

XM Radio

Digital Standard for

R&S[®] Signal Generators

Operating Manual



1171.5183.52 – 07

This document describes the following software options:

- R&S®AMU-K56
1402.9905.02
- R&S®AFQ-K256
1401.6002.02
- R&S®SMATE-K56
1404.7751.02
- R&S®SMBV-K56/-K256
1415.8183.02, 1415.8402.02
- R&S®SMJ-K56/-K256
1404.1806.02, 1409.2606.02
- R&S®SMU-K56/-K256
1161.1162.02, 1161.1240.02

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®AMU is abbreviated as R&S AMU, R&S®AFQ is abbreviated as R&S AFQ, R&S®SMATE is abbreviated as R&S SMATE, R&S®SMBV is abbreviated as R&S SMBV, R&S®SMJ is abbreviated as R&S SMJ, R&S®SMU 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,
 - 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.

Quick Start Guide

This manual 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 instrument 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.

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

Service Manual

This 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 orderd 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.

1.2 Conventions Used in the Documentation

The following conventions are used throughout this documentation:

Typographical conventions

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.

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

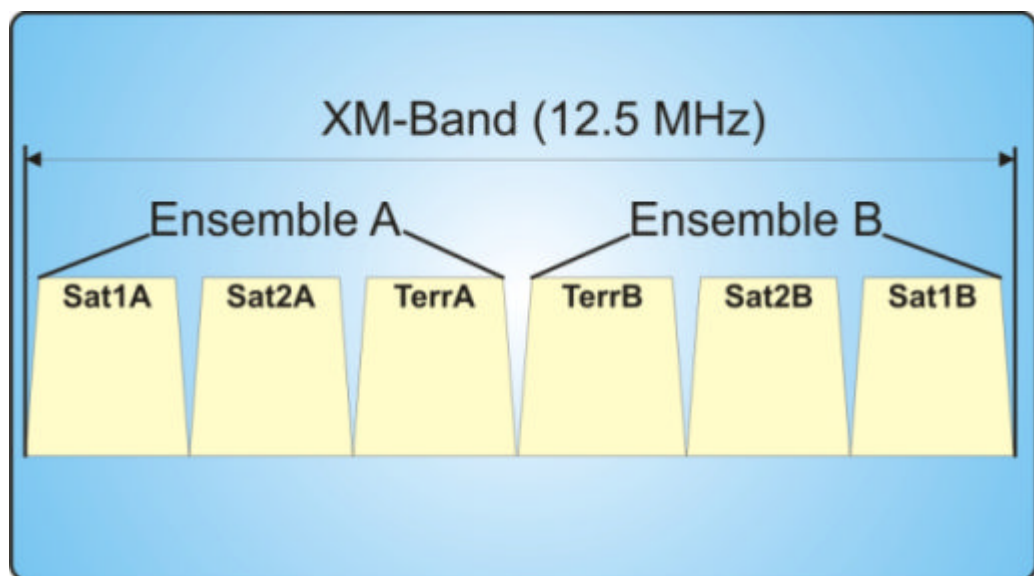


Fig. 2-1: XM-Radio Frequency Band

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

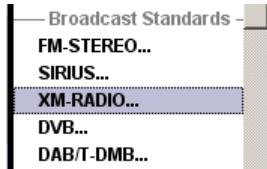
Table 2-1: Carrier frequencies

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

Ensemble	Channel	Frequency [MHz]	Polarization
	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".



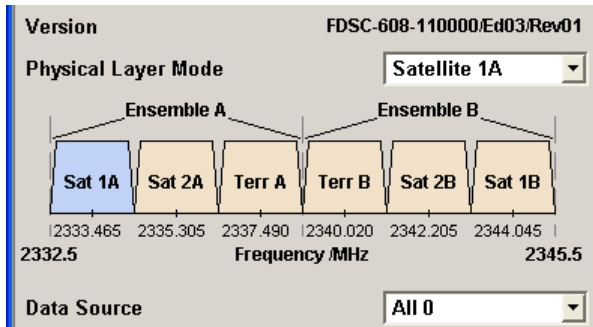
3.1 Main Menu for XM-RADIO Signals

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

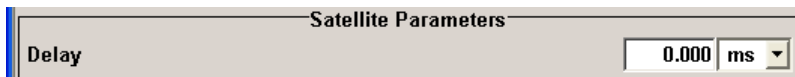
The upper menu section is where the XM-RADIO digital standard is activated and deactivated. Configuration settings can be stored and already stored configuration settings can be loaded.



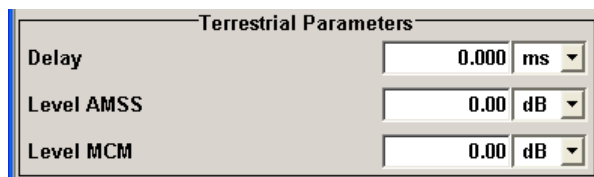
In the next section, the physical layer mode and the data source are selected.



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 or deactivates the XM-RADIO standard.

Activating this standard deactivates all the other digital standards and digital modulation modes.

In case of two-path instruments, this affects the same path.

The XM-RADIO signal is generated according to the performed settings.

SCPI command:

```
[ :SOURce<hw> ] :BB:XMRadio:STATe on page 30
```

Set To Default

Calls the default settings.

Parameter	Value
State	Remains unchanged
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

SCPI command:

```
[ :SOURce<hw> ] :BB:XMRadio:PRESet on page 28
```

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.

"File Manager" Calls the "File Manager".

The "File Manager" is used to copy, delete, and rename files and to create new directories.

SCPI command:

[:SOURce<hw>] :BB:XMRadio:SETTING:CATalog on page 29

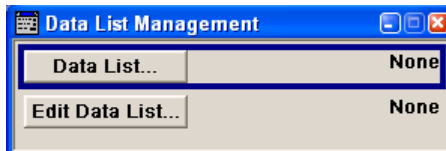
[:SOURce<hw>] :BB:XMRadio:SETTING:LOAD on page 29

[:SOURce<hw>] :BB:XMRadio:SETTING:STORe on page 30

[:SOURce<hw>] :BB:XMRadio:SETTING:DELeTe on page 29

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
```

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:DATA](#) on page 27

[\[:SOURce<hw>\]:BB:XMRadio:DATA:DSElect](#) on page 27

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.

SCPI command:

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

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.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:LAYer](#) on page 28

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.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:DATA](#) on page 27

[\[:SOURce<hw>\]:BB:XMRadio:DATA:PATTern](#) on page 27

[\[:SOURce<hw>\]:BB:XMRadio:DATA:DSElect](#) on page 27

Frame Counter

The parameter is available for Data List only.

Displays the number of frames.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:FCOUNTER](#) on page 28

Delay

Sets the signal delay.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:SATELLITE:DELAY](#) on page 28

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

Level AMSS

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

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:TERRESTRIAL:POWER:AMSS](#) on page 31

Level MCM

Sets the level for the multicarrier modulation (MCM).

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:TERRESTRIAL:POWER:MCM](#) on page 31

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 14.

SCPI 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 16.

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

SCPI 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.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:TRIGGER:EXECUTE](#) on page 36

Arm

Stops signal generation manually.

The "Arm" button is displayed only if the trigger modes "Armed Retrigger" or "Armed Auto" have been selected.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:TRIGger:ARM:EXECute` on page 36

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 24.

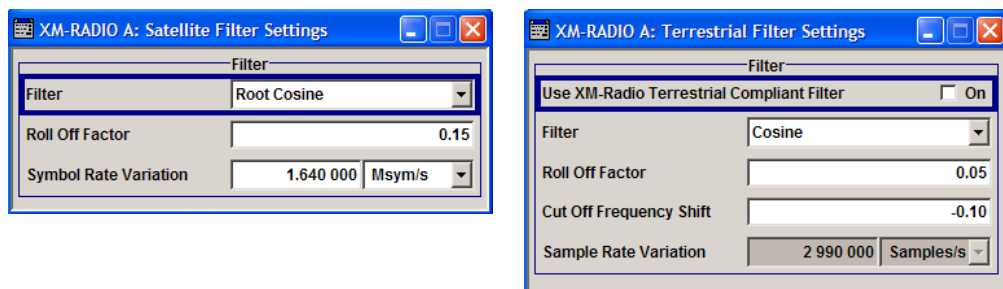
SCPI command:

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.

SCPI command:

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

on page 32

Filter

Sets the baseband filter.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:FILTer:TYPE` on page 32

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:FILTer:TYPE` on page 32

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.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:FILTer:PARAmeter:APCO25`

on page 32

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

on page 33

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

on page 33

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

on page 34

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

on page 34

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

on page 34

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:FILTer:PARAmeter:APCO25`

on page 32

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

on page 33

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

on page 33

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

on page 34

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

on page 34

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

on page 35

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.

SCPI command:

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

`COFS` on page 35

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.

SCPI command:

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

on page 33

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

on page 34

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

on page 33

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

on page 34

Symbol Rate Variation

(available for physical layer mode Satellite only).

Sets the symbol rate of the signal.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:SRATe:VARiation` on page 35

Sample Rate Variation

(available for physical layer mode Terrestrial only).

Displays the terrestrial sample rate variation.

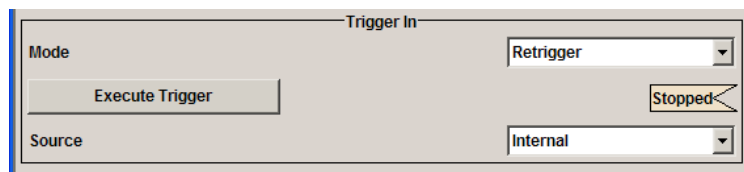
SCPI command:

`[:SOURce<hw>] :BB:XMRadio:TERReStrial:SRATe:VARiation` on page 35

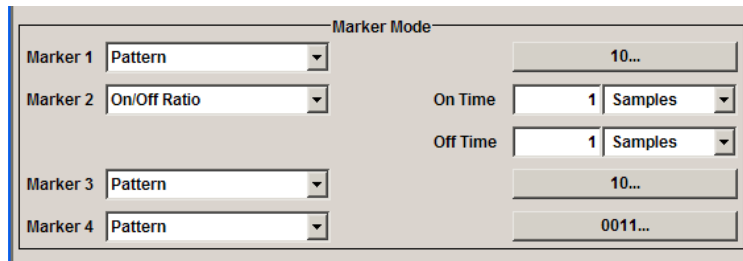
3.3 Trigger/Marker/Clock Settings

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

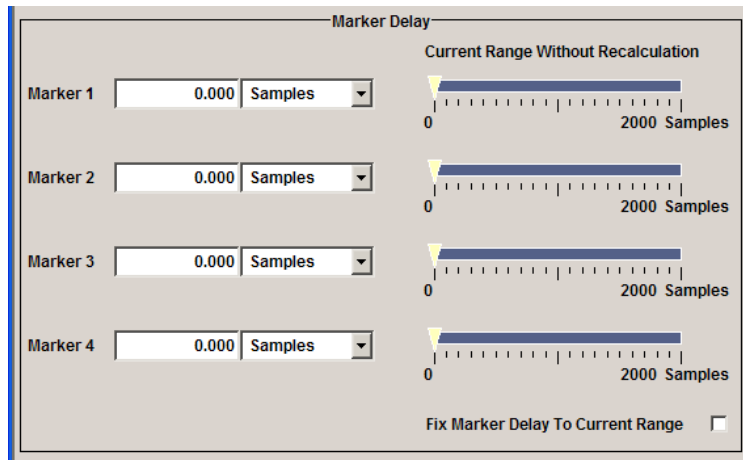
The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



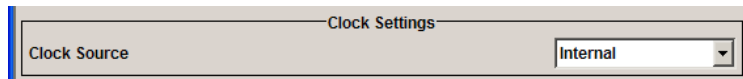
The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.



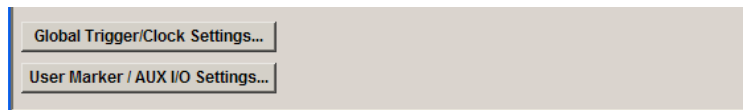
The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.



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.

The trigger mode determines the effect of a trigger 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. Button "Arm" stops signal generation. A subsequent trigger event (internal with "Execute Trigger" 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. Button "Arm" stops signal generation. A subsequent trigger event (internal with "Execute Trigger" 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 with "Execute Trigger" or external) causes a restart.

SCPI command:

[\[:SOURCE<hw>\]:BB:XMRadio:SATellite\[:TRIGGER\]:SEQUENCE](#) on page 39

[\[:SOURCE<hw>\]:BB:XMRadio:TERRESTRIAL\[:TRIGGER\]:SEQUENCE](#)
on page 39

Signal Duration Unit

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

SCPI command:

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

Signal Duration

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

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

SCPI command:

[\[:SOURCE<hw>\]:BB:XMRadio:SATellite:TRIGGER:SLLENGTH](#) on page 40

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

Running/Stopped

Displays the status of signal generation for all trigger modes. This display appears only when signal generation is enabled ("State" On).

"Running"	The modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode. If "Armed_Auto" and "Armed_Retrigger" have been selected, generation of signals can be stopped with the "Arm" button. A new trigger (internally with "Execute Trigger" or externally) causes a restart.
-----------	--

"Stopped" The signal is not generated, and the instrument waits for a trigger event (internal or external).

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:TRIGger:RMODE](#) on page 37

Arm

Stops signal generation. 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).

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:TRIGger:ARM:EXECute](#) on page 36

Execute Trigger

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.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:TRIGger:EXECute](#) on page 36

Trigger Source

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

"Internal" The trigger event is executed by "Execute Trigger".

"Internal (Base-

band A/B)" The trigger event is executed by the trigger signal from the second path

"External The trigger event is executed with the aid of the active edge of an external (TRIGGER 1 / trigger signal.

2)" The trigger signal is supplied via the TRIGGER connector.

The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the "Global Trigger/Clock Settings" dialog.

SCPI command:

[\[:SOURce<hw>\]:BB:XMRadio:SATEllite:TRIGger:SOURce](#) on page 38

[\[:SOURce<hw>\]:BB:XMRadio:TERRestrial:TRIGger:SOURce](#) on page 38

Sync. Output to External Trigger

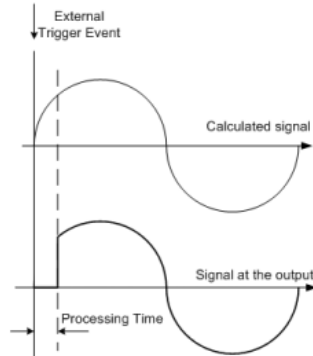
(enabled for Trigger Source External)

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

"On"

Corresponds to the default state of this parameter.

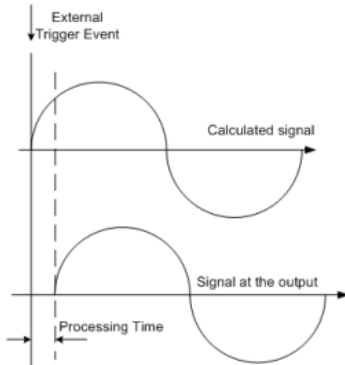
The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



"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.



SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:TRIGger:EXTernal:SYNChronize:OUTPut` on page 37

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger:EXTernal:SYNChronize:OUTPut` on page 37

Trigger Delay

Sets the trigger signal delay in samples on external triggering or on internal triggering via the second path.

Sets the trigger signal delay in samples on external triggering.

This enables the R&S Signal Generator to be synchronized with the device under test or other external devices.

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

SCPI command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER[:EXTERNAL<ch>]:DELAY`
on page 40

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER[:EXTERNAL<ch>]:`
`DELAY` on page 42

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OBASband:DELAY`
on page 39

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER:OBASband:DELAY`
on page 41

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.

SCPI command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER[:EXTERNAL<ch>]:`
`INHIBIT` on page 41

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER[:EXTERNAL<ch>]:`
`INHIBIT` on page 43

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OBASband:INHIBIT`
on page 40

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER:OBASband:INHIBIT`
on page 41

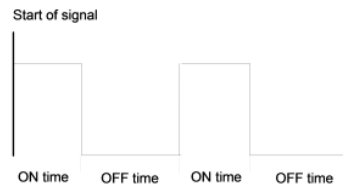
3.3.2 Marker Mode

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

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.



SCPI command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:ONTime`
on page 47

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER:OUTPUT<ch>:ONTime`
on page 50

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:OFFTime`
on page 47

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER:OUTPUT<ch>:OFFTime`
on page 50

"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."

SCPI command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PERIOD`
on page 48

`[:SOURCE<hw>] :BB:XMRadio:TERrestrial:TRIGGER:OUTPUT<ch>:PERIOD`
on page 50

"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.

SCPI command:

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PULSE:DIVIDER`
on page 48

`[:SOURCE<hw>] :BB:XMRadio:SATellite:TRIGGER:OUTPUT<ch>:PULSE:FREQUENCY`
on page 49

"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.

SCPI command:

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

on page 48

SCPI command:

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

on page 46

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

on page 46

MCM Position

(available for Physical Layer Mode Terrestrial only)

Sets the position of the MCM symbol.

SCPI command:

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

MCMPosition on page 49

3.3.3 Marker Delay

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

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.

SCPI command:

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

on page 44

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

on page 45

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.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay:MINimum` on page 45

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

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

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay:MAXimum` on page 45

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.

SCPI command:

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

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:TRIGger:OUTPut:DELay:FIXed` on page 44

3.3.4 Clock Settings

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

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.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:CLOCK:SOURce` on page 52

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:CLOCK:SOURce` on page 52

Clock Mode

Enters the type of externally supplied clock.

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

"Multiple Sam- A multiple of the sample clock (for physical layer mode Terrestrial) or a
ple/Symbol" 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.

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:CLOCK:MODE` on page 51

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:CLOCK:MODE` on page 51

Clock Multiplier

Enters the multiplication factor for clock type "Multiple".

SCPI command:

`[:SOURce<hw>] :BB:XMRadio:SATellite:CLOCK:MULTiplier` on page 52

`[:SOURce<hw>] :BB:XMRadio:TERRestrial:CLOCK:MULTiplier` on page 52

Measured External Clock

Indicates the measured frequency of the external clock signal. This enables the user to
permanently monitor the frequency of the externally introduced clock.

This information is displayed only if the external clock source has been selected.

SCPI command:

`CLOC:INP:FREQ?`

3.3.5 Global Settings

The buttons in this section lead to submenu for general trigger, clock and mapping set-
tings.

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 impe-
dance and the polarity of the clock and trigger inputs.

In the case of two-path instruments, these settings are valid for both paths.

The parameters in this menu affect all digital modulations and standards, and are descri-
bed 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" menu, used 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 commands in the `Source:BB:XMR` subsystem are described in the following section.

This subsystem contains commands for the XM Radio standard. These settings concern activation and deactivation of the standard, filter, clock, and trigger settings, defining satellite parameters and the terrestrial parameters.

SOURce<hw>

For one-path instruments, the keyword `SOURce` is optional and can be omitted.

The numeric suffix to `SOURce` distinguishes between signal generation for path A and path B in the case of two-path instruments:

- `SOURce[1]` = path A
The keyword `SOURce` is optional and can be omitted
- `SOURce2` = path B
The keyword `SOURce` is mandatory, i.e. the command must contain the keyword with suffix 2.

OUTPut<ch>

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

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 placeholder `<root>` in the syntax of the command.

- `D:\` - for selecting the internal hard disk of Windows instruments
- `E:\` - for selecting the memory stick which is inserted at the USB interface of Windows instruments
- `/var/<instrument>` - for selecting the internal flash card of Linux instrument, where `<instrument>` is the instrument name, e.g. `smbv`.
- `/usb` - for selecting the memory stick which is inserted at the USB interface of Linux instrument.

4.1 Main Settings

<code>[SOURce<hw>]:BB:XMRadio:DATA</code>	27
<code>[SOURce<hw>]:BB:XMRadio:DATA:DSElect</code>	27
<code>[SOURce<hw>]:BB:XMRadio:DATA:PATtern</code>	27
<code>[SOURce<hw>]:BB:XMRadio:FCOUNTER</code>	28
<code>[SOURce<hw>]:BB:XMRadio:LAYer</code>	28
<code>[SOURce<hw>]:BB:XMRadio:PRESet</code>	28
<code>[SOURce<hw>]:BB:XMRadio:SATellite:DELay</code>	28
<code>[SOURce<hw>]:BB:XMRadio:SETTing:CATalog</code>	29

<code>[:SOURce<hw>]:BB:XMRadio:SETTing:DELeTe</code>	29
<code>[:SOURce<hw>]:BB:XMRadio:SETTing:LOAD</code>	29
<code>[:SOURce<hw>]:BB:XMRadio:SETTing:STORE</code>	30
<code>[:SOURce<hw>]:BB:XMRadio:STATe</code>	30
<code>[:SOURce<hw>]:BB:XMRadio:TERReStrial:DELay</code>	30
<code>[:SOURce<hw>]:BB:XMRadio:TERReStrial:POWeR:AMSS</code>	31
<code>[:SOURce<hw>]:BB:XMRadio:TERReStrial:POWeR:MCM</code>	31
<code>[:SOURce<hw>]:BB:XMRadio:VERSiOn</code>	31

`[: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.

`[: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.

`MMEMoRY:CDIR '<root>\Lists\DM\IqData'`

selects the directory for the data lists.

`BB:XMR:DATA:DSEL 'XMRadio_list1'`

selects file 'XMRadio_list1' as the data source. This file must be in the directory `<root>\Lists\DM\IqData` and have the file extension `*.dm_iqd`.

`[:SOURce<hw>]:BB:XMRadio:DATA:PATTern <Pattern>`

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

Parameters:

`<Pattern>` integer

*RST: #B10

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

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

Queries the number of frames.

Return values:

<> float

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

Usage: Query only

[: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.

[: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

[:SOURCE<hw>]:BB:XMRadio:SATEllite:DELay <Delay>

This command sets the signal delay in physical layer mode satellite.

Parameters:

<Delay> float

Range: 0 ms to 63 ms
 Increment: 0.001 ms
 *RST: 0 ms

Example:

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

[: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 `MMEM:CDIRECTory`. Only files with the file extension `*.xmradio` will be listed.

Return values:

<Catalog> string

Example:

MMEM:CDIR '<root>\user\XMRADIO'
 sets the default directory to <root>\user\XMRADIO.
 BB:XMR:SETT:CAT?
 reads out all the files with XM-RADIO settings in the default directory.
 Response: "xmradio_1, xmradio_2"
 the files `xmradio1` and `xmradio2`' are available.

Usage:

Query only

[:SOURCE<hw>]:BB:XMRadio:SETTING:DELeTe <Delete>

This command deletes the selected file with "XM-RADIO" settings. 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. The file extension may be omitted. Only files with the file extension `*.xmradio` will be deleted.

Setting parameters:

<Delete> string

Example:

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

Usage:

Setting only

[:SOURCE<hw>]:BB:XMRadio:SETTING:LOAD <Load>

This command loads the selected file with "XM-RADIO" settings. 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. The file extension may be omitted. Only files with the file extension `*.xmradio` will be loaded.

Setting parameters:

<Load> string

Example:

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

Usage:

Setting only

[:SOURce<hw>]:BB:XMRadio:SETTing:STORe <Store>

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:

<Store> string

Example:

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

Usage:

Setting only

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

The command activates modulation in accordance with the "XM-RADIO" standard. Activating this standard deactivates all the other digital standards and digital modulation modes.

In case of two-path instruments, this affects the same path.

Parameters:

<State> 0|1|OFF|ON

```
*RST: ON
```

Example:

```
BB:XMR:STAT ON
activates modulation in accordance with the "XM-RADIO" standard.
```

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

This command sets the signal delay in physical layer mode terrestrial.

Parameters:

<Delay> float

Range: 0 ms to 63 ms

Increment: 0.001 ms

```
*RST: 0 ms
```

Example:

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

[: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 dB to 12 dB
 Increment: 0.01 dB
 *RST: 0 dB

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

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

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

Parameters:

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

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

[: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

4.2 Filter Settings

[:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:TCFilter[:STATe].....32
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:TYPE.....32
 [:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:TYPE.....32
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:APCO25.....32
 [:SOURce<hw>]:BB:XMRadio:TERRestrial:FILTer:PARAMeter:APCO25.....32
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAMeter:COSSine.....33

[:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:COsine.....33
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:GAUSSs.....33
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:GAUSSs.....33
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:LPASs.....33
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:LPASs.....33
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:LPASSEVM.....34
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:LPASSEVM.....34
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:PGAuss.....34
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:PGAuss.....34
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:RCOSine.....34
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:RCOSine.....34
 [:SOURce<hw>]:BB:XMRadio:SATellite:FILTer:PARAmeter:SPHase.....34
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:SPHase.....35
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:FILTer:PARAmeter:COsine:COFS.....35
 [:SOURce<hw>]:BB:XMRadio:SATellite:SRATe:VARiAtion.....35
 [:SOURce<hw>]:BB:XMRadio:TERReStrial:SRATe:VARiAtion.....35

[:SOURce<hw>]:BB:XMRadio:TERReStrial: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: ON

Example:

BB:XM:TER:FIL:TCF:STAT ON
 activates the XM-Radio terrestrial compliant filter.

[: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|GAUSSs|LGAuss|CONE|COF705|
 COEqualizer|COFequalizer|C2K3x|APCO25|SPHase|
 RECTangle|PGAuss|LPASs|LPASSEVM|DIRac|ENPShape|
 EWPSHape

*RST: COSine

Example:

BB:XM:TER:FIL:TYPE COS
 sets the cosine filter type.

[: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: 0.05
 *RST: 0.20

Example:

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

[: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 0.99
 Increment: 0.05
 *RST: 0.20

Example:

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

[: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: 0.20

Example:

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

[: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 2.0
 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.

```
[: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 2.0  
                    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.

```
[: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:    0.20
```

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

```
[: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 0.99  
                    Increment: 0.01  
                    *RST:    0.20
```

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

```
[: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: 0.20

Example: BB:XMRadio:TERRESTRIAL:FILT:PAR:SPH 0.15
 the BxT is set to 0.15.

[: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 1.0
 Increment: 0.01
 *RST: 0.0

Example: BB:XMRadio:TERRESTRIAL:FILT:PAR:COs:COFS 0.04
 the "cut of frequency shift" value is set to 0.04.

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

The command enters the output symbol rate.

Parameters:

<Variation> float
 Range: 1.0e6 symb/s to 2.0e6 symb/s
 Increment: 1.0 symb/s
 *RST: 1.64e6 symb/s

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

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

Queries the output sample rate.

Return values:

<Variation> float

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

Usage: Query only

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.

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[: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:XM:TRIG:ARM:EXEC`
 stops signal generation for trigger modes "Armed Auto" and "Armed Retrigger".

Usage: Event

[:SOURCE<hw>]:BB:XMRadio:TRIGGER:EXECute

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

[: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).

Example: `*RST: RST value`

`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

[: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.

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

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

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

The command selects the trigger source.

Parameters:

<Source>

INTernal|EXTernal|BEXTernal|OBASeband

INTernal

Triggering is executed by means of the Trigger command

SOURce:BB:XMR:TERRestrial:TRIGger:EXECute or *TRG in the case of remote control and by means of "Execute Trigger" in the case of manual operation.

EXTernal

Triggering is executed by means of the signal on the TRIGGER 1 connector.

BEXTernal

Triggering is executed by means of the signal on the TRIGGER 2 connector.

OBASeband

Triggering is executed by means of the trigger signal from the second path (two-path instruments only).

*RST: INTernal

Example:

BB:XMR:TERR:TRIG:SOUR EXT

sets external triggering via the TRIGGER 1 connector.

```
[: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.

```
[: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 2³²-1 symbols

Increment: 1 symbol

*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.

[: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> float
Range: 0 to $2^{32}-1$ symbols
Increment: 1 symbol
*RST: 0 symbols

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.

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

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

Parameters:

<Slength> float
Range: 1 to max
*RST: 1

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

[: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: 0.0 to $2^{32}-1$ symbols
Increment: 1 symbol
*RST: 0.0

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.

[[: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> float

Range: 0 to $2^{32}-1$ symbols
 Increment: 1 symbol
 *RST: 0

Example:

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

[[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OBASeband: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 $2^{32}-1$ samples
 Increment: 1 sample
 *RST: 0 samples

Example:

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

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

The command 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> float

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

Example:

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

[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:SLENgth <Slength>

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

Parameters:

<Slength> float
 Range: 1 to max
 *RST: 1

Example: BB:XMRadio:TERRestrial:TRIG:SLEN 5000
 selects the generation of 5000 samples.

[: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:SLENgth`) to be output in the "Single" trigger mode (`SOUR:BB:XMRadio:TERRestrial:TRIG:SEQ SING`).

Parameters:

<Slunit> TPL|MCM|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.

Example: *RST: SAMPlE
 BB:XMRadio:TERRestrial:TRIG:SEQ SING
 sets trigger mode Single.
 BB:XMRadio:TERRestrial:TRIG:SLUN TPL
 sets unit TPL frame for the entry of sequence length.
 BB:XMRadio:TERRestrial:TRIG:SLEN 2
 sets a sequence length of 2 TPL frames. Two TPL frames will be output after the next trigger event.

[: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: 0.0 to 2³²-1 samples
 Increment: 1 sample
 *RST: 0 samples

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

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

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

Parameters:

<Inhibit> float
 Range: 0 to 2³²-1
 Increment: 1 sample
 *RST: 0 samples

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

4.4 Marker Settings

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

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[:SOURce<hw>]:BB:XMRadio:SATellite:TRIGger:OUTPut<ch>:DELay:MAXimum.....	44
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[:SOURce<hw>]:BB:XMRadio:TERRestrial:TRIGger:OUTPut<ch>:DELay.....	45
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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:XMRadio:TERR:TRIG:OUTP:DEL:FIX ON
 restricts the marker signal delay setting range to the dynamic range.

[: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:XMRadio:SAT:TRIG:OUTP2:DEL 1600
 sets a delay of 1600 symbols for the signal on connector MARKER 2.

[: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:XMRadio:TRIG:OUTP:DEL:FIX ON
 restricts the marker signal delay setting range to the dynamic range.

BB:XMRadio: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

[[: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:XMR:SAT:TRIG:OUTP:DEL:FIX ON

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

BB:XMR: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

[[: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.

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

The command queries the maximum marker delay for setting SOURce:BB:XMRadio:TERR:TRIG:OUTP: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

[[: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

[[: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

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`).

*RST: RATio

Example:

`BB:XMR:TERR:TRIG:OUTP2:MODE TPL`

a marker signal is generated at the beginning of each TPL frame.

[: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> float

Range: 1 to 2²⁴-1 symbols

Increment: 1 symbol

*RST: 1

Example:

`BB:XMR:SAT:TRIG:OUTP2:OFFT 200`

sets an OFF time of 200 symbols for marker signal 2.

[: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> float

Range: 1 to $2^{24} - 1$ symbols
 Increment: 1 symbol
 *RST: 1

Example:

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

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

The command defines the bit pattern used to generate the marker signal in the setting SOURce:BB:XMRadio:SATellite:TRIGger:OUTPut:MODE PATTern. 0 is marker off, 1 is marker on.

Parameters:

<Pattern> <32 bit pattern>

*RST: #B,1

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.

[: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> float

Range: 1 symbol to $(1^{24}-1)$ symbols
 Increment: 1 symbol
 *RST: 1

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.

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

The command sets the divider for Pulse marker mode (SOUR:BB:XMR:SAT:TRIG:OUTP:MODE PULSe). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Parameters:

<Divider> float
 Range: 2 to 2¹⁰
 Increment: 1
 *RST: 2

Example:

BB:XMR:SAT:TRIG:OUTP2:PULS:DIV 2
 sets the divider to 2 for the marker signal on output MARKER 2.
 BB:XMR:SAT:TRIG:OUTP2:FREQ?
 queries the resulting pulse frequency of the marker signal.
 Response:
 66 000
 the resulting pulse frequency is 66 kHz.

**[[: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:XMR:SAT:TRIG:OUTP2:PULS:DIV 2
 sets the divider marker signal on output MARKER 2 to the value 2.
 BB:XMR:SAT:TRIG:OUTP2:MODE PULS
 enables the pulsed marker signal.
 BB:XMR:SAT:TRIG:OUTP2:PULS:FREQ?
 queries the pulse frequency of the marker signal.
 Response:
 33 000
 the resulting pulse frequency is 33 kHz.

Usage: Query only

**[[: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> float

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.

[: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> float

Range: 1 to 2²⁴-1 samples
 Increment: 1 sample
 *RST: 1 sample

Example:

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

[: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> float

Range: 1 to 2²⁴-1 samples
 Increment: 1 sample
 *RST: 1 sample

Example:

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

[: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:XMR:TERR:TRIG:OUTP:MODE.

Parameters:

<Period> float
 Range: 1 to 1²⁴-1 samples
 Increment: 1 sample
 *RST: 1 sample

Example:

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

4.5 Clock Settings

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

<code>[[:SOURce<hw>]:BB:XMRadio:SATellite:CLOCK:MODE</code>	51
<code>[[:SOURce<hw>]:BB:XMRadio:TERrestrial:CLOCK:MODE</code>	51
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<code>[[:SOURce<hw>]:BB:XMRadio:SATellite:CLOCK:MULTIPLIER</code>	52
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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 (:BB :
 [variable not defined:var1]:CLOCK:SOUR EXT).

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
 (for physical layer transmission Terrestrial)
 When MSAMPLE is used, a multiple of the sample clock is supplied via the CLOCK connector and the sample clock is derived internally from this. The multiplier is entered with the command
 BB:XMRadio:TERrestrial:CLOCK:MULTIPLIER.
 *RST: SAMPLE

<Mode> SYMBOL|MSYMBOL
 (for physical layer transmission Satellite)
 When MSYMBOL is used, a multiple of the symbol clock is supplied via the CLOCK connector and the symbol clock is derived internally from this. The multiplier is entered with the command :
 BB:XMRadio:SATellite:CLOCK:MULTIPLIER.
 *RST: SYMBOL

Example: `BB:XMR:TERR:CLOC:MODE SAMP`
 selects clock type "Sample", i.e. the supplied clock is a sample clock.

[: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:XMR:TERR:CLOC:SOUR EXT`

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

`BB:XMR:TERR:CLOC:MODE SAMP`

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

[: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> float

Range: 1 to 64

Increment: 1

*RST: 4

Example:

`BB:XMR:TERR:CLOC:SOUR EXT`

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

`BB:XMR:TERR:CLOC:MODE MSAM`

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

`BB:XMR:TERR:CLOC:MULT 12`

the multiplier for the external clock rate is 12.

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