DVB-H
Digital Standard for R&S®Signal Generators
Operating Manual

1008.0970.12 ─ 16

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMBV-K52
  1415.8148.xx
- R&S®SMU-K52
  1408.7010.02
- R&S®AMU-K52
  1402.9557.02
- R&S®SMATE-K52
  1404.7800.02
- R&S®SMJ-K52
  1404.2106.02

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

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

Contents

1 Preface

1.1 Documentation Overview

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

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.

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 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.

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 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 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.

Convention	Description
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 Notes on Screenshots

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

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

1.2.3 Naming of Software Options

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

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

Example:

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

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

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

2 Introduction

The R&S Signal Generator enables you to generate signals in accordance with the DVB-H (Digital Video Broadcasting - Transmission System for Handheld Terminals) standard.

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

2.1 Modulation System DVB-H

The following block diagramm shows the components of the DVB-H transmission system.

In this release, only the high-priority input is available.

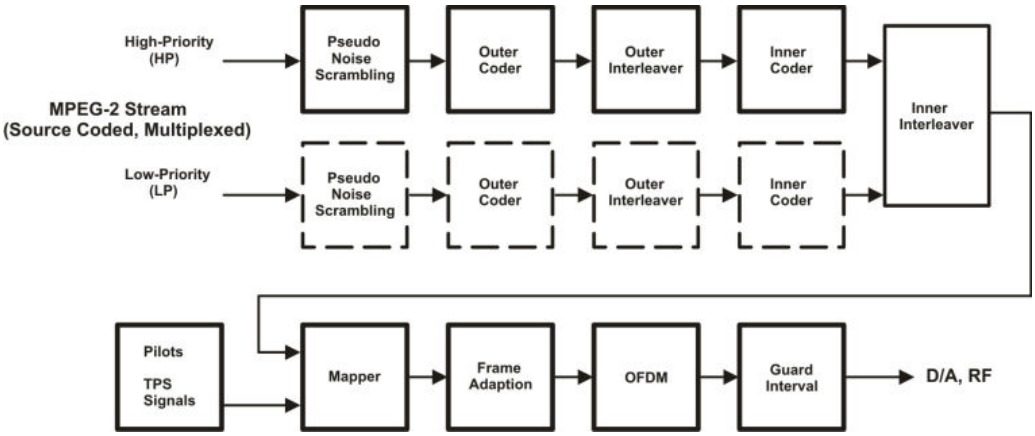
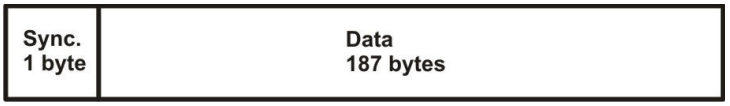


Fig. 2-1: Components of the Transmission System DVB-H

2.1.1 Pseudo Noise Scrambler

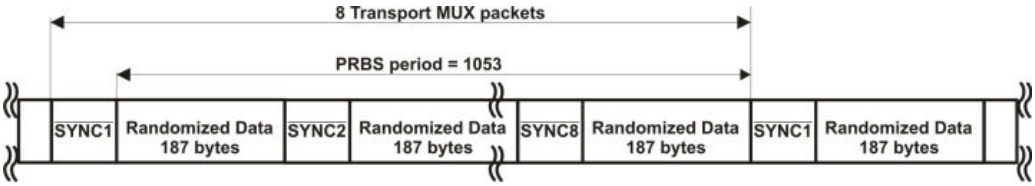
The MPEG-2 transport packet stream is organized in fixed packet length of 188 bytes. This includes 187 data bytes and one sync byte.



The data packets of the input stream are transformed to a Pseudo Random Binary Sequence (PRBS) in order to obtain a bit sequence that has a positive effect on the transmitted RF spectrum.

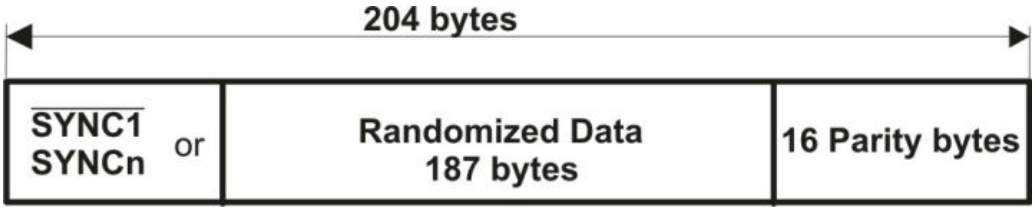
The PRBS polynomial is specified as: $1 + x^{14} + x^{15}$

The PRBS generator is loaded with the sequence "100101010000000" at the start of every eight transport packet. To provide an initialization signal for the descrambler, the sync byte of the first transport packet in a group of eight packets is bit-wise inverted from 0x47 to 0xb8, whereas the sync bytes of the next seven packets remain 0x47. After that, the PRBS generator runs continuously through the eight packets with a PRBS period of 1503 bytes (8 packets * 188 bytes - 1sync byte).



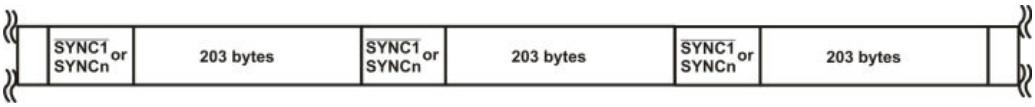
2.1.2 Outer Coder

The outer coder is a Reed-Solomon encoder RS (204,188, t = 8). The RS coding is applied to each randomized transport packet (188 byte) to generate an error protected packet with a length of 204 bytes (188 randomized transport packets + 16 parity bytes). With this RS code up to eight erroneous bytes can be detected in the transport stream packet and corrected.



2.1.3 Outer Interleaver

The outer interleaver is an convolutional interleaver with I = 12 branches. Each branch "j" is a FIFO shift register with depth j x 17 cells = 204 bytes.



2.1.4 Inner Coder

The inner coder is a punctured convolution code, based on a mother convolutional code of rate 1/2 with 64 states. The inner coder encodes the input data, punctures certain bits to obtain higher code rates, and serializes the I/Q symbols to be transmitted.

The integrated puncturer removes bits from the redundant data stream. Puncturing slightly impairs the characteristics of the code. The code rates that can be set are 1/2, 2/3, 3/4, 5/6 and 7/8. The code rate can be selected according to the required transmission characteristics of the system.

Table 2-1: Puncturing pattern and transmitted sequence after conversion for the possible code rates

Code Rates r	Puncturing Pattern	Transmitted Sequence (after parallel-to-serial conversions)
1/2	X:1 Y:1	X_1Y_1
2/3	X:10 Y:11	$X_1Y_1Y_2$
3/4	X:101 Y:110	$X_1Y_1Y_2X_3$
5/6	X:10101 Y:11010	$X_1Y_1Y_2X_3Y_4X_5$
7/8	X:1000101 Y:1111010	$X_1Y_1Y_2Y_3Y_4X_5Y_6X_7$

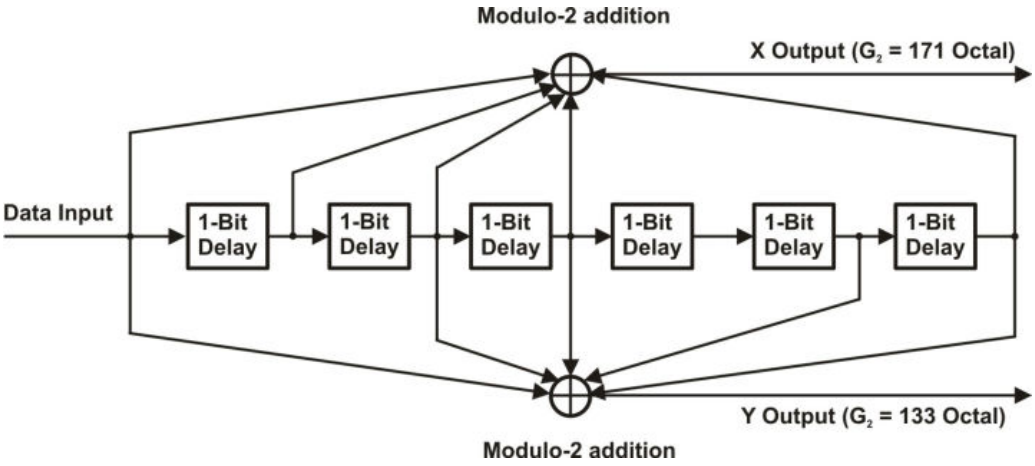


Fig. 2-2: Mother convolutional code rate of 1/2

2.1.5 Inner Interleaver

The inner interleaver consists of a bit-wise interleaving followed by symbol interleaving. Both interleaving processes are block based.

In non-hierarchical mode, the input bit stream for the bit-wise interleaving is multiplexed into v sub-streams depending on the modulation mode with v representing the number of bits/symbol:

Modulation Mode	Sub-Stream v
QPSK	2
16-QAM	4
64-QAM	6

In hierachical mode, the high priority stream is demultiplexed into two sub-streams and the low priority stream is demultiplexed into v-2 sub-streams.

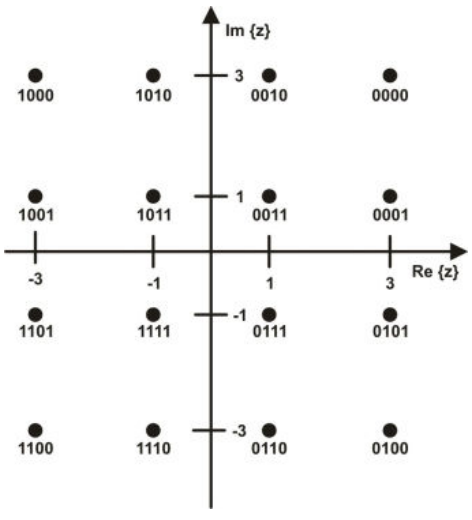
The outputs of the v bit interleavers are grouped to form the digital data symbols, such that each symbol of v bits will consist of exactly one bit from each of the v interleavers.

The purpose of the symbol interleaver is to map v bit words onto 1512 (2K mode), 3024 (4K mode), or 6048 (8K mode) active carriers per OFDM symbol. The symbol interleaver acts on blocks of 1512 (2K mode), 3024 (4K mode), or 6048 (8K mode) data symbols. Furthermore, for the interleaver is an in-depth mode available for 2K and 4K in which the interleaver always maps the v bit words onto 6048. This is described in detail in chapter 2.2.1, "4K Mode and In-Depth Interleavers", on page 14.

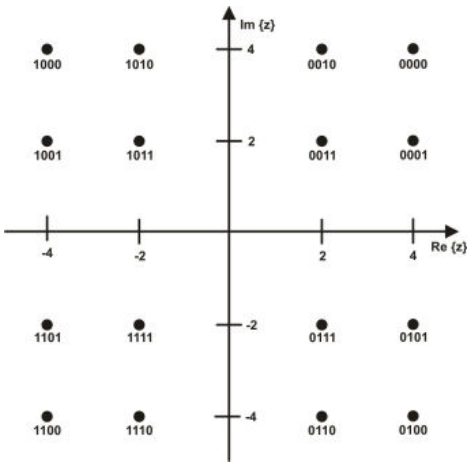
2.1.6 Mapper

All data carriers in one OFDM symbol are modulated using either QPSK, 16-QAM, or 64-QAM.

Additionally, for the hierarchical mode, non-uniform 16-QAM and non-uniform 64 QAM constellations are available with different values for parameter α. α ist the minimum distance separating two constellation points carrying different HP-bit values divided by the minimum distance separating any two constellation points. For non-hierarchical transmission, the constellation is shaped as if α is 1.



16 QAM mapping with α = 1



16 QAM mapping with α = 2

2.1.7 Frame Adaption

The transmitted signal is organized in super-frames. Each super-frame consists of 4 frames.

Each frame contains scattered pilot cells, continual pilot carriers, and TPS carriers. The pilots can be used for frame synchronization, frequency synchronization, time synchronization, channel estimation, and transmission mode identification.

Each frame consists of 68 OFDM symbols. Each symbol consists of a guard interval and a useful part. The symbols in an OFDM frame are numbered from 0 to 67.

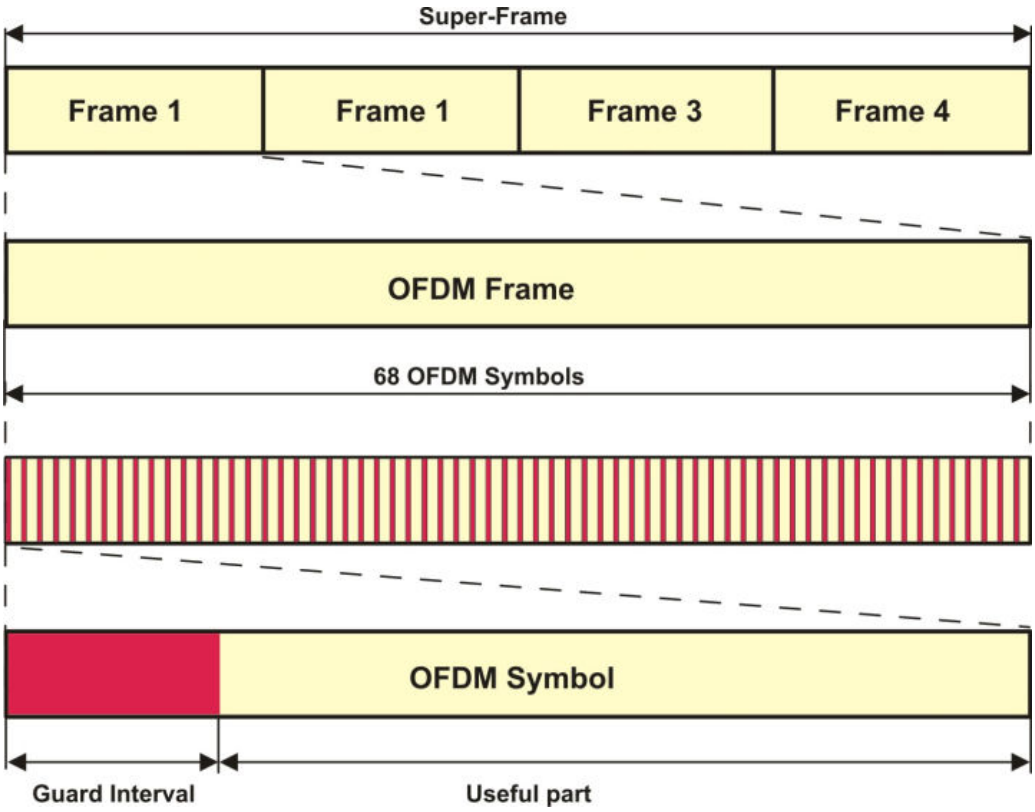


Fig. 2-3: OFDM frame structure

Each OFDM symbol is constituted by a set of carriers. The number of carriers depends on the OFDM mode:

OFDM Mode	No. of Carriers
2K	1705
4K	3409
8K	6817

2.1.8 Transport Parameter Signalling

The Transport Parameter Signalling (TPS) carriers are used to signalling parameters related to the transmission scheme. The TPS is transmitted parallel on 17 TPS carriers for the 2K mode, 34 carriers for the 4K mode, and 68 carriers for the 8K mode. Every TPS carrier in the same symbol conveys the same differentially encoded information bit.

The TPS parameter bits are described in chapter 3.3, "TPS Settings", on page 26.

2.2 Extensions to DVB-T

The Digital Video Broadcasting - Handheld (DVB-H) standard is based on the earlier standard DVB-T, which is used for terrestrial digital broadcasting.

DVB-H provides features to meet the specific requirements for handheld, mobile terminals such as:

- power off some part of the reception chain to increase the battery duration
- ease access to the services when receivers switching to the next cell
- migitate the effects of man-maid noise and severe mobile multipath channels on the receiving capabilities
- offer sufficient flexibility and scalability to allow reception of services at various speeds
- offer the flexibility to be used in various transmission bands and channel bandwiths

The basic technical extensions that make it possible to receive digital video broadcasting services on handheld terminals are:

- 4K Mode and In-Depth Interleavers
- Time-Slicing
- Forward Error Correction for Multiprotocol Encapsulated Data (MPE-FEC)

2.2.1 4K Mode and In-Depth Interleavers

The additional 4K mode is an trade-off between transmission cell size and mobile reception capabilities to improve network planning flexibility. The 4K mode is suitable for single transmitter operation and for small and medium single frequency networks (SFN). It provides a Doppler tolerance allowing very high speed reception. The mobile reception is faster compared to the 8K mode and the cell size is bigger compared to the 2K mode.

The additional in-depth interleavers increase the flexibility of the interleaving for the 2K and 4K mode. The depth of the inner interleaver is enlarged to four consecutive OFDM symbols (2K) or to two consecutive OFDM symbols (4K).

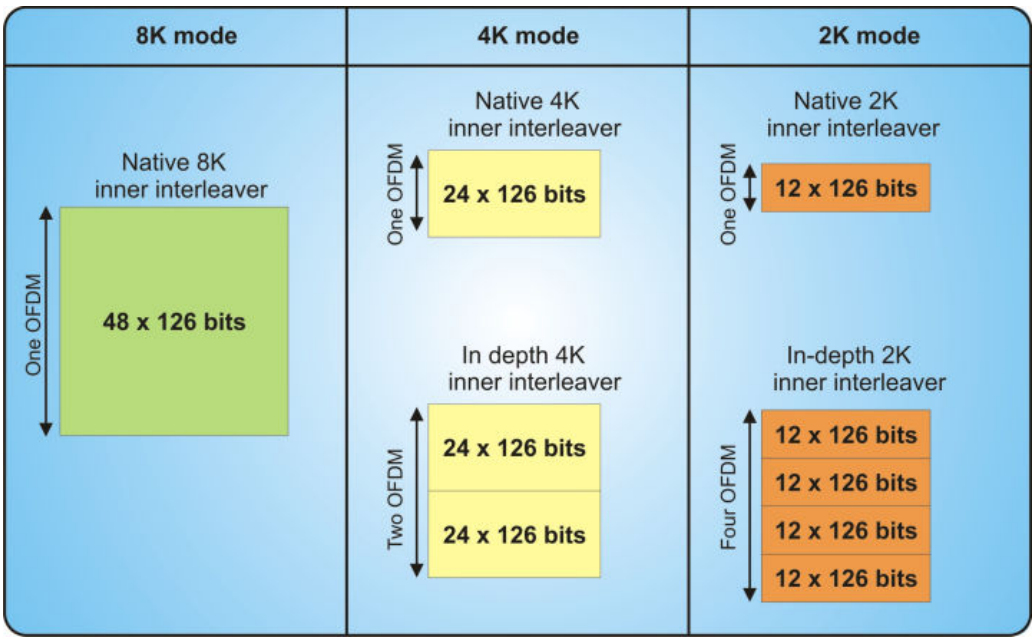


Fig. 2-4: In-Depth Interleaver for 2K and 4K Mode

2.2.2 Time-Slicing

The time-slicing module provided with DVB-H reduces the average power consumption of the receiving handheld terminals and enables smooth and seamless service hand-over.

IP datagramms are transmitted as data bursts in small time slots using a significantly higher instantaneous bit rate compared to traditional streaming bit rates. During the off times (between the bursts), the receiving handheld is inactive and therefore using less power.

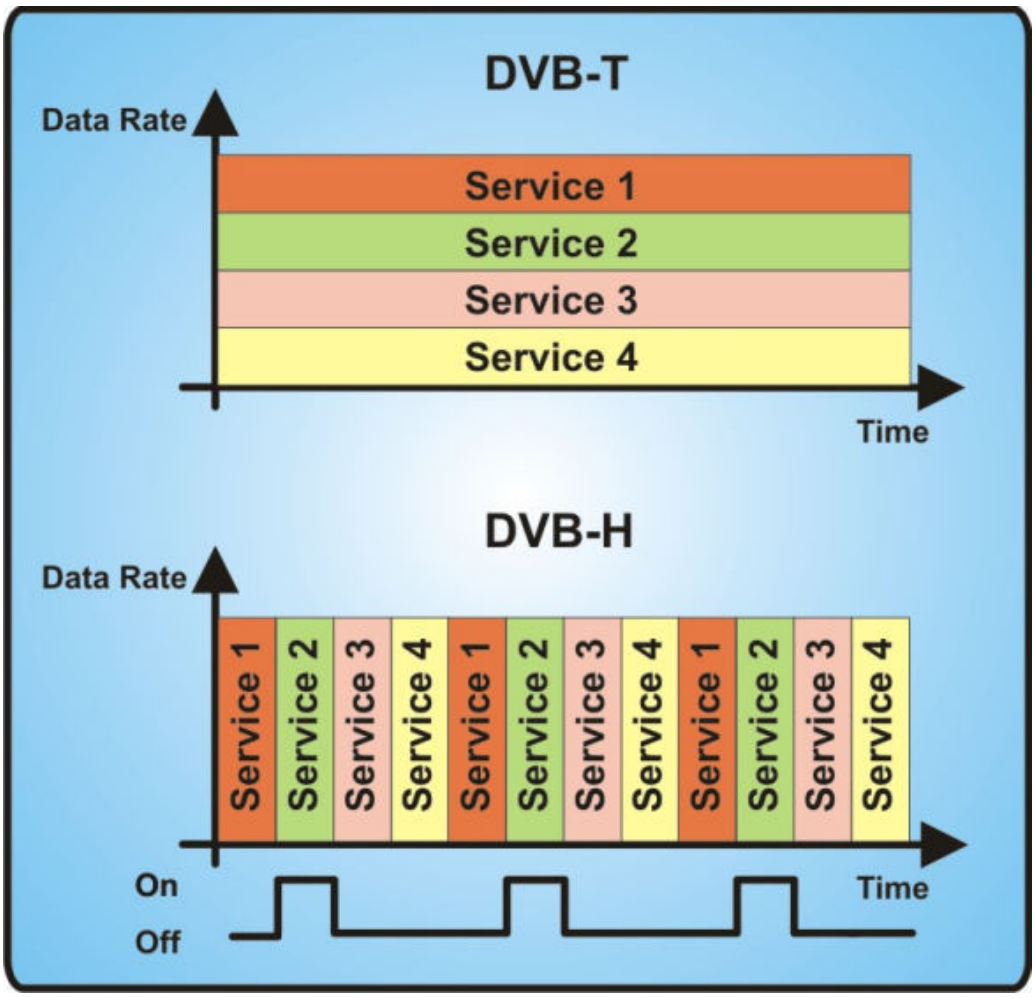


Fig. 2-5: DVB-H Time-Slicing

The point of time when the next burst is transmitted (delta_t) is indicated within the burst currently being received.

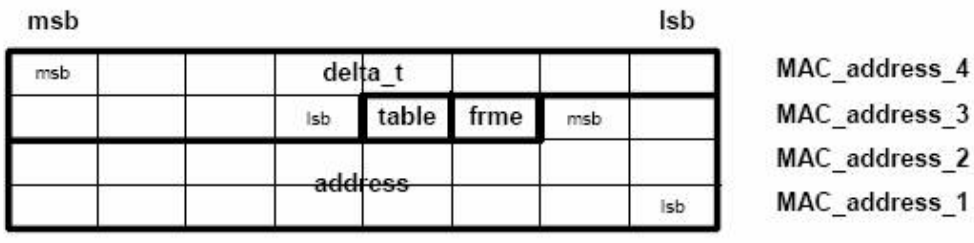


Fig. 2-6: Next Burst Indication

Time-slicing enables a handheld receiver to stay active only for a fraction of time, that is, when the burst is transmitted. Note that while the receiver is inactive between the bursts, the transmission stream is constantly on, that is, the transmission stream is never interrupted. Between the off times of a particular service, other services are transmitted in bursts in a sequence.

In addition, time-slicing allows to use the receiver to monitor neighbouring cells during the off times. Performing the cell switching during an off time enables a smooth and seamless service handover.

Time-slicing is mandatory for DVB-H.

2.2.3 Forward Error Correction for Multiprotocol Encapsulated Data (MPE-FEC)

The MPE-FEC module provided with DVB-H impoves the carrier-to-noise (C/N) performance and the Doppler performance in mobile channels and improve the tolerance to impulse interference.

This is accomplished by adding an additional Reed-Solomon code (RS 255,191) in conjunction with a block interleaver. The MPE-FEC module provides a specific frame structure; the MPE-FEC frame. The MPE-FEC frame consists of an application data table (ADT) with 191 columns for the IP datagramms and an Reed-Solomon data table (RDT) with 61 columns for the Reed-Solomon parity information.

The IP datagramms are introduced vertically column-by-column. Empty cells and columns are padded with zeros. The RS code is coded line-by-line: For each row of 191 IP datagramm bytes the 64 parity bytes are calculated, using the RS code. This provides a virtual interleaving effect, because all RS data bytes are calculated from the IP datagramms.

After the coding is finished, the IP datagramms are encapsulated and transmitted in an MPE section and the parity information data of each column in the RDT table are transmitted in an MPE-FEC section.

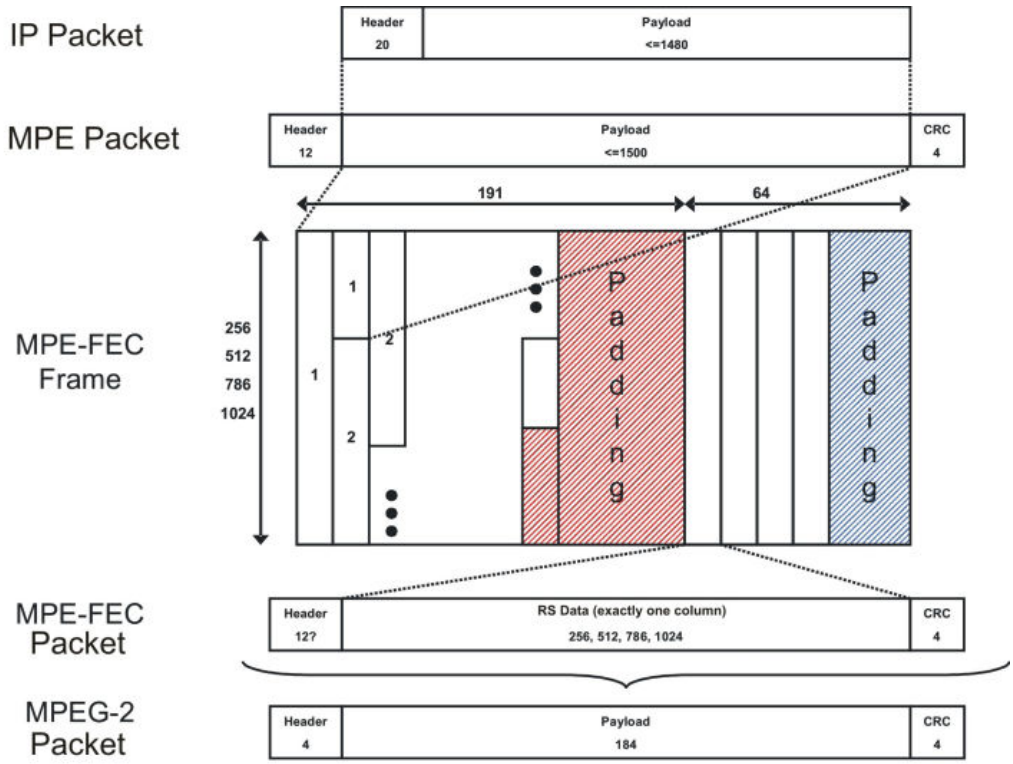


Fig. 2-7: MPE-FEC Packet/Frame Structure

Transmitting the IP datagramms and parity information data in separate sections allows the receiver to choose whether to use the MPE-FEC feature or not. If the MPE-FEC decoder is not implemented or if the feature is not activated in the receiver, the transmitted MPE-FEC sections with the parity information data are ignored, that is, only the payload with the IP datagramms is taken under consideration.

MPE-FEC is optional for DVB-H.

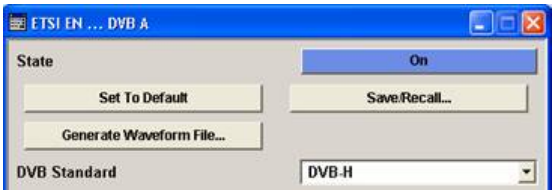
3 DVB-H User Interface

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

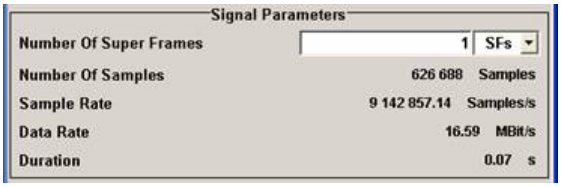
3.1 General Settings

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

The upper menu section is where the DVB-H digital standard is selected, enabled, and reset, and where the generated waveform file can be selceted.



In the "Signal Parameters" section, the number of super-frames can be selected and signal relevant parameters are displayed, if a signal is being generated.



The buttons in the lower menu section lead to submenus to configure the system and 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:DVB:STATe on page 48

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"
Number of Super-Frames	1
Hierarchy Mode	Non-hierarchical
HP Sorce	PN 23
Filter Type	Cosine
Clipping	OFF
Trigger Mode	Auto
Cell Identification	ON
Time-Slicing	ON
ID [4 hex]	0000
MPE-FEC	OFF
PN Scrambler	ON
Outer Coder	ON
Outer Interleaver	ON
Inner Coder	ON
Rate	1/2
Inner Bit Interleaver	ON
Inner Symbol Interleaver	ON
Inner Interleaver Mode	Native
TX Mode	2 K
OFDM/RF Bandwith	8 MHz
Modulation	QPSK
Alpha	1
Guard Inerval	1/8

Remote command:
[:SOURce<hw>]:BB:DVB:PRESet on page 46

Save/Recall...
Calls the "Save/Recall" dialog.

From the "Save/Recall" dialog, the "File Select" windows for saving and recalling DVB-H configurations and the "File Manager" is called.

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

The complete settings in the DVB-H menu are saved and recalled.

"Recall DVB-H Setting"	Opens the "File Select" window for loading a saved DVB-H configuration. The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.
"Save DVB-H Setting"	Opens the "File Select" window for saving the current DVB-H signal configuration. The name of the file is specified in the File name entry field, the directory selected in the save into 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 dialog is used to copy, delete, and rename files and to create new directories.

Remote command:
`[:SOURce<hw>]:BB:DVB:SETTing:CATalog?` on page 47
`[:SOURce<hw>]:BB:DVB:SETTing:LOAD` on page 47
`[:SOURce<hw>]:BB:DVB:SETTing:STORe` on page 48
`[:SOURce<hw>]:BB:DVB:SETTing:STORe:FAST` on page 48
`[:SOURce<hw>]:BB:DVB:SETTing:DELete` on page 47

Generate Waveform File…
Calls the "Generate Waveform" dialog. This dialog is used to store the current DVB-H signal as ARB signal in a waveform file.

This file can be loaded in the ARB menu and processed as multicarrier or multisegment signal.

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

Remote command:
`[:SOURce<hw>]:BB:DVB:WAVeform:CREate` on page 49

DVB Standard
Selects the DVB standard to be used to generate the modulation signal.

Note: In this release only DVB-H is available.

Remote command:
`[:SOURce<hw>]:BB:DVB:STANdard` on page 48

Number of Super Frames
Sets the number of the transmitted super-frames. Each super-frame consists of four OFDM frames.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SFRames` on page 50

Number of Samples
Displays the number of the transmitted samples.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SAMPle:LENGth?` on page 50

Sample Rate
Displays the sample rate.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SAMPle:RATE?` on page 50

Data Rate
Displays the data rate.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:DRATe?` on page 49

Duration
Displays the signal duration.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:DURation?` on page 49

System Configuration…
Calls the System Configuration menu for configuring the DVB-H system.

The hierarchy mode and the data source are displayed next to the button.

The menu is described in chapter 3.2, "System Configuration", on page 23.

Remote command:
n.a.

TPS Settings…
Calls the "TPS Settings" menu for setting the TPS parameters and viewing the status of the parameter bits.

The menu is described in chapter 3.3, "TPS Settings", on page 26.

Remote command:
n.a.

Filtering/Clipping
Calls the menu for setting baseband filtering and clipping. The current filter and the clipping state are displayed next to the button.

The menu is described in chapter 3.4, "Filter / Clipping Settings", on page 31.

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 3.5, "Trigger/Marker/Clock Settings", on page 34.

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:DVB:TRIGger:EXECute` on page 56

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:ARM:EXECute` on page 56

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

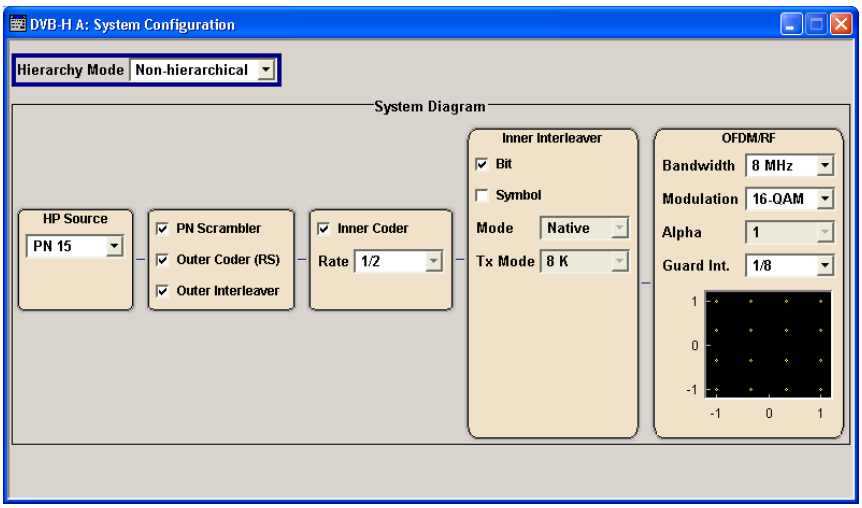
This menu is described in chapter 3.5.4, "Clock Settings", on page 41.

Remote command:
n.a.

3.2 System Configuration

The "System Configuration" dialog allows to configure the DVB system. The DVB system is displayed in form of a block diagram including all parameters necessary to configure the system.

The system diagram depends on the selected "Hierarchy Mode".



Hierarchy Mode
Selects the hierarchy mode.

"Hierarchical" Both inputs are used. The inputs are identical and simply differ in the prioritization.

"Non-hierarchical" The high priority input is used.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:HMODe` on page 69

HP/LP Source
Selects the data source.

LP is provided in hierarchical mode, see Hierarchy Mode.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:DATA` on page 69
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:DATA:DSELection` on page 70

PN Scrambler
Activates/deactivates the PN scrambling. The data packets of the incoming transport stream are transformed to a Pseudo Random Binary Sequence (PRBS) in order to obtain a bit sequence that has a positive effect on the transmitted RF spectrum.

For details, refer to chapter 2.1.1, "Pseudo Noise Scrambler", on page 9.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:PNSCrambler[:STATe]` on page 71

Outer Coder (RS)
Activates/deactivates the outer coder. The outer coder applies a Reed-Solomon error correction code to the PRBS data stream. For details, refer to chapter 2.1.2, "Outer Coder", on page 10.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:OCODer[:STATe]` on page 71

Outer Interleaver
Activates/deactivates the outer convolutional interleaver. For details, refer to chapter 2.1.3, "Outer Interleaver", on page 10.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:OINTerleaver[:STATe]`
on page 71

Inner Coder
Activates/deactivates the inner coder. The inner coder is a punctured convolutional error-correcting coder. For details, refer to chapter 2.1.4, "Inner Coder", on page 10.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:ICODer[:STATe]` on page 70

Rate
Selects the code rate of the inner coder. A number of incoming bits (m) to be encoded is transformed into an bit symbol (containing n-bits), where m/n is the code rate. For details, refer to chapter 2.1.4, "Inner Coder", on page 10.

Note: This field is available only if the inner code state is set to active.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:ICODer:RATE` on page 70

Inner Bit Interleaver
Activates/deactivates the inner bit interleaver. For details, refer to chapter 2.1.5, "Inner Interleaver", on page 11.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:BIT[:STATe]`
on page 71

Inner Symbol Interleaver
Activates/deactivates the inner symbol interleaver. For details, refer to chapter 2.1.5, "Inner Interleaver", on page 11.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol[:STATe]`
on page 72

Inner Interleaver Mode
Selects the inner interleaver mode. Interleaver mode In-depth is available only for transmission mode 2K and 4K. For details, refer to chapter 2.1.5, "Inner Interleaver", on page 11.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol:MODE`
on page 72

Inner Interleaver Tx Mode
Selects the transmission mode. This setting determines the number of the OFDM sub-carriers. For transmission mode 8K, the in-depth interleaver mode is not available. For details, refer to chapter 2.1.5, "Inner Interleaver", on page 11.

Note: Transmission mode 4K is only available for DVB-H.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol:TMODe
on page 72

OFDM/RF Bandwidth
Selects the system Bandwidth.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:BWIDth on page 73

OFDM/RF Modulation
Selects the constellation for the OFDM modulation. For details, refer to chapter 2.1.6, "Mapper", on page 12.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:MODulation on page 73

OFDM/RF Alpha
Selects the alpha value. This value is used to shape the constellation of the modulation. For non-hierarchical mode, this value is always 1 an can not be changed. For details, refer to chapter 2.1.6, "Mapper", on page 12.

Note: The values in the list are selectable only if "Hierarchical" is selected in the "Hierarchy Mode" field and a modulation type other than QPSK is selected. In this release only the Non-hierarchical mode is available.

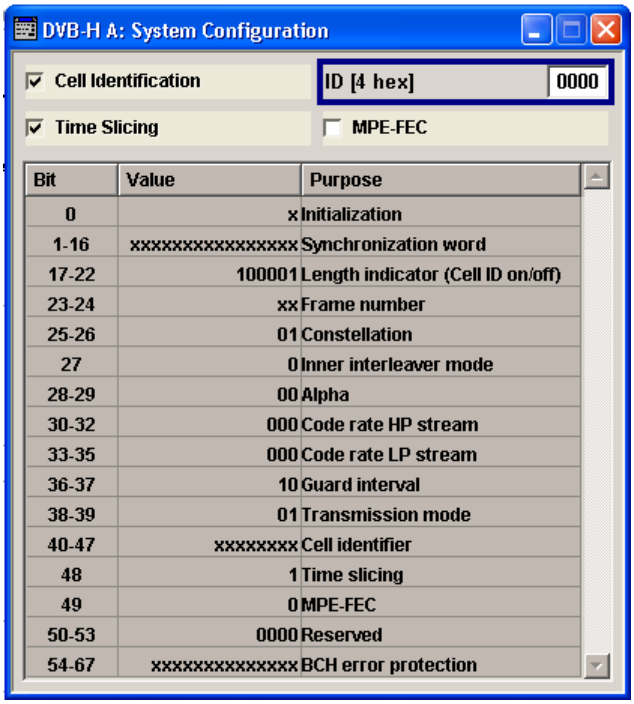
Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:ALPHa on page 72

OFDM/RF Guard Int
Selects the value for the guard interval. The guard interval extends the length of the transmitted symbol. The guard intervals are given as fractions of a symbol period.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:GINTerval on page 73

3.3 TPS Settings

The "TPS Settings" dialog allows to select the bits to transmit via the TPS signal and displays the status of the parameter bits.



Cell Identification
Activates/deactivates the TPS cell identification. If activated, the cell from which the signal comes from is identified.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:ID:STATe` on page 74

ID [4 hex]
Sets the cell ID for cell identification. The cell ID identifies the cell from which the signal is transmitted. This value is read by the receiver only if Cell Identification is activated.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:ID:PATTern` on page 74

Time Slicing
Indicates the status of the time-slicing bit. If activated, the average power consumption of the terminal is reduced. Time-slicing information has to be included in the transport stream and is not generated by this application. Time slicing is always on for DVB-H and always off for DVB-T.

For details, refer to chapter 2.2.2, "Time-Slicing", on page 15.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:TSLicing[:STATe]?` on page 74

MPE FEC
Activates/deactivates the multiprotocol encapsulation forward error correction bit. MPE-FEC must be performed in the transport stream and is not provided by this application.

For details, refer to chapter 2.2.3, "Forward Error Correction for Multiprotocol Encapsulated Data (MPE-FEC)", on page 17.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:MFEC[:STATe] on page 74

TPS Table

The TPS parameter bit table displays the status of the transmitted TPS parameter bits.

Bit	Value	Purpose
0	x	Initialization
1-16	xxxxxxxxxxxxxxx	Synchronization word
17-22	100001	Length indicator (Cell ID on/off)
23-24	xx	Frame number
25-26	10	Constellation
27	0	Inner interleaver mode
28-29	00	Alpha
30-32	000	Code rate HP stream
33-35	000	Code rate LP stream
36-37	10	Guard interval
38-39	01	Transmission mode
40-47	xxxxxxxx	Cell identifier
48	1	Time slicing
49	1	MPE-FEC
50-53	0000	Reserved
54-67	xxxxxxxxxxxxxx	BCH error protection

Table 3-1: TPS signaling information transmitted in DVB-H

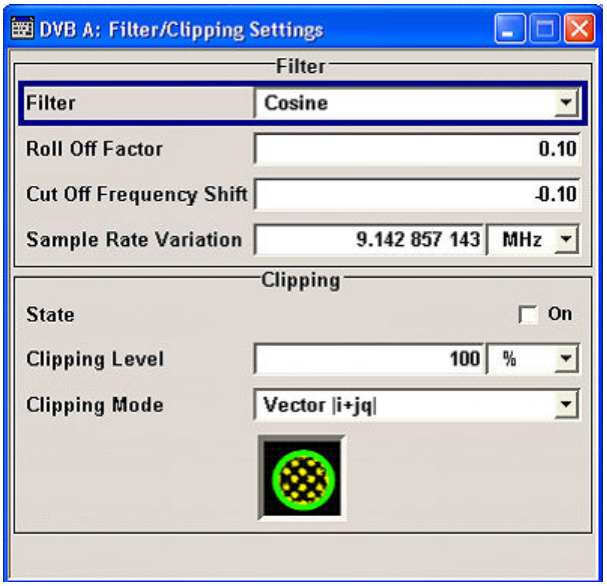
Bit number	Format	Purpose
0	0/1	Initialization bit for the differential 2-PSK modulation. The modulation of the TPS initialization bit is derived from the PRBS sequence
1-16		Bits 1 to 16 of the TPS are the synchronization words for the TPS blocks in the super-frames:
	0011010111101110	Synchronization word for the first and the third TPS block in each super-frame
	11001010000100001	Synchronization word for the second and the fourth TPS block in each super-frame
17-22		The first 6 bits of the TPS information is used as a TPS length indicator to signal the number of used bits of the TPS:
	010111	Cell Identification is not transmitted (23 TPS bits in use)
	011111	Cell Identification information is transmitted (31 TPS bits in use)
	100001	Cell Identification information is transmitted for DVB-H (33 TPS bits in use)
23-24		Indicates the frame in the super-frame. Four frames constitute a super-frame.
	00	Frame 1 in the super-frame

Bit number	Format	Purpose
	01	Frame 2 in the super-frame
	10	Frame 3 in the super-frame
	11	Frame 4 in the super-frame
25-26		Indicates the constellation
	00	QPSK
	01	16-QAM
	10	64-QAM
	11	Reserved
27		Indicates the interleaver mode. The in-depth interleaver can be used for 2K and 4K transmission mode. For transmission mode 8K, only the native interleaver shall be used:
	0	The native interleaver is used
	1	The in-depth interleaver is used
28-29		Indicates the hierarchical transmission and the value of the Alpha-factor
	00	Transmission in non-hierarchical mode
	01	Alpha = 1
	10	Alpha = 2
	11	Alpha = 4
30-32		Indicates the code rate for the HP transmission stream
	000	½
	001	2/3
	010	3/4
	011	5/6
	100	7/8
	101	reserved
	110	reserved
	111	reserved
33-35		Indicates the code rate for the LP transmission stream
	000	½
	001	2/3
	010	3/4
	011	5/6
	100	7/8

Bit number	Format	Purpose
	101	reserved
	110	reserved
	111	reserved
36-37		Indicates the value for the guard interval
	00	1/32
	01	1/16
	10	1/8
	11	1/4
38-39		Indicates the transmission mode
	00	2K mode
	01	8K mode
	10	4K mode
	11	reserved
40-47	Cell_id	32 bits are used for the cell ID. Every frame contains eight bits. The eight bits are used to identify the cell from which the signal comes from.
48		Indicates the usage of time-slicing
	0	Time-slicing is not used
	1	At least one elementary stream uses time-slicing
49		Indicates the usage of MPE-FEC
	0	MPE-FEC is not used
	1	At least one elementary stream uses MPE-FEC
50-53	reserved	
54-67	xxxxxxxxxxxxxxx	BCH Error Protection

3.4 Filter / Clipping Settings

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



The dialog comprises the settings, necessary to configure the baseband filter and to enable clipping.

3.4.1 Filter Settings

Provided are the following settings:

Filter
Selects the baseband filter.

Remote command:
`[:SOURce<hw>]:BB:DVB:FILTer:TYPE` on page 53

Roll Off Factor or BxT
Sets the filter parameter.

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

Remote command:
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:APCO25` on page 51
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:COSine` on page 51
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:GAUSs` on page 51
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:PGAuss` on page 52
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:RCOSine` on page 53
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:SPHase` on page 53

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:DVB:FILTer:PARameter:COSine:COFS` on page 51

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

Remote command:
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:LPASs` on page 52
`[:SOURce<hw>]:BB:DVB:FILTer:PARameter:LPASSEVM` on page 52

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

Remote command:
`[:SOURce<hw>]:BB:DVB:SRATe:VARiation` on page 54

3.4.2 Clipping Settings

DVB-H signals may have a quite high crest factor (~ 11dBm) because of high amplitude variations that come along with OFDM signals having a noise-like spectrum. High crest factors entail two basic problems:

- The nonlinearity of the power amplifier (compression) causes intermodulation which expands the spectrum (spectral regrowth).
- Since the level in the D/A converter is relative to the maximum value, the average value is converted with a relatively low resolution. This results in a high quantization noise.

Both effects increase the adjacent-channel power.

Since clipping the signal not only changes the peak value but also the average value, the effect on the crest factor is unpredictable.

The following pictures demonstrate the affect of clipping with vector mode (|i+jq|), using the default signal configuration with a PN23 input sequence.

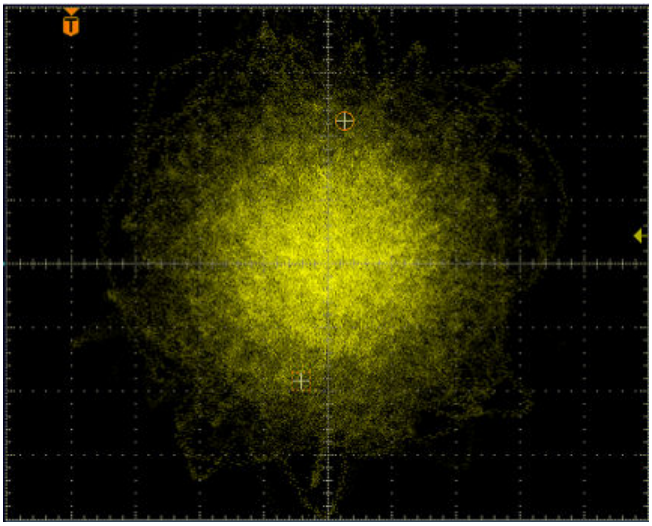


Fig. 3-1: Constellation diagram of the signal without clipping, shows the level mapping

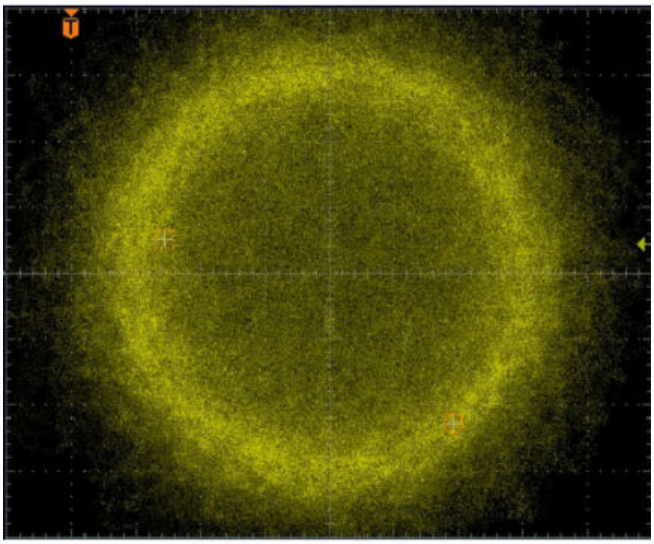


Fig. 3-2: Constellation diagram with clipping level 10 %, vector mode (|i+jq|)

Provided are the following settings:

Clipping State
Switches baseband clipping on and off.

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

Remote command:
`[:SOURce<hw>]:BB:DVB:CLIPping:STATe` on page 55

Clipping Level
Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote command:
`[:SOURce<hw>]:BB:DVB:CLIPping:LEVel` on page 54

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

"Vector | i + jq |" The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.

"Scalar | i | , | q |" The limit is related to the absolute maximum of all the I and Q values | i | + | q |.

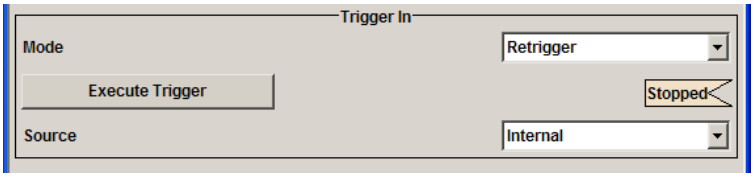
The I and Q components are mapped separately, the angle changes.

Remote command:
`[:SOURce<hw>]:BB:DVB:CLIPping:MODE` on page 54

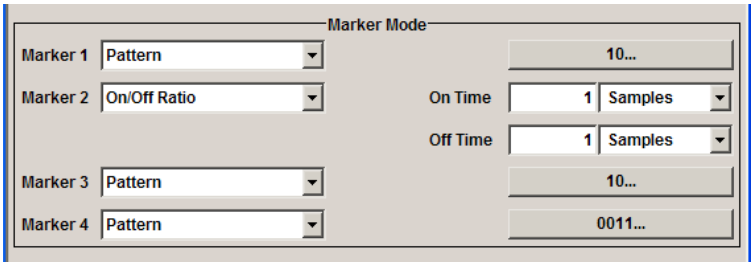
3.5 Trigger/Marker/Clock Settings

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

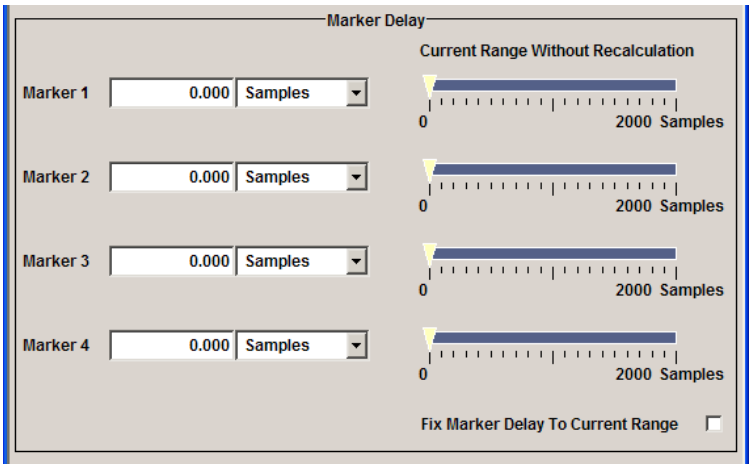
The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



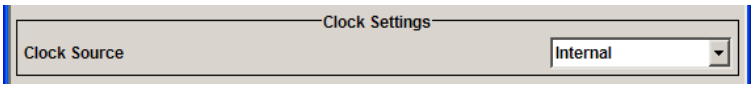
The "Marker Mode" section is where the marker signals at the "Marker" output connectors are configured.



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.

3.5.1 Trigger Settings

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:DVB[:TRIGger]:SEQuence` on page 60

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:SLUNit` on page 58

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.

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:SLENgth` on page 58

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:DVB:TRIGger:RMODe?` on page 58

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:ARM:EXECute` on page 56

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:DVB:TRIGger:EXECute` on page 56

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:DVB:TRIGger:SOURce` on page 59

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

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

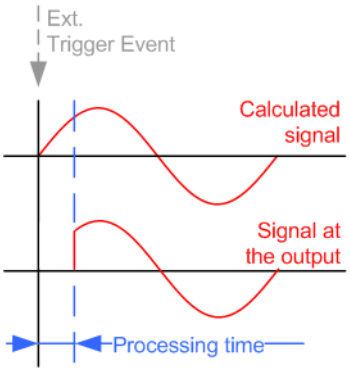
For R&S SMBV instruments:

For 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.

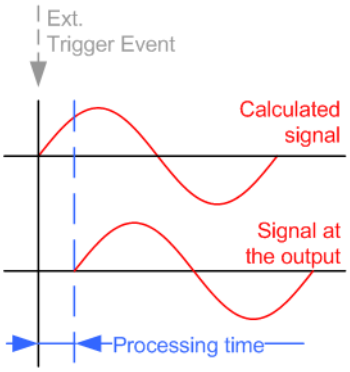
Table 3-2: Typical Applications

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:DVB:TRIGger:EXTernal:SYNChronize:OUTPut` on page 56

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:DVB:TRIGger[:EXTernal<ch>]:DELay` on page 59
`[:SOURce<hw>]:BB:DVB:TRIGger:OBASeband:DELay` on page 57

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:DVB:TRIGger[:EXTernal<ch>]:INHibit` on page 60
`[:SOURce<hw>]:BB:DVB:TRIGger:OBASeband:INHibit` on page 57

3.5.2 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.

"Restart" A marker signal is generated at the start of every sequence length loop.

"Super Frame Start" A marker signal is generated at the start of every super-frame period.

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

"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:DVB:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 65
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 65

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:PATTern` on page 65

"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:DVB:TRIGger:OUTPut<ch>:ONTime` on page 64
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:OFFTime` on page 64

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:MODE` on page 63

3.5.3 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 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:DVB:TRIGger:OUTPut<ch>:DELay` on page 62

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:DVB:TRIGger:OUTPut<ch>:DELay:MINimum?` on page 63
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:DELay:MAXimum?` on page 62

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:DVB:TRIGger:OUTPut:DELay:FIXed` on page 62

3.5.4 Clock Settings

The clock settings are used to set the clock source and a delay if required.

Sync. Mode
(for R&S SMBV only)

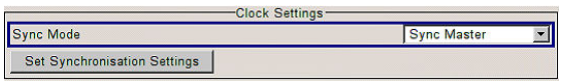
Selects the synchronization mode.

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:DVB:CLOCk:SYNChronization:MODE on page 68

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:DVB:CLOCk:SYNChronization:EXECute on page 68

Clock Source
Selects the clock source.

"Internal" The internal clock reference is used to generate the sample clock.

"External" The external clock reference is fed in as the sample clock or multiple thereof via the CLOCK connector.
The sample 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:DVB:CLOCk:SOURce on page 67

Clock Mode
Enters the type of externally supplied clock.

"Sample" A sample clock is supplied via the CLOCK connector.

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

Remote command:
[:SOURce<hw>]:BB:DVB:CLOCk:MODE on page 66

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

Remote command:
[:SOURce<hw>]:BB:DVB:CLOCk:MULTiplier on page 66

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

Remote command:
CLOCk:INPut:FREQuency?

3.5.5 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 DVB options in a remote environment. We assume that the R&S Signal Generator has already been set up for remote operation in a network as described in the R&S Signal Generator documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

Conventions used in SCPI command descriptions

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

The commands in the `SOURce:BB:DVB` subsystem are described in three sections, separated into general remote commands, commands for system configuration and TPS settings.

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 DVB are described here:

4.1 General Commands

This subsystem contains commands for the primary and general settings of the DVB standard. These settings concern activation and deactivation of the standard, filter, clock, and trigger settings.

4.1.1 Primary Commands

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

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

Not affected is the state set with the command `SOURce<hw>:BB:DVB:STATe`

Example: `SOURce1:BB:DVB:PRESet`

Usage: Event

Manual operation: See "Set To Default" on page 20

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

This command reads out the files with DVB-H settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.DVB` will be listed.

Return values:
<Catalog> string

Example: `MMEM:CDIR '<root>DVB'`
sets the default directory to `<root>DVB`.
`BB:DVB:SETT:CAT?`
reads out all the files with DVB-H settings in the default directory.
`Response: 'DVB_1','DVB_2'`
the files `DVB_1` and `DVB_2` are available.

Usage: Query only

Manual operation: See "Save/Recall..." on page 21

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

This command deletes the selected file with DVB-H 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 `*.DVB` will be deleted.

Setting parameters:
<Filename> string

Example: `BB:DVB:SETT:DEL '<root>DVB'`
deletes the specified file with DVB-H settings.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 21

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

This command loads the selected file with DVB-H 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 `*.DVB` will be loaded.

Setting parameters:
<Filename> string

Example: `BB:DVB:SETT:LOAD 'DVB_1'`
loads file '`DVB_1`'.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 21

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

This command stores the current DVB-H 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. DVB-H settings are stored as files with the specific file extensions `*.DVB`.

Setting parameters:
<Filename> string

Example: `BB:DVB:SETT:STOR 'DVB_1'`
stores the current DVB-H settings into file '`DVB_1`'.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 21

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

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

Manual operation: See "Save/Recall..." on page 21

[:SOURce<hw>]:BB:DVB:STANdard <Standard>

The command selects the DVB standard to be used.

Note:

In this release only DVB-H is available.

Parameters:
<Standard> DVBH | DVBT
*RST: DVBH

Example: `BB:DVB:STAN DVBH`
selects the DVB-H standard to be used.

Manual operation: See "DVB Standard" on page 21

[:SOURce<hw>]:BB:DVB: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:DVB:STATe ON`

Manual operation: See "State" on page 20

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

This command creates a waveform using the current settings of the "DVB-H" menu. The file name is entered with the command. The file is stored with the predefined file extension `*.wv`. The file name and the directory it is stored in are user-definable.

Setting parameters:
<Filename> string

Example: `MMEM:CDIR '<root>waveform'`
sets the default directory to `<root>waveform`.
`BB:DVB:WAV:CRE 'DVB_1'`
creates the waveform file `DVB.wv` in the default directory.

Usage: Setting only

Manual operation: See "Generate Waveform File..." on page 21

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:DRATe?

The command queries the data rate.

Return values:
<DRate> float
Increment: 0.01

Example: `BB:DVB:DVBH:DRAT?`
queries the data rate.

Usage: Query only

Manual operation: See "Data Rate" on page 22

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:DURation?

The command queries the signal duration.

Return values:
<Duration> float

Example: `BB:DVB:DVBH:DUR?`
queries the signal duration.

Usage: Query only

Manual operation: See "Duration" on page 22

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SAMPle:LENGth?

Queries the number of the transmitted samples.

Return values:
<Length> integer

Example: `BB:DVB:DVBH:SAMP:LENG?`
queries the number of the transmitted samples.

Usage: Query only

Manual operation: See "Number of Samples" on page 22

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SAMPle:RATE?

The command queries the sample rate.

Return values:
<Rate> float

Example: `BB:DVB:DVBH:SAMP:RATE?`
queries the sample rate.

Usage: Query only

Manual operation: See "Sample Rate" on page 22

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SFRames <SFrames>

The command sets the number of super-frames to be transmitted.

Parameters:
<SFrames> integer
Range: 1 to 100
*RST: 1

Example: `BB:DVB:DVBH:SFR 50`
sets the number of the transmitted super-frames to 50.

Manual operation: See "Number of Super Frames" on page 22

4.1.2 Filter Settings

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:APCO25 <Apco25>

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

Parameters:

<Apco25> float

Range: 0.05 to 0.99
Increment: 0.01
*RST: 0.20

Example: `BB:DVB:FILT:PAR:APCO25 0.2`
sets the roll-off factor to 0.2 for filter type APCO25.

Manual operation: See "Roll Off Factor or BxT" on page 31

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:COSine <Cosine>

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

Parameters:

<Cosine> float

Range: 0 to 1.0
Increment: 0.01
*RST: 0.10

Example: `BB:DVB:FILT:PAR:COS 0.35`
sets the roll-off factor to 0.35 for filter type Cosine.

Manual operation: See "Roll Off Factor or BxT" on page 31

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

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

Parameters:

<Cofs> float

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

Example: `BB:DVB:FILT:PAR:COS:COFS 0.35`
sets the "cut off frequency shift' value to 0.35.

Manual operation: See "Cut Off Frequency Shift" on page 32

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:GAUSs <Gauss>

The command sets the B x T for the Gauss filter type.

Parameters:

<Gauss> float

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

Example: `BB:DVB:FILT:PAR:GAUS 0.5`
sets B x T to 0.5 for the Gauss filter type.

Manual operation: See "Roll Off Factor or BxT" on page 31

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:LPASs <LPass>

The command sets the cut off frequency factor for the Lowpass (APC opt.) filter type.

Parameters:

<LPass> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:DVB:FILT:PAR:LPAS 0.5`
the cut off frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 32

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:LPASSEVM <LPassEvm>

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

Parameters:

<LPassEvm> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:DVB:FILT:PAR:LPAS 0.5`
the cut off frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 32

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:PGAuss <PGauss>

The command sets the B x T for the Pure Gauss filter type.

Parameters:

<PGauss> float

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

Example: `BB:DVB:FILT:PAR:GAUS 0.5`
sets B x T to 0.5 for the Pure Gauss filter type.

Manual operation: See "Roll Off Factor or BxT" on page 31

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:RCOSine <RCosine>

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

Parameters:

<RCosine> float

Range: 0 to 1.0
Increment: 0.01
*RST: 0.22

Example: `BB:DVB:FILT:PAR:RCOS 0.22`
sets the roll-off factor to 0. 22 for filter type Root Cosine.

Manual operation: See "Roll Off Factor or BxT" on page 31

[:SOURce<hw>]:BB:DVB:FILTer:PARameter:SPHase <SPhase>

The command sets the B x T for the Split Phase filter type.

Parameters:

<SPhase> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 2.00

Example: `BB:DVB:FILT:PAR:SPH 0.5`
sets B x T to 0.5 for the Split Phase filter type.

Manual operation: See "Roll Off Factor or BxT" on page 31

[:SOURce<hw>]:BB:DVB:FILTer:TYPE <Type>

The command selects the filter type.

Parameters:

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

*RST: GAUSs

Example: `BB:DVB:FILT:TYPE RCOS`
sets the filter type RCOSine.

Manual operation: See "Filter" on page 31

[:SOURce<hw>]:BB:DVB:SRATe:VARiation <Variation>

The command enters the output sample rate.

A variation of this parameter only affects the ARB clock rate, all other signal parameters remain unchanged. If the sampling rate in the frame configuration menu is changed, this parameter is reset to the chosen sampling rate.

Parameters:

<Variation> float

Range: 400 Hz to 40 MHz
*RST: 0.001 Hz

Example: `BB:DVB:SRAT:VAR 40 MHz`
sets the output sample rate to 40 MHz.

Manual operation: See "Sample Rate Variation " on page 32

4.1.3 Clipping Settings

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

The command sets the limit for level clipping. This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Parameters:

<Level> integer

Range: 1 PCT to 100 PCT
Increment: 1 PCT
*RST: 100

Example: `BB:DVB:CLIP:LEV 80`
sets the limit for level clipping to 80% of the maximum level.
`BB:DVB:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping Level" on page 33

[:SOURce<hw>]:BB:DVB:CLIPping:MODE <Mode>

The command sets the method for level clipping.

Parameters:

<Mode> VECTor | SCALar

VECTor
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

*RST: VECTor

Example: `BB:DVB:CLIP:MODE VECT`
sets the amplitude as reference level.

Manual operation: See "Clipping Mode" on page 34

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

The command activates level clipping. The value is defined with the command `:BB:DVB:CLIPping:LEVel`, the mode of calculation with the command `:BB:DVB:CLIPping:MODE`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:DVB:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping State" on page 33

4.1.4 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:DVB:TRIGger:ARM:EXECute

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

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

Usage: Event

Manual operation: See "Arm" on page 23

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

The command executes a trigger. The internal trigger source must be selected using the command `SOUR:BB:DVB:TRIG:SOUR INT` and a trigger mode other than "AUTO" must be selected using the command `SOUR:BB:DVB:TRIG:SEQ`.

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

Usage: Event

Manual operation: See "Execute Trigger" on page 23

[:SOURce<hw>]:BB:DVB: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" on page 37 for a detailed description of the applications of this setting.

Parameters:

<Output> 0 | 1 | OFF | ON

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:DVB:TRIG:SOUR EXT`
sets external triggering.
`BB:DVB:TRIG:EXT:SYNC:OUTP ON`
enables synchrounous output to external trigger

Manual operation: See "Sync. Output to External Trigger" on page 37

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

Sets the trigger delay for triggering by the trigger signal from the second path.

Parameters:

<Delay> float

Range: 0 to 65535
Increment: 0.01
*RST: 0
Default unit: samples

Example:
```
BB:DVB:TRIG:SOUR OBAS
BB:DVB:TRIG:OBAS:DEL 50
```

Manual operation: See "Trigger Delay" on page 39

[:SOURce<hw>]:BB:DVB:TRIGger:OBASeband: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
Default unit: samples

Example: `BB:DVB:TRIG:SOUR OBAS`
`BB:DVB:TRIG:INH 200`

Manual operation: See "Trigger Inhibit" on page 39

[:SOURce<hw>]:BB:DVB:TRIGger:RMODe?

The command queries the current status of signal generation for all trigger modes with DVB-H modulation on.

Return values:

<RMode> STOP | RUN

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

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

Example: `BB:DVB:TRIG:SOUR EXT`
sets external triggering.
`BB:DVB:TRIG:MODE ARET`
selects the Armed_Retrigger mode
`BB:DVB:TRIG:RMOD?`
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 36

[:SOURce<hw>]:BB:DVB:TRIGger:SLUNit <SLunit>

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

Parameters:

<SLunit> FRAMe | SEQuence

*RST: SEQuence

Example: `BB:DVB:TRIG:SLUN SEQ`

Manual operation: See "Signal Duration Unit" on page 36

[:SOURce<hw>]:BB:DVB:TRIGger:SLENgth <SLength>

Sets the length of the signal sequence to be output in the "Single" trigger mode (`SOUR:BB:DVB:SEQ SING`).

The unit is defined with command SOUR:BB:DVB:TRIG:SLUNit. It is then possible to output deliberately just part of the frame, an exact sequence of the frame, or a defined number of repetitions of the frame.

Parameters:

<SLength> integer

Range: 1 to 7000
*RST: 4

Example: BB:DVB:SEQ SING
sets trigger mode Single.
BB:DVB:TRIG:SLUN FRAM
sets unit frames for the entry of sequence length.
BB:DVB:TRIG:SLEN 200
sets a sequence length of 200 frames. The current frame will be output 200 times after the next trigger event.

Manual operation: See "Signal Duration" on page 36

[:SOURce<hw>]:BB:DVB: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:DVB:TRIGger:SOURce EXTernal
sets external triggering via the TRIGGER 1 connector.

Manual operation: See "Trigger Source" on page 37

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

Specifies the trigger delay (expressed as a number of samples) for external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Parameters:

<Delay> float

Range: 0 to 65535
Increment: 0.01
*RST: 0
Default unit: Sample

Example:
```
BB:DVB:TRIG:SOUR EXT
BB:DVB:TRIG:DEL 50
```

Manual operation: See "Trigger Delay" on page 39

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

Specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example:
```
BB:DVB:TRIG:SOUR EXT1
BB:DVB:TRIG:INH 200
```

Manual operation: See "Trigger Inhibit" on page 39

[:SOURce<hw>]:BB:DVB[: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:DVB: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:DVB:TRIG:ARM:EXEC` and started again when a trigger event occurs.

SINGle
The modulation signal is generated only when a trigger event occurs. After the trigger event, the signal is generated once to the set sequence length (`SOUR:BB:DVB:TRIG:SLEN`). Every subsequent trigger event causes a restart.

*RST: AUTO

Example: `BB:DVB: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 35

4.1.5 Marker Settings

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

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

The command restricts the marker delay setting range to the current 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:DVB:TRIG:OUTP:DEL:FIX ON`
restricts the marker signal delay setting range to the current range.

Manual operation: See "Fix marker delay to current range" on page 41

[:SOURce<hw>]:BB:DVB: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:DVB: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 (2^24 - 1) samples
Increment: 0.01
*RST: 0

Example: `BB:DVB:TRIG:OUTP:DEL 1600`
sets a delay of 1600 samples for the corresponding marker signal.

Manual operation: See "Marker x Delay" on page 41

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

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

Return values:

<Maximum> float

Example: `BB:DVB:TRIG:OUTP:DEL:FIX ON`
restricts the marker signal delay setting range to the dynamic range.
`BB:DVB:TRIG:OUTP:DEL:MAX?`
queries the maximum of the dynamic range.
Response:
`20000`
the maximum for the marker delay setting is 20000 samples.

Usage: Query only

Manual operation: See "Current Range without Recalculation" on page 41

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

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

Return values:
<Minimum> float

Example: `BB:DVB:TRIG:OUTP:DEL:FIX ON`
restricts the marker signal delay setting range to the dynamic range.
`BB:DVB: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 41

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

Defines the signal for the selected marker output.

Parameters:

<Mode> RESTart | SFRame | SFRAMe | FRAMe | PULSe | PATTern | RATio | TRIGger

RESTart
A marker signal is generated at the start of every sequence length loop. Restart mode is available only for ETI data source.

SFRame
A marker signal is generated at the start of every super-frame period.

FRAMe
A marker signal is generated at the start of every frame.

PULSe
A marker pulse is generated continuously according to the frequency and frequency divider.

PATTern
A marker signal is generated due to a bit pattern given by the user. Each bit represents a sample and can be switched on or off.

RATio
A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.

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

*RST: RESTart

Example: `BB:DVB:TRIG:OUTP:MODE FRAME`
selects the frame marker signal for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 40

[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:OFFTime <OffTime>
[:SOURce<hw>]:BB:DVB: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:DVB:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Parameters:

<Ontime> integer

Range: 1 to 2^24-1 (16 777 215) samples
Increment: 1 sample
*RST: 1

Example: `BB:DVB:TRIG:OUTP2:ONT 2000`
sets an ON time of 2000 samples for marker 2.

Manual operation: See "Marker Mode" on page 40

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

The command defines the bit pattern used to generate the marker signal.

Parameters:

<Pattern> 32 bit pattern

*RST: 0

Example: `BB:DVB:TRIG:OUTP2:PATT #H39FE0000,32`
sets the bit pattern.
`BB:DVB:TRIG:OUTP:MODE PATT`
activates the marker signal according to a bit pattern for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 40

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

The command sets the divider for the pulsed marker signal in the setting `SOURce:BB:DVB:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by dividing the symbol rate by the divider.

Parameters:

<Divider> integer

Range: 2 to 1024
Increment: 1
*RST: 0

Example: `BB:DVB:TRIG:OUTP:PULS:DIV 2`
sets the divider for the corresponding marker signal to the value 2.
`BB:DVB:TRIG:OUTP2: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 40

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

The command queries the pulse frequency of the pulsed marker signal in the setting `:BB:DVB:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by dividing the symbol rate by the divider. The divider is defined with command `:BB:DVB:TRIG:OUTP:PULS:DIV`.

Return values:

<Frequency> float

Example: `BB:DVB:TRIG:OUTP2:PULS:DIV 2`
sets the divider for the corresponding marker signal to the value 2.
`BB:DVB:TRIG:OUTP2:MODE PULS`
enables the pulsed marker signal.
`BB:DVB:TRIG:OUTP:FREQ?`
queries the resulting pulse frequency of the marker signal.
Response:
`66 000`
the resulting pulse frequency is 66 kHz.

Usage: Query only

Manual operation: See "Marker Mode" on page 40

4.1.6 Clock Settings

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

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

The command enters the type of externally supplied clock (`BB:DVB:CLOCk:SOURce EXTernal`). When `MSAM` is used, a multiple of the sample clock is supplied and the clock is derived internally from it. The multiplier is entered with the command `:BB:DVB:CLOCk:MULTiplier`.

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> SAMP | MSAMp
*RST: SAMP

Example: `BB:DVB:CLOC:MODE MSAM`
sets the type of externally supplied clock.

Manual operation: See "Clock Mode" on page 42

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

The command specifies the multiplier for clock type "Multiple Sample" (`:BB:DVB: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: `SOURce1:BB:DVB:CLOCk:SOURce EXTernal`
selects the external clock source.
`SOURce1:BB:DVB:CLOCk:MODE MSAMple`
selects clock type "Multiple Sample", i.e. the supplied clock has a rate which is a multiple of the sample rate.
`SOURce1:BB:DVB:CLOC:MULTiplier 12`
the multiplier for the external clock rate is 12.

Manual operation: See "Clock Multiplier" on page 42

[:SOURce<hw>]:BB:DVB: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. Selection `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. Commands `:BB:DVB:CLOCk:MODE` and `:MULTiplier` are used to enter the type of the external clock.

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

*RST: INTernal

Example: `BB:DVB:CLOC:SOUR EXT`
selects the external clock source. The clock is supplied via the CLOCK connector.
`BB:DVB:CLOC:MODE MSAM`
selects clock type "Multiple Sample", i.e. the supplied clock has a rate which is a multiple of the sample rate.
`BB:DVB:CLOC:MULT 12`
the multiplier for the external clock rate is 12.

Manual operation: See "Clock Source" on page 42

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

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

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

Usage: Event

Manual operation: See "Set Synchronization Settings" on page 42

[:SOURce<hw>]:BB:DVB: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.

Note:

If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.

Avoid unnecessary cable length and branching points.

Parameters:

<Mode> NONE | MASTer | SLAVe

NONE
The instrument is working in stand-alone mode.

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

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

*RST: NONE

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

Manual operation: See "Sync. Mode" on page 41

4.2 System Configuration

This subsystem contains commands regarding the system configuration of the DVB signal.

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:HMODe <HMode>

The command selects either to use one path or both path with different priorization.

Note:

In this release only the non-hierarchical mode is available.

Parameters:

<HMode> NHIerarchical | HIERarchical | NHIErarchical | HIErarchical

*RST: NHIErarchical

Example: `BB:DVB:DVBH:HMOD NHI`
selects the non-hierarchical mode to be used. Only path one is used, that is, no priorization is necessary.

Manual operation: See "Hierarchy Mode" on page 24

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:DATA <Data>

The command selects the data source to be used.

Parameters:

<Data> PAC0 | PAC1 | PN15 | PN23 | DLISt

ZERO
Internal 0 is used.

ONE
Internal 1 is used.

PN15/23
PRBS data as per CCITT with period lengths between 29-1 and 223-1 is generated internally.

DLISt
Internal data from a TS file is used.

*RST: PN23

Example: `BB:DVB:DVBH:HP:DATA PN23`
selects PN23 as data source.

Manual operation: See "HP/LP Source" on page 24

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:DATA:DSELection <Dselection>

The command selects the TS file for the data source selection.

The lists are stored as files with the fixed file extensions `*.gts`, `*.ts`, or `*.trp` 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:
<Dselection> string

Example: `BB:DVB:DVBH:HP:DATA DLIS`
selects the data list as the data source.
`MMEM:CDIR '<root>Lists'`
selects the directory for the data lists.
`BB:DVB:DVBH:HP:DATA:DSEL 'dvb_1'`
selects the file `dvb_1` as the data source.This file must be in the directory and have the file extension `*.gts`, `*.ts`, or `*.trp`.

Manual operation: See "HP/LP Source" on page 24

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:ICODer:RATE <Rate>

The command selects the code rate of the inner coder.

Parameters:
<Rate> CR1D2 | CR2D3 | CR3D4 | CR5D6 | CR7D8
*RST: CR1D2

Example: `BB:DVB:DVBH:HP:ICOD:RATE CR1D2`
sets the rate to CR1D2.

Manual operation: See "Rate" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:ICODer[:STATe] <State>

The command activates/deactivates the inner coder.

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

Example: `BB:DVB:DVBH:HP:ICOD ON`
activates the inner coder.

Manual operation: See "Inner Coder" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:OCODer[:STATe] <State>

The command activates/deactivates the outer coder (RS).

Parameters:

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

Example: `BB:DVB:DVBH:HP:OCOD:STAT ON`
activates the outer coder.

Manual operation: See "Outer Coder (RS)" on page 24

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:OINTerleaver[:STATe] <State>

The command activates/deactivates the outer interleaver.

Parameters:

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

Example: `BB:DVB:DVBH:HP:OINT ON`
activates the outer interleaver.

Manual operation: See "Outer Interleaver" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:PNSCrambler[:STATe] <State>

The command activates/deactivates the PN scrambler.

Parameters:

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

Example: `BB:DVB:DVBH:HP:PNSC ON`
activates the PN scrambling, that is, transforming the data packets of the incoming transport stream to a Pseudo Random Binary Sequence (PRBS).

Manual operation: See "PN Scrambler" on page 24

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:BIT[:STATe] <State>

The command activates/deactivates the inner bit interleaver.

Parameters:

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

Example: `BB:DVB:DVBH:IINT:BIT ON`
activates the inner bit interleaver.

Manual operation: See "Inner Bit Interleaver" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol:MODE <Mode>

The command selects the inner interleaver mode.

Parameters:

<Mode> NATive | NATIve | IDEPth

NATive
The interleaver interleaves the bits over one OFDMA symbol.

IDEPth
The interleaver interleaves the bits over two (4K transmission mode) or four (2K transmission mode) OFDMA symbols.

*RST: NATive

Example: `BB:DVB:DVBH:IINT:SYMB:MODE NAT`
sets the inner interleaver mode to "Native".

Manual operation: See "Inner Interleaver Mode" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol:TMODe <TMode>

The command selects the transmission mode.

Parameters:

<TMode> T2K | T4K | T8K

*RST: T2K

Example: `BB:DVB:DVBH:IINT:SYMB:TMOD T2K`
sets the transmission mode to T2K.

Manual operation: See "Inner Interleaver Tx Mode" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol[:STATe] <State>

The command activates/deactivates the inner symbol interleaver.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `BB:DVB:DVBH:IINT:SYMB ON`
activates the inner symbol interleaver.

Manual operation: See "Inner Symbol Interleaver" on page 25

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:ALPHa <Alpha>

The command selects the α value. This value is used to shape the constellation of the modulation. For DVB-H, this value is always 1.

Parameters:

<Alpha> 1 | 2 | 4

*RST: 1

Example: `BB:DVB:DVBH:OFDM:ALPH 1`
sets the α value to 1.

Manual operation: See "OFDM/RF Alpha" on page 26

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:BWIDth <BWidth>

The command selects the system bandwith.

Parameters:
<BWidth> 5 | 6 | 7 | 8
*RST: 8 MHz

Example: `BB:DVB:DVBH:OFDM:BWID 8`
sets the OFDM bandwith to 8 MHz.

Manual operation: See "OFDM/RF Bandwidth" on page 26

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:GINTerval <GInterval>

The command selects the OFDM/RF guard interval.

Parameters:
<GInterval> GI1D4 | GI1D8 | GI1D16 | GI1D32
*RST: GI1D8

Example: `BB:DVB:DVBH:OFDM:GINT GI1D8`
sets the OFDM guard interval to 1/8 of the symbol period.

Manual operation: See "OFDM/RF Guard Int " on page 26

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:MODulation <Modulation>

The command selects the constellation for the OFDM modulation.

Parameters:
<Modulation> QPSK | QAM16 | QAM64
*RST: QPSK

Example: `BB:DVB:DVBH:OFDM:MOD QAM16`
selects 16-QAM as the constellation for the OFDM modulation.

Manual operation: See "OFDM/RF Modulation" on page 26

4.3 TPS Settings

This subsystem contains commands regarding the TPS settings of the DVB signal.

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:ID:PATTern <Pattern>

The command sets the pattern for cell identification.

Parameters:

<Pattern> integer

Range: 0000 to FFFF
*RST: 0000

Example: `BB:DVB:DVBH:TPS:ID:PATT 0000`
sets the cell identification to 0000.

Manual operation: See "ID [4 hex]" on page 27

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:ID:STATe <State>

The command activates/deactivates the TPS cell identification.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:DVB:DVBH:TPS:ID:STAT ON`
activates the TPS cell identification.

Manual operation: See "Cell Identification" on page 27

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:MFEC[:STATe] <State>

The command activates/deactivates the multiprotocol encapsulation forward error correction bit.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:DVB:DVBH:TPS:MFEC:STAT ON`
activates the multiprotocol encapsulation forward error correction bit.

Manual operation: See "MPE FEC" on page 27

[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:TSLicing[:STATe]?

Queries the time slicing state.

Return values:

<State> 0 | 1 | OFF | ON

always 1 for DVB-H
always 0 for DVB-T

Usage: Query only

Manual operation: See "Time Slicing" on page 27

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