TERR:FILT:PAR:PGA 0.15
 the BxT is set to 0.15.

Manual operation: See "[Roll Off Factor / BxT](#)" on page 16

[:SOURCE<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:RCOSine <RCosine>
[:SOURCE<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAmeter:RCOSine
 <RCosine>

The command sets the roll-off factor for the root cosine filter type.

Parameters:

<RCosine> float
 Range: 0.05 to 1.0
 Increment: 0.01
 *RST: 0.20

Example:

BB:XMR:TERR:FILT:PAR:RCOS 0.15
 the roll-off factor is set to 0.15.

Manual operation: See "[Roll Off Factor / BxT](#)" on page 16

[:SOURCE<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:SPHase <SPHase>
[:SOURCE<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAmeter:SPHase <SPHase>

The command sets the BxT for the split phase filter type.

Parameters:

<SPHase> float
 Range: 0.15 to 2.5
 Increment: 0.01
 *RST: 2

Example:

BB:XMR:TERR:FILT:PAR:SPH 0.15
 the BxT is set to 0.15.

Manual operation: See "[Roll Off Factor / BxT](#)" on page 16

[:SOURCE<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAmeter:COSine:COFS
 <Cofs>

The command sets the cut of frequency shift value for the Cosine filter type.

Parameters:

<Cofs> float
 Range: -0.1 to 1
 Increment: 0.01
 *RST: -0.1

Example: BB:XMR:TERR:FILT:PAR:COF:COFS 0.04
 the "cut of frequency shift" value is set to 0.04.

Manual operation: See ["Cut Off Frequency Shift"](#) on page 17

[:SOURce<hw>]:BB:XMRadio:SATellite:SRATe:VARIation <Variation>

The command enters the output symbol rate.

Parameters:

<Variation> integer
 Range: 1E6 symb/s to 2E6 symb/s
 *RST: 1.64E6 symb/s

Example: BB:XMR:SAT:SRAT:VAR 4000000
 sets the output sample rate to 4e6 symbols/s.

Manual operation: See ["Symbol Rate Variation"](#) on page 18

[:SOURce<hw>]:BB:XMRadio:TERRestrial:SRATe:VARIation?

Queries the output sample rate.

Return values:

<Variation> integer
 *RST: 2.99E6

Example: BB:XMR:TERR:SRAT:VAR?
 queries the output sample rate.
 Response:
 2990000
 the output sample rate is 2990000 samples/s.

Usage: Query only

Manual operation: See ["Sample Rate Variation"](#) on page 18

4.3 Trigger Settings

EXTernal<ch>

The numeric suffix to EXTernal<ch> distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

[:SOURce<hw>]:BB:XMRadio:TRIGger:ARM:EXECute.....41
 [:SOURce<hw>]:BB:XMRadio:TRIGger:EXECute.....41
 [:SOURce<hw>]:BB:XMRadio:TRIGger:RMODE?.....42
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:EXTernal:SYNChronize:OUTPut.....42
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger:EXTernal:SYNChronize:OUTPut.....42
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:SOURce.....43
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger:SOURce.....43
 [:SOURce<hw>]:BB:XMRadio:SATellite[:TRIGger]:SEQUence.....43
 [:SOURce<hw>]:BB:XMRadio:TERRestial[:TRIGger]:SEQUence.....43
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OBASeband:DELay.....44
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OBASeband:INHibit.....45
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:SLENgth.....45
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger[:EXTernal<ch>]:DELay.....45
 [:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger[:EXTernal<ch>]:INHibit.....46
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger:OBASeband:DELay.....46
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger:OBASeband:INHibit.....46
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger:SLENgth.....47
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger:SLUNit.....47
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger[:EXTernal<ch>]:DELay.....48
 [:SOURce<hw>]:BB:XMRadio:TERRestial:TRIGger[:EXTernal<ch>]:INHibit.....48

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

Stops signal generation for trigger modes "Armed Auto" and "Armed Retrigger". A subsequent internal or external trigger event restart signal generation.

Example: BB : XMR : TRIG : ARM : EXEC
 stops signal generation for trigger modes "Armed Auto" and "Armed Retrigger".

Usage: Event

Manual operation: See "Arm" on page 15

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

Executes a trigger. The internal trigger source must be selected using the command SOUR : BB : XMR : SAT | TERR : TRIG : SOUR INT and a trigger mode other than "AUTO" must be selected using the command SOUR : BB : XMR : SAT | TERR : TRIG : SEQ.

Example: BB : XMR : SAT | TERR : TRIG : SOUR INT
 sets internal triggering.
 BB : XMR : SAT | TERR : TRIG : SEQ RETR
 sets Retrigger mode, i.e. every trigger event causes signal generation to restart.
 BB : XMR : TRIG : EXEC
 executes a trigger.

Usage: Event

Manual operation: See "Execute Trigger" on page 15

[:SOURce<hw>]:BB:XMRadio:TRIGger:RMODE?

Queries the current status of signal generation for all trigger modes with modulation on.

Return values:

<RMode> STOP | RUN

STOP
The signal is generated. A trigger event occurred in the triggered mode.

RUN
The signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command `BB:XMR:TRIG:ARM:EXECute` (armed trigger modes only).

*RST: RST value

Example:

```
BB:XMR:SAT|TERR:TRIG:SOUR EXT
sets external triggering via the TRIGGER connector.
BB:XMR:SAT|TERR:TRIG:MODE ARET
selects the Armed_Retrigger mode
BB:XMR:TRIG:RMODE?
queries the current status of signal generation.
Response: Run
the signal is generated, an external trigger was executed.
```

Usage: Query only

Manual operation: See "[Running/Stopped](#)" on page 20

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:EXTernal:SYNChronize:OUTPut <Output>**[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:EXTernal:SYNChronize:OUTPut <Output>**

(enabled for "Trigger Source" External)

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

For R&S SMBV instruments:

See also [Sync. Output to External Trigger](#) for a detailed description of the applications of this setting.

Parameters:

<Output>

ON | OFF

ON

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.

*RST: ON

Example:

BB:XMR:TERR:TRIG:SOUR EXT

sets external triggering.

BB:XMR:TERR:TRIG:EXT:SYNC:OUTP ON

enables synchronous output to external trigger

Manual operation: See "[Sync. Output to External Trigger](#)" on page 21

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:SOURce <Source>

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:SOURce <Source>

Selects the trigger source.

Parameters:

<Source>

INTernal|OBASeband|BEXTernal|EXTernal

INTernal

manual trigger or *TRG.

EXTernal | BEXTernal

trigger signal on the TRIGGER 1/2 connector.

OBASeband

trigger signal from the other path

*RST: INTernal

Example:

SOURce1:BB:XMRadio:TRIGger:SOURce EXTernal

sets external triggering via the TRIGGER 1 connector.

Manual operation: See "[Trigger Source](#)" on page 21

[:SOURce<hw>]:BB:XMRadio:SATellite[:TRIGger]:SEQUence <Sequence>

[:SOURce<hw>]:BB:XMRadio:TERRestrial[:TRIGger]:SEQUence <Sequence>

The command selects the trigger mode.

Parameters:

<Sequence>

AUTO | RETRigger | AAUTo | ARETrigger | SINGLE

AUTO

The modulation signal is generated continuously.

RETRigger

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

AAUTo

The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command

`SOUR:BB:XMR:TRIG:ARM:EXEC` and started again when a trigger event occurs.

ARETrigger

The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart.

Signal generation is stopped with command

`SOUR:BB:XMR:TRIG:ARM:EXEC` and started again when a trigger event occurs.

SINGLE

The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command `SOUR:BB:XMR:TERR:TRIG:SLen`. Every subsequent trigger event causes a restart.

*RST: AUTO

Example:

`BB:XMR:TERR:SEQ AAUT`

sets the "Armed_auto" trigger mode; the device waits for the first trigger (e.g. with *TRG) and then generates the signal continuously.

Manual operation: See "[Trigger Mode](#)" on page 19

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

The command specifies the trigger delay (expressed as a number of symbols) for triggering by the trigger signal from the second path.

Parameters:

<Delay>

float

Range: 0 to 65535

Increment: 0.01

*RST: 0

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

Manual operation: See "[Trigger Delay](#)" on page 23

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OBASband:INHibit <Inhibit>

The command specifies the number of symbols by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path.

Parameters:

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

Example: `BB:XMR:SAT:TRIG:SOUR OBAS`
 sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:XMR:SAT:TRIG:INH 200`
 sets a restart inhibit for 200 symbols following a trigger event.

Manual operation: See "[Trigger Inhibit](#)" on page 23

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:SLENgth <SLength>

The command sets the sequence length of the signal in symbols.

Parameters:

<SLength> integer
 Range: 1 to 4294967295
 *RST: 1

Example: `BB:XMR:SAT:TRIG:SLEN 5000`
 selects the generation of 5000 symbols.

Manual operation: See "[Signal Duration](#)" on page 20

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

The command specifies the trigger delay (expressed as a number of symbols) for external triggering.

Parameters:

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

Example: `BB:XMR:SAT:TRIG:SOUR EXT`
sets an external trigger via the TRIGGER 1 connector.
`BB:XMR:SAT:TRIG:DEL 50`
sets a delay of 50 symbols for the trigger.

Manual operation: See ["Trigger Delay"](#) on page 23

[:SOURCE<hw>]:BB:XMRadio:SATellite:TRIGGER[:EXTERNAL<ch>]:INHIBIT <Inhibit>

The command specifies the number of symbols by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering.

Parameters:

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

Example: `BB:XMR:SAT:TRIG:SOUR EXT`
selects an external trigger via the TRIGGER 1 connector.
`BB:XMR:SAT:TRIG:INH 200`
sets a restart inhibit for 200 symbols following a trigger event.

Manual operation: See ["Trigger Inhibit"](#) on page 23

[:SOURCE<hw>]:BB:XMRadio:TERRestrial:TRIGGER:OBASband:DELAY <Delay>

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

Parameters:

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

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

Manual operation: See ["Trigger Delay"](#) on page 23

[:SOURCE<hw>]:BB:XMRadio:TERRestrial:TRIGGER:OBASband:INHIBIT <Inhibit>

Specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path.

Parameters:

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

Example: `BB:XMR:TERR:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:XMR:TERR:TRIG:INH 200`
sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See ["Trigger Inhibit"](#) on page 23

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:SENGth <SLength>

The command sets the sequence length of the signal in number of samples.

Parameters:

<SLength> integer
Range: 1 to 4294967295
*RST: 1

Example: `BB:XMR:TERR:TRIG:SENG 5000`
selects the generation of 5000 samples.

Manual operation: See ["Signal Duration"](#) on page 20

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:SLUNit <SLunit>

The command defines the unit for the entry of the length of the signal sequence (`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger:SENGth`) to be output in the "Single" trigger mode (`SOUR:BB:XMRadio:TERR:TRIG:SEQ SING`).

Parameters:

<SLunit> MCM | TPL | SAMPlE
TPL
The signal sequence is entered in TPL frames.
MCM
The signal sequence is entered in MCM symbols.
SAMPlE
The signal sequence is entered in samples.
*RST: TPL

Example: `BB:XMR:TERR:SEQ SING`
sets trigger mode Single.
`BB:XMR:TERR:TRIG:SLUN TPL`
sets unit TPL frame for the entry of sequence length.
`BB:XMR:TERR:TRIG:SENG 2`
sets a sequence length of 2 TPL frames. Two TPL frames will be output after the next trigger event.

Manual operation: See ["Signal Duration Unit"](#) on page 20

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

The command specifies the trigger delay (expressed as a number of samples) for external triggering.

Parameters:

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

Example: BB:XMRadio:TERRestrial:TRIG:SOUR EXT
 sets an external trigger via the TRIGGER 1 connector.
 BB:XMRadio:TERRestrial:TRIG:DEL 50
 sets a delay of 50 samples for the trigger.

Manual operation: See ["Trigger Delay"](#) on page 23

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

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

Parameters:

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

Example: BB:XMRadio:TERRestrial:TRIG:SOUR EXT
 selects an external trigger via the TRIGGER 1 connector.
 BB:XMRadio:TERRestrial:TRIG:INH 200
 sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See ["Trigger Inhibit"](#) on page 23

4.4 Marker Settings

This section lists the remote control commands, necessary to configure the markers.

[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut:DELay:FIXed.....	49
[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut:DELay:FIXed.....	49
[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay.....	49
[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay:MAXimum?.....	50
[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay:MINimum?.....	50
[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay.....	50
[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:MAXimum?.....	51
[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:MINimum?.....	51
[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:MODE.....	51

<code>[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:MODE</code>	51
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`[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut:DELay:FIXed <Fixed>`
`[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut:DELay:FIXed <Fixed>`

The command restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is generated.

Parameters:

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

Example:

`BB:XM:TER:TRIG:OUTP:DEL:FIX ON`
 restricts the marker signal delay setting range to the dynamic range.

Manual operation: See "[Fix marker delay to current range](#)" on page 26

`[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay <Delay>`

The command defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of symbols. Command `:BB:XMRadio:SATellite:TRIGger:OUTPut:DELay:FIXed` can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Parameters:

`<Delay>` float
 Range: 0 to 2³² - 1 symbols
 Increment: 1 symbol
 *RST: 0

Example:

`BB:XM:SAT:TRIG:OUTP2:DEL 1600`
 sets a delay of 1600 symbols for the signal on connector MARKER 2.

Manual operation: See "[Marker x Delay](#)" on page 25

[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DElay:MAXimum?

The command queries the maximum marker delay for setting :BB:XMRadio:SAT:TRIG:OUTP:DEL:FIX ON.

Return values:

<Maximum> float

Example:

BB:XM:TRIG:OUTP:DEL:FIX ON

restricts the marker signal delay setting range to the dynamic range.

BB:XM:TRIG:OUTP:DEL:MAX?

queries the maximum of the dynamic range.

Response: 2000

the maximum for the marker delay setting is 2000 symbols.

Usage: Query only

Manual operation: See "[Current Range without Recalculation](#)" on page 26

[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DElay:MINimum?

The command queries the minimum marker delay for setting :BB:XMRadio:SATellite:TRIGger:OUTPut:DElay:FIXed ON.

Return values:

<Minimum> float

Example:

BB:XM:SAT:TRIG:OUTP:DEL:FIX ON

restricts the marker signal delay setting range to the dynamic range.

BB:XM:SAT:TRIG:OUTP:DEL:MIN?

queries the minimum of the dynamic range.

Response: "0"

the minimum for the marker delay setting is 0 symbols.

Usage: Query only

Manual operation: See "[Current Range without Recalculation](#)" on page 26

[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DElay <Delay>

The command defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of samples. Command :BB:XMRadio:TERRestrial:TRIGger:OUTPut:DElay:FIXed can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Parameters:

<Delay> float
 Range: 0 to $2^{32}-1$ samples
 Increment: 1 sample
 *RST: 0 samples

Example: `BB:XMR:TERR:TRIG:OUTP2:DEL 1600`
sets a delay of 1600 samples for the signal on connector MARKER 2.

Manual operation: See "[Marker x Delay](#)" on page 25

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:MAXimum?

The command queries the maximum marker delay for setting
`SOURce:BB:XMRadio:TERRestrial:TRIGger:OUTPut:DEL:FIX ON.`

Return values:
<Maximum> float

Example: `BB:XMR:TERR:TRIG:OUTP:DEL:FIX ON`
restricts the marker signal delay setting range to the dynamic range.
`BB:XMR:TERR:TRIG:OUTP:DEL:MAX?`
queries the maximum of the dynamic range.
Response: 2000
the maximum for the marker delay setting is 2000 samples.

Usage: Query only

Manual operation: See "[Current Range without Recalculation](#)" on page 26

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:MINimum?

The command queries the minimum marker delay for setting
`SOURce:BB:XMRadio:TERRestrial:TRIGger:OUTPut:DELay:FIXed ON.`

Return values:
<Minimum> float

Example: `BB:XMR:TERR:TRIG:OUTP:DEL:FIX ON`
restricts the marker signal delay setting range to the dynamic range.
`BB:XMR:TERR:TRIG:OUTP:DEL:MIN`
queries the minimum of the dynamic range.
Response: 0
the minimum for the marker delay setting is 0 samples.

Usage: Query only

Manual operation: See "[Current Range without Recalculation](#)" on page 26

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:MODE <Mode>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:MODE <Mode>

The command defines the signal for the selected marker output.

Parameters:

<Mode> TPL | MCM | USER | RATio | PATtern | PULSe | TRIGger

TPL
A marker signal is generated at the beginning of each TPL (Terrestrial Physical Layer) frame.

MCM
A marker signal is generated at the beginning of each MCM (Multicarrier Modulation) symbol.

USER
A marker signal is generated at the beginning of every user-defined period. The period is defined with
BB:XMR:SAT | TERR:TRIG:OUT:PER.

RATio
A marker signal corresponding to the Time Off / Time On specifications in the commands
SOURce:BB:XMRadio:TRIGger:OUTPut:OFFT and
SOURce:BB:XMRadio:TRIGger:OUTPut:ONT is generated.

PATtern
A marker signal is generated according to the user defined pattern (command
SOURce:BB:XMRadio:SATellite:TRIGger:OUTPut: PATtern).

TRIGger
A received internal or external trigger signal is output at the marker connector.
*RST: RATio

Example: BB:XMR:TERR:TRIG:OUTP2:MODE TPL
a marker signal is generated at the beginning of each TPL frame.

Manual operation: See "Marker Mode" on page 24

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:OFFTime <OffTime>

The command sets the number of symbols in a period (ON time + OFF time) during which the marker signal in setting
SOURce:BB:XMRadio:SATellite:TRIGger:OUTPut:MODE RATio on the marker outputs is OFF.

Parameters:

<OffTime> integer
Range: 1 to 16777215
*RST: 1

Example: BB:XMR:SAT:TRIG:OUTP2:OFFT 200
sets an OFF time of 200 symbols for marker signal 2.

Manual operation: See "Marker Mode" on page 24

[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:ONTime <OnTime>

The command sets the number of symbols in a period (ON time + OFF time) during which the marker signal in setting

SOURce:BB:XMR:SATellite:TRIGger:OUTPut:MODE RATIo on the marker outputs is ON.

Parameters:

<OnTime> integer
 Range: 1 to 16777215
 *RST: 1

Example: BB:XMR:SAT:TRIG:OUTP2:ONT 200
 sets an ON time of 200 symbols for marker 2.

Manual operation: See "[Marker Mode](#)" on page 24

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

Defines the bit pattern used to generate the marker signal in the setting

SOURce:BB:XMRRadio:SATellite:TRIGger:OUTPut:MODE PATTern. 0 is marker off, 1 is marker on.

Parameters:

<Pattern> 64 bits

Example: BB:XMR:SAT:TRIG:OUTP2:PATT #B000000011111111,15
 sets a bit pattern.

BB:XMR:SAT:TRIG:OUTP2:MODE PATT
 activates the marker signal according to a bit pattern on output MARKER 2.

Manual operation: See "[Marker Mode](#)" on page 24

[[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:PERiod <Period>

The command sets the repetition rate for the signal at the marker outputs, expressed in terms of symbols. The setting is only valid for selection "USER" in

SOURce:BB:XMR:TERR:TRIG:OUTP:MODE.

Parameters:

<Period> integer
 Range: 2 to 16777215
 *RST: 2

Example: BB:XMR:SAT:TRIG:OUTP2:MODE USER
 selects the user marker for the signal on connector MARKER 2.
 BB:XMR:SAT:TRIG:OUTP2:PER 1600
 sets a period of 1600 symbols, i.e. the marker signal is repeated every 1600th symbol.

Manual operation: See "[Marker Mode](#)" on page 24

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

The command sets the divider for Pulse marker mode (SOUR:BB:XMRadio:SATellite:TRIGger:OUTPut:MODE PULSe). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Parameters:

<Divider> integer
 Range: 2 to 1024
 *RST: 2

Example:

BB:XMRadio:SATellite:TRIGger:OUTPut2:PULSe:DIV 2
 sets the divider to 2 for the marker signal on output MARKER 2.
 BB:XMRadio:SATellite:TRIGger:OUTPut2:FREQ?
 queries the resulting pulse frequency of the marker signal.
 Response:
 66 000
 the resulting pulse frequency is 66 kHz.

Manual operation: See "[Marker Mode](#)" on page 24

[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:PULSe:
FREQUency?

The command queries the pulse frequency of the pulsed marker signal in the setting SOURce:BB:XMRadio:SATellite:TRIGger:OUTPut:MODE PULSe. The pulse frequency is derived by dividing the symbol rate by the divider.

Return values:

<Frequency> float

Example:

BB:XMRadio:SATellite:TRIGger:OUTPut2:PULSe:DIV 2
 sets the divider marker signal on output MARKER 2 to the value 2.
 BB:XMRadio:SATellite:TRIGger:OUTPut2:MODE PULS
 enables the pulsed marker signal.
 BB:XMRadio:SATellite:TRIGger:OUTPut2:PULSe:FREQ?
 queries the pulse frequency of the marker signal.
 Response:
 33 000
 the resulting pulse frequency is 33 kHz.

Usage: Query only

Manual operation: See "[Marker Mode](#)" on page 24

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:MCMPosition
 <McmPosition>

(available for Physical Layer Mode Terrestrial only)

Sets the position of the MCM symbol.

The setting is only valid for selection "MCM" in
 SOURce:BB:XMR:TERR:TRIG:OUTP:MODE.

Parameters:

<McmPosition> integer
 Range: 1 to 23
 Increment: 1
 *RST: 1

Example:

BB:XMR:TERR:TRIG:OUTP2:MODE MCM
 selects the MCM marker for the signal on connector MARKER 2.
 BB:XMR:TERR:TRIG:OUTP2:MCMP 20
 sets the MCM position.

Manual operation: See "[MCM Position](#)" on page 25

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:OFFTime
 <OffTime>

The command sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting

SOURce:BB:XMRadio:TERRestrial:TRIGger:OUTPut:MODE RATIO on the marker outputs is OFF.

Parameters:

<OffTime> integer
 Range: 1 to 16777215
 *RST: 1

Example:

BB:XMR:TERR:TRIG:OUTP2:OFFT 200
 sets an OFF time of 200 samples for marker signal 2.

Manual operation: See "[Marker Mode](#)" on page 24

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:ONTime
 <OnTime>

The command sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting

SOURce:BB:XMR:TERRestrial:TRIGger:OUTPut:MODE RATIO on the marker outputs is ON.

Parameters:

<OnTime> integer
 Range: 1 to 16777215
 *RST: 1

Example:

BB:XMR:TERR:TRIG:OUTP2:ONT 200
 sets an ON time of 200 samples for marker 2.

Manual operation: See "[Marker Mode](#)" on page 24

**[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:PERiod
<Period>**

The command sets the repetition rate for the signal at the marker outputs, expressed in terms of samples. The setting is only valid for selection "USER" in
SOURce:BB:XMRadio:TERRestrial:TRIG:OUTP:MODE.

Parameters:

<Period> integer
Range: 2 to 16777215
*RST: 2

Example:

BB:XMRadio:TERRestrial:TRIG:OUTP2:MODE USER
selects the user marker for the signal on connector MARKER 2.
BB:XMRadio:TERRestrial:TRIG:OUTP2:PER 1600
sets a period of 1600 samples, i.e. the marker signal is repeated every 1600th sample.

Manual operation: See "Marker Mode" on page 24

4.5 Clock Settings

This section lists the remote control commands, necessary to configure the clock.

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**[[:SOURce<hw>]:BB:XMRadio:SATellite:CLOCK:MODE <Mode>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:CLOCK:MODE <Mode>**

The command enters 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:

BB:XMRadio:TERRestrial:CLOCK:MODE SAMP
selects a sample clock.

Manual operation: See "Clock Mode" on page 27

[:SOURce<hw>]:BB:XMRadio:SATellite:CLOCK:SOURce <Source>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:CLOCK:SOURce <Source>

The command 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; selecting AINTERNAL is only possible for path B.

Parameters:

<Source> INTernal | EXTernal | AINTernal

INTernal

The internal clock reference is used.

EXTernal

The external clock reference is supplied to the CLOCK connector.

*RST: INTernal

Example:

BB:XMRadio:TERR:CLOCK:SOUR EXT

selects an external clock reference. The clock is supplied via the CLOCK connector.

BB:XMRadio:TERR:CLOCK:MODE SAMP

specifies that a sample clock is supplied via the CLOCK connector.

Manual operation: See ["Clock Source"](#) on page 27

[:SOURce<hw>]:BB:XMRadio:SATellite:CLOCK:MULTIplier <Multiplier>
[:SOURce<hw>]:BB:XMRadio:TERRestrial:CLOCK:MULTIplier <Multiplier>

The command specifies the multiplier for clock mode Multiple Sample (`:BB:XMRadio:TERRestrial:CLOCK:MODE MSAMple`) in the case of an external clock source.

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
 Increment: 1
 *RST: 4

Example:

BB:XMRadio:TERR:CLOCK:SOUR EXT

selects the external clock source. The clock is supplied via the CLOCK connector.

BB:XMRadio:TERR:CLOCK:MODE MSAM

selects clock mode "Multiple Sample", i.e. the supplied clock has a rate which is a multiple of the sample rate.

BB:XMRadio:TERR:CLOCK:MULT 12

the multiplier for the external clock rate is 12.

Manual operation: See ["Clock Multiplier"](#) on page 28

[:SOURce<hw>] :BB:XMRadio:SATellite:CLOCK:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command `BB:XMR:SAT:CLOC:SYNC:MODE`.

Example: `BB:XMR:SAT:CLOC:SYNC:MODE MAST`
the instrument is configured to work as a master one.
`BB:XMR:SAT:CLOC:SYNC:EXEC`
all synchronization's settings are adjusted accordingly.

Usage: Event

Manual operation: See "[Set Synchronization Settings](#)" on page 27

[:SOURce<hw>] :BB:XMRadio:SATellite:CLOCK:SYNChronization:MODE <Mode>

Selects the synchronization mode.

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

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 system and reference clock signal and the trigger signal from another instrument working in a master mode.

*RST: NONE

Example: `BB:XMR:SAT:CLOC:SYNC:MODE MAST`
the instrument is configured to work as a master one.

Manual operation: See "[Sync. Mode](#)" on page 26

[:SOURce<hw>] :BB:XMRadio:TERRestrial:CLOCK:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command `BB:XMR:TERR:CLOC:SYNC:MODE`.

Example: `BB:XMR:TERR:CLOC:SYNC:MODE MAST`
the instrument is configured to work as a master one.
`BB:XMR:TERR:CLOC:SYNC:EXEC`
all synchronization's settings are adjusted accordingly.

Usage: Event

Manual operation: See "[Set Synchronization Settings](#)" on page 27

[:SOURce<hw>]:BB:XMRadio:TERRestrial:CLOCK:SYNChronization:MODE
<Mode>

Selects the synchronization mode.

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

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 system and reference clock signal and the trigger signal from another instrument working in a master mode.

*RST: NONE

Example:

BB:XMRSAT:CLOCK:SYNCHRONIZATION:MODE MAST

the instrument is configured to work as a master one.

Manual operation: See "[Sync. Mode](#)" on page 26

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