R&S®SMW-K52
DVB-H/T
User Manual

1175.6778.02 ─ 07

Test & Measurement

User Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMW-K52
  1413.6090.xx

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

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

Contents

1 Preface

1.1 Documentation Overview

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

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

Online Help

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

Getting Started

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

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

User Manual

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

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

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

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

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

Service Manual

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

Release Notes

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

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

Web Help

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

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

Tutorials

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

Application Notes

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

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

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

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

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

1.2.2 Conventions for Procedure Descriptions

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

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

1.2.3 Notes on Screenshots

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

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

2 Welcome to the DVB-H/T Digital Standard

The R&S SMW-K52 is a firmware application that adds functionality to generate signals in accordance with the DVB-H (Digital Video Broadcasting - Transmission System for Handheld Terminals) standard.

DVB (digital video broadcasting) provides a communications infrastructure for powerful transmission of MPEG-2-based data. Besides satellite-based (DVB-S), terrestrial (DVB-T) and cable-bound (DVB-C) transmission schemes, the latest version (DVB-H) is for portable/handheld terminals. DVB-H is an extension to DVB and is compatible with the basic concept of the standard. The extensions bring advantages that are especially important for portable devices: low power consumption, small hardware and robustness against fading effects.

In recent years, mobile phones and video applications have merged more and more. Some years ago, the mobile phone was only a means of making phone calls; today one can watch TV on handheld devices. These new applications are becoming more and more important.

The main advantages of the DVB-H / DVB-T digital standard option R&S SMW-K52 are:

- possibility to test both mobile communications standards (such as W-CDMA 3GPP FDD, TD-SCDMA, GSM/EDGE) and DVB-H or -DVB-T using only one signal generator
- simple creation of standard-compliant DVB-H or DVB-T signals

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMW user manual. The latest version is available for download at the product homepage.

Installation

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

2.1 Accessing the DVB-H/T Dialog

To open the dialog with DVB-H/T settings

► In the block diagram of the R&S SMW, select "Baseband > DVB".

A dialog box opens that displays the provided general settings.

The signal generation is not started immediately. To start signal generation with the default settings, select "State > On".

2.2 Scope

Tasks (in manual or remote operation) that are also performed in the base unit in the same way are not described here.

In particular, this includes:

- Managing settings and data lists, i.e. storing and loading settings, creating and accessing data lists, accessing files in a particular directory, etc.
- Information on regular trigger, marker and clock signals as well as filter settings, if appropriate.
- General instrument configuration, such as checking the system configuration, configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S SMW user manual.

3 About this Digital Standard

The follwoing sections provide some background information on basic terms and principles used in the DBV-H/T.

3.1 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.

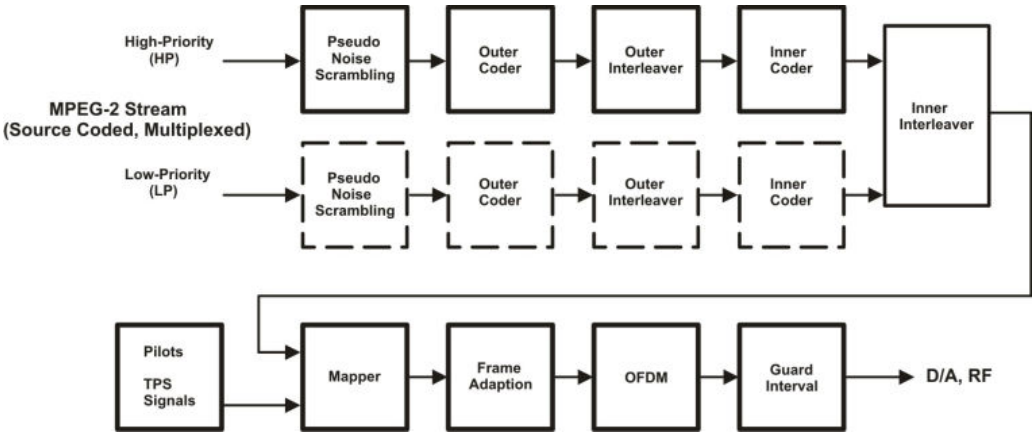
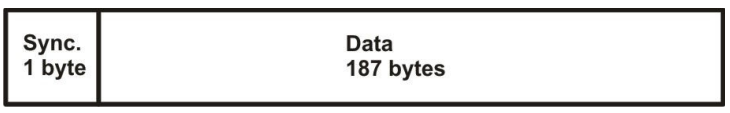


Fig. 3-1: Components of the Transmission System DVB-H

3.1.1 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.

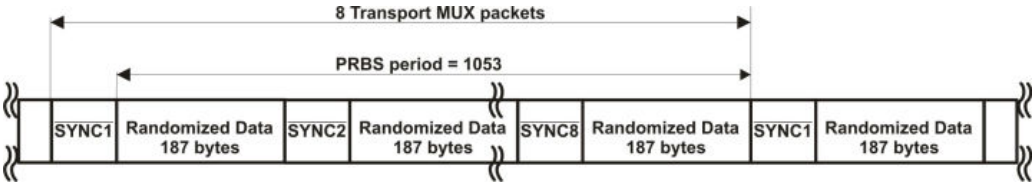


The data packets of the input stream are transformed to a Pseudo Random Binary Sequence (PRBS) in order to obtain a bit sequence that has a positive effect on the transmitted RF spectrum.

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

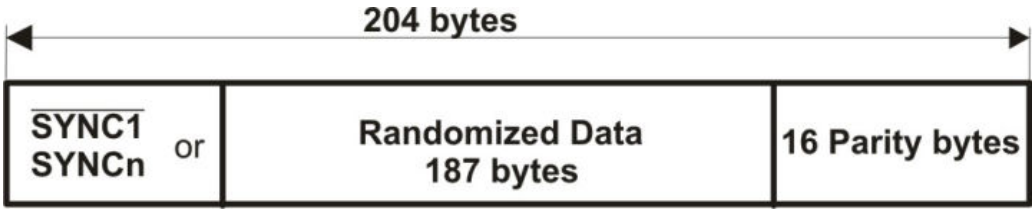
The PRBS generator is loaded with the sequence "100101010000000" at the start of every eight transport packet. To provide an initialization signal for the descrambler, the sync byte of the first transport packet in a group of eight packets is bit-wise inverted

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).



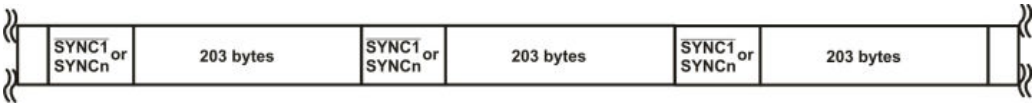
3.1.2 Outer Coder

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.



3.1.3 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.



3.1.4 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 3-1: 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	$X_1Y_1Y_2Y_3Y_4X_5Y_6X_7$

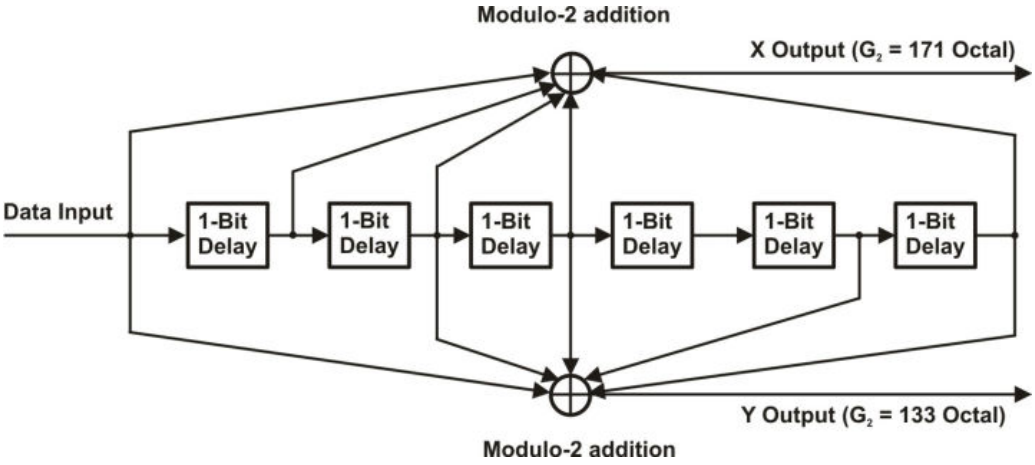


Fig. 3-2: Mother convolutional code rate of 1/2

3.1.5 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.

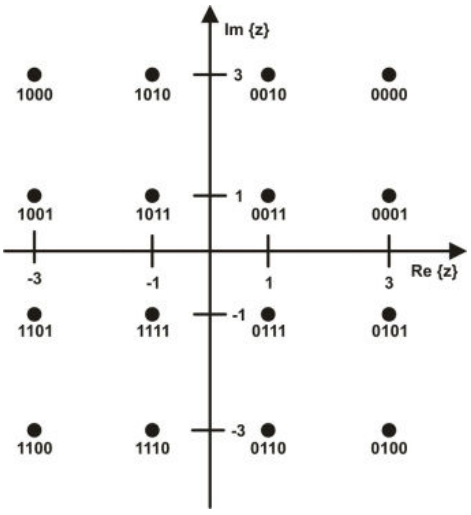
The outputs of the v bit interleavers are grouped to form the digital data symbols, such that each symbol of v bits will consist of exactly one bit from each of the v interleavers.

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 3.2.1, "4K Mode and In-Depth Interleavers", on page 15.

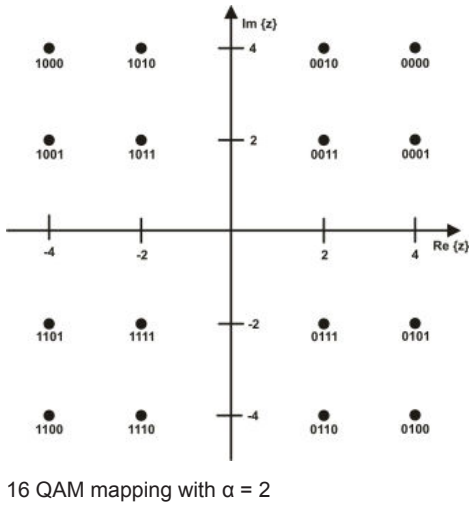
3.1.6 Mapper

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

3.1.7 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.

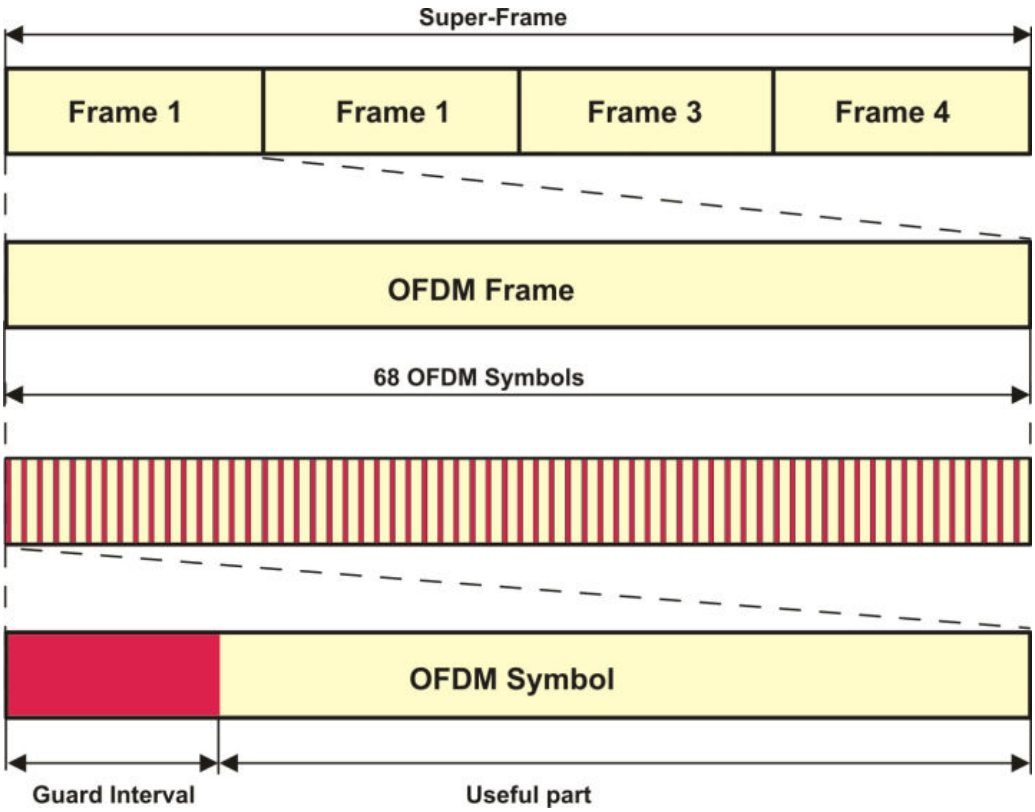


Fig. 3-3: OFDM frame structure

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

3.1.8 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 4.7, "TPS Settings", on page 35.

3.2 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)

3.2.1 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).

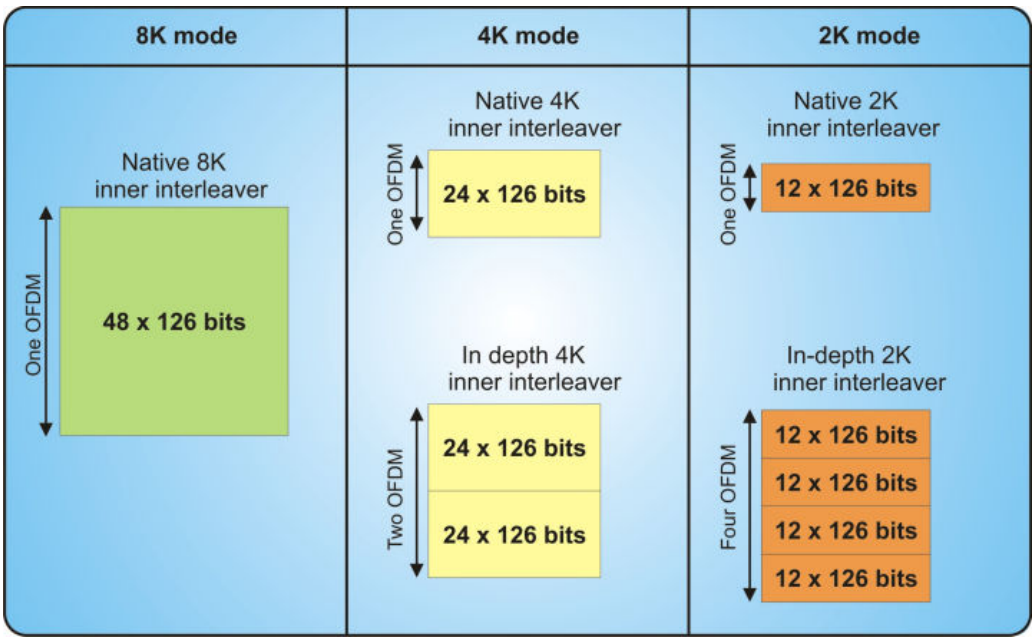


Fig. 3-4: In-Depth Interleaver for 2K and 4K Mode

3.2.2 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.

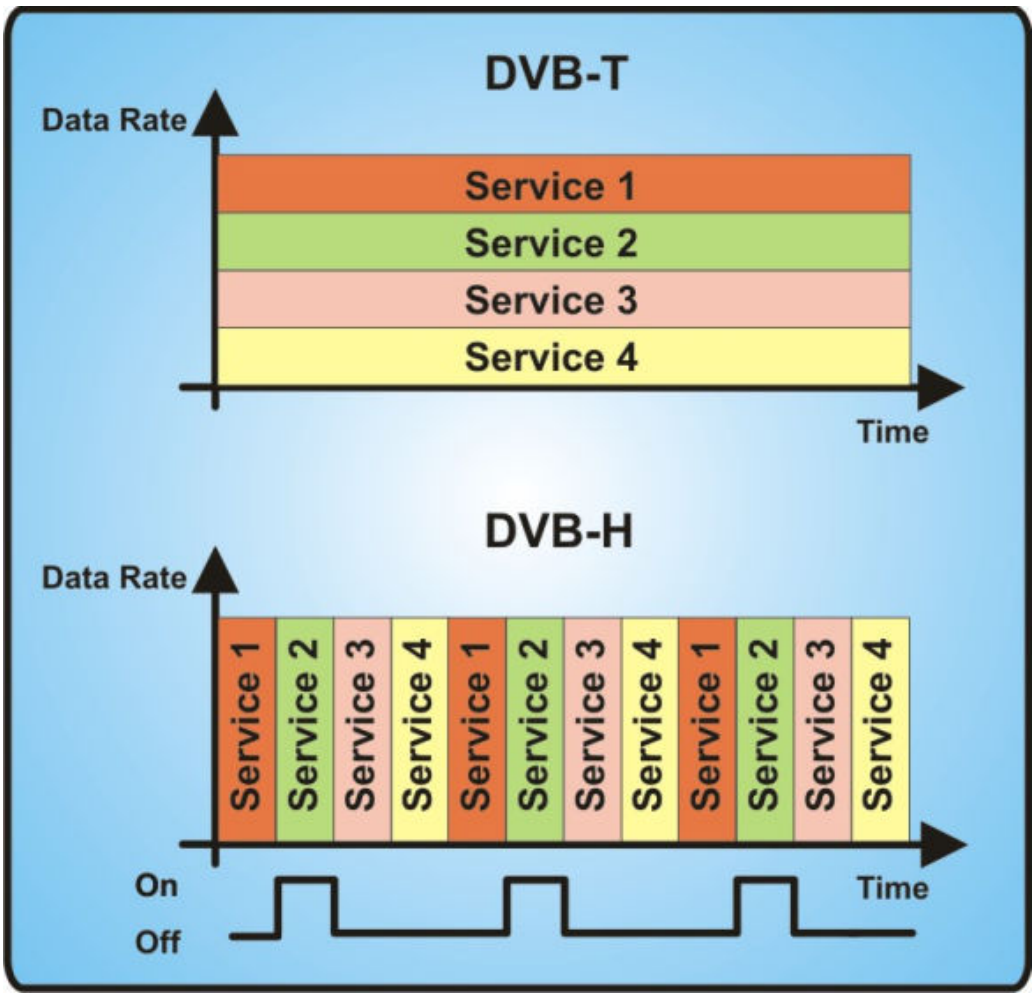


Fig. 3-5: DVB-H Time-Slicing

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

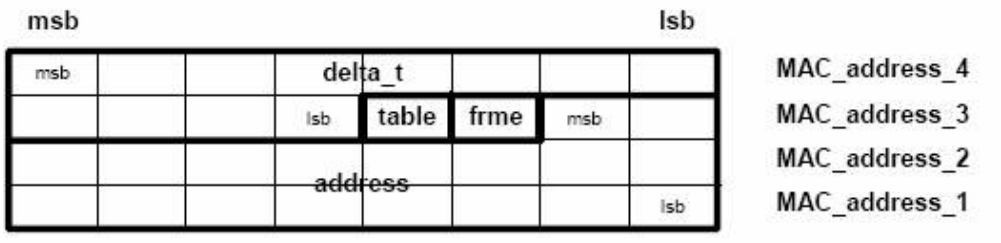


Fig. 3-6: Next Burst Indication

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.

3.2.3 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.

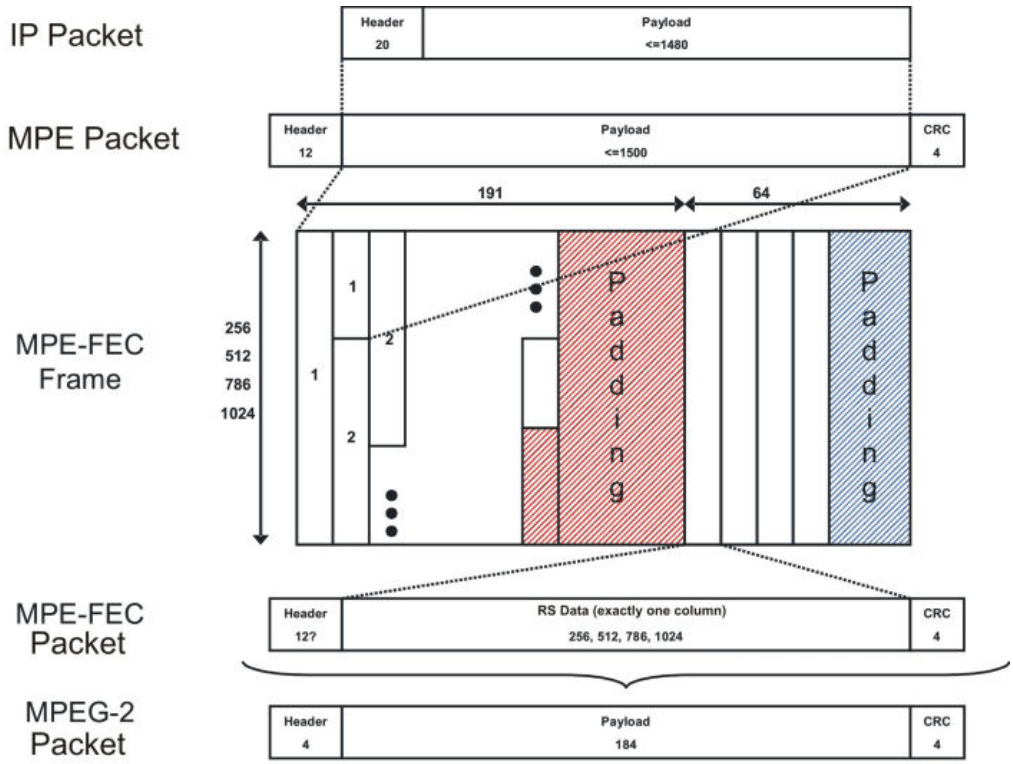


Fig. 3-7: MPE-FEC Packet/Frame Structure

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.

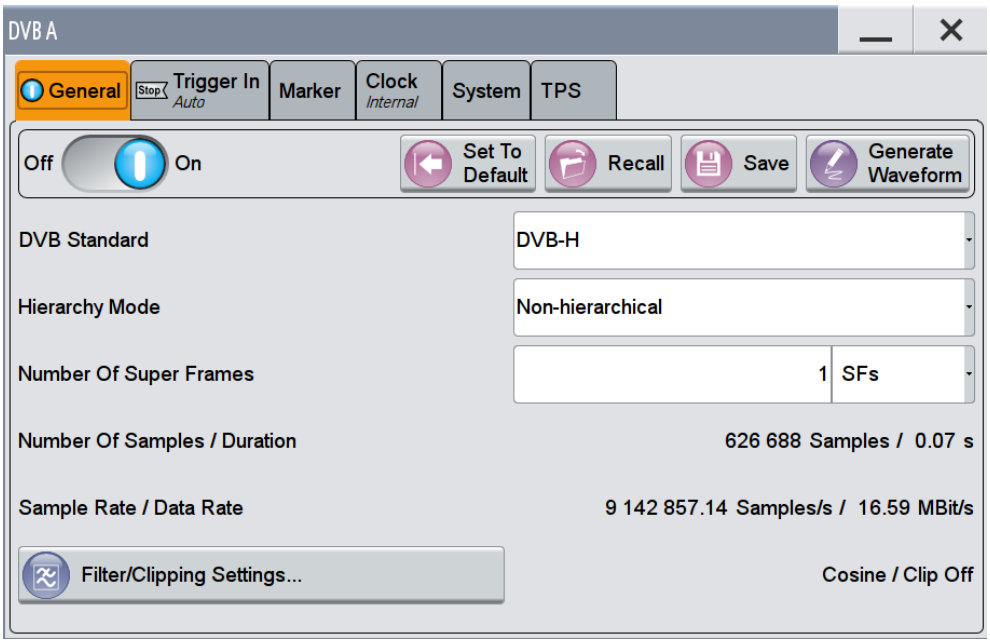
4 DVB Configuration and Settings

► To access the DVB settings, select "Baseband > DVB".

The remote commands required to define these settings are described in chapter 5, "Remote-control commands", on page 44.

4.1 General Settings

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



This dialog comprises the standard general settings.

Provided are the following settings:

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

Remote command:
`[:SOURce<hw>]:BB:DVB:STATe` on page 47

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 Source	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	½
Inner Bit Interleaver	ON
Inner Symbol Interleaver	ON
Inner Interleaver Mode	Native
TX Mode	2 K
OFDM/RF Bandwidth	8 MHz
Modulation	QPSK
Alpha	1
Guard Interval	1/8

Remote command:
`[:SOURce<hw>]:BB:DVB:PRESet` on page 45

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

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

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

Remote command:
[:SOURce<hw>]:BB:DVB:SETTing:CATalog? on page 45
[:SOURce<hw>]:BB:DVB:SETTing:LOAD on page 46
[:SOURce<hw>]:BB:DVB:SETTing:STORe on page 46
[:SOURce<hw>]:BB:DVB:SETTing:DELete on page 46

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

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

Remote command:
[:SOURce<hw>]:BB:DVB:WAVeform:CREate on page 47

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

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

Hierarchy Mode
Selects the hierarchy mode.

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

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

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:HMODe on page 66

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 48

Number of Samples / Duration
Displays the number of the transmitted samples and the signal duration.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SAMPle:LENGth? on page 48
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:DURation? on page 48

Sample Rate / Data Rate
Displays the sample and data rates.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:SAMPle:RATE? on page 48
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:DRATe? on page 47

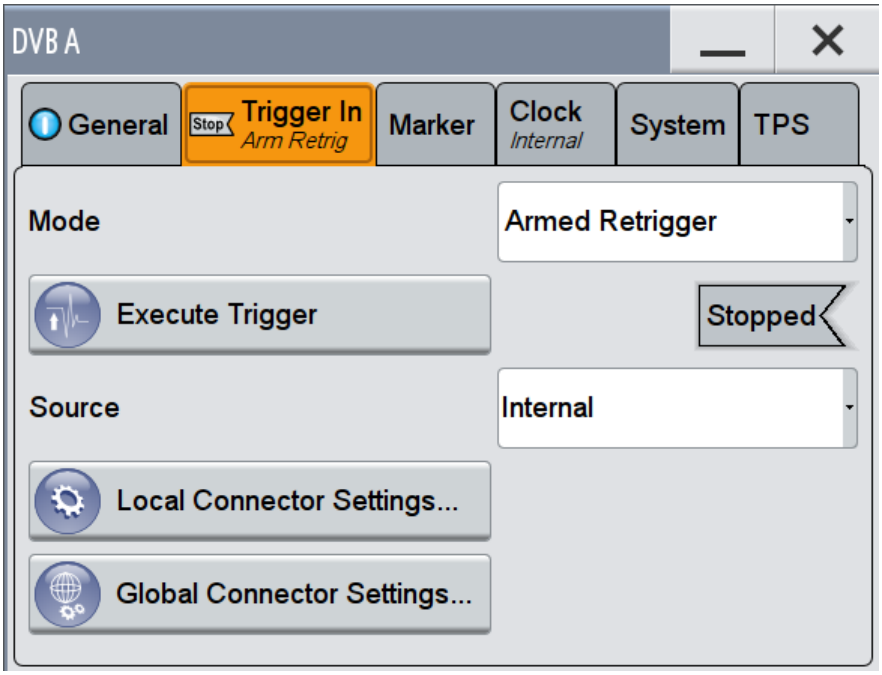
Filter / Clipping Settings
Access to the dialog for setting baseband filtering and clipping, see chapter 4.8, "Filter / Clipping Settings", on page 39.

4.2 Trigger Settings

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

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

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



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

Routing and Enabling a Trigger

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

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

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

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

Trigger Settings Common to All Basebands

To enable simultaneous signal generation in all basebands, the R&S SMW couples the trigger settings in the available basebands in any instrument's configuration involving signal routing with signal addition (e.g. MIMO configuration, routing and summing of basebands and/or streams).

The icon indicates that common trigger settings are applied.

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

Trigger Mode ← Trigger Settings Common to All Basebands

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

For more information, refer to chapter "Basics" in the R&S SMW user manual.

- "Auto"
  The signal is generated continuously.
- "Retrigger"
  The signal is generated continuously. A trigger event (internal or external) causes a restart.
- "Armed_Auto"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously.
  An "Arm" stops the signal generation. A subsequent trigger event (internal with or external) causes a restart.
- "Armed_Retrigger"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
  An "Arm" stops signal generation. A subsequent trigger event (internal with or external) causes a restart.
- "Single"
  The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".
  Every subsequent trigger event (internal or external) causes a restart.

Remote command:

`[:SOURce<hw>]:BB:DVB[:TRIGger]:SEQuence` on page 58

Signal Duration Unit ← Trigger Settings Common to All Basebands
Defines the unit for describing the length of the signal sequence to be output in the "Single" trigger mode.

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

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

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

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

Running/Stopped ← Trigger Settings Common to All Basebands
For enabled modulation, displays the status of signal generation for all trigger modes.

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

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

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:ARM:EXECute` on page 54

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:EXECute` on page 54

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

- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "Internal (Baseband A/B)"
  The trigger event is provided by the trigger signal from the other basebands.
  If common trigger settings are applied, this trigger source is disabled.
- "External Global Trigger 1 / 2"
  The trigger event is the active edge of an external trigger signal provided and configured at the global USER connectors.
- "External Global Clock 1 / 2"
  The trigger event is the active edge of an external global clock signal provided and configured at the global USER connectors.
- "External Local Trigger"

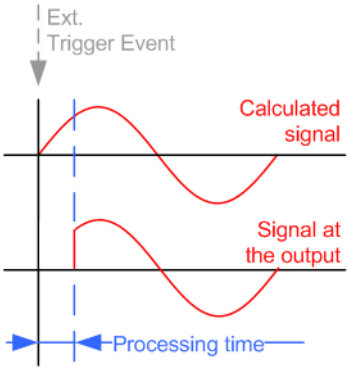
The trigger event is the active edge of an external trigger signal provided and configured at the local T/M/(C) connector.
With coupled trigger settings, the signal has to be provided at the T/M/C 1/2/3 connectors.

- "External Local Clock"
  The trigger event is the active edge of an external local clock signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C 1 connector.

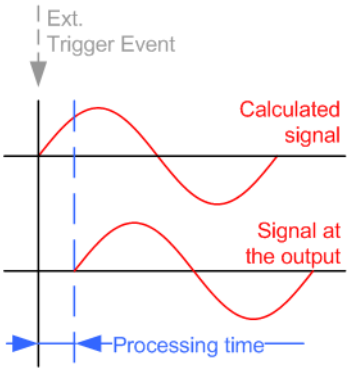
Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:SOURce` on page 57

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

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



"Off" The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is output.
This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.



Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:EXTernal:SYNChronize:OUTPut`
on page 54

External Trigger Inhibit ← Trigger Settings Common to All Basebands
For external trigger signal or trigger signal from the other path, sets the duration a new trigger event subsequent to triggering is suppressed. In "Retrigger" mode for example, a new trigger event will not cause a restart of the signal generation until the specified inhibit duration does not expire.

For more information, see chapter "Basics" in the R&S SMW User Manual.

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger[:EXTernal]:INHibit` on page 58
`[:SOURce<hw>]:BB:DVB:TRIGger:OBASeband:INHibit` on page 55

Trigger Delay
Delays the trigger event of the signal from:
- the external trigger source
- the other path
- the other basebands (internal trigger), if common trigger settings are used.

Use this setting to:
- synchronize the instrument with the device under test (DUT) or other external devices
- postpone the signal generation start in the basebands compared to each other

For more information, see chapter "Basics on ..." in the R&S SMW User Manual.

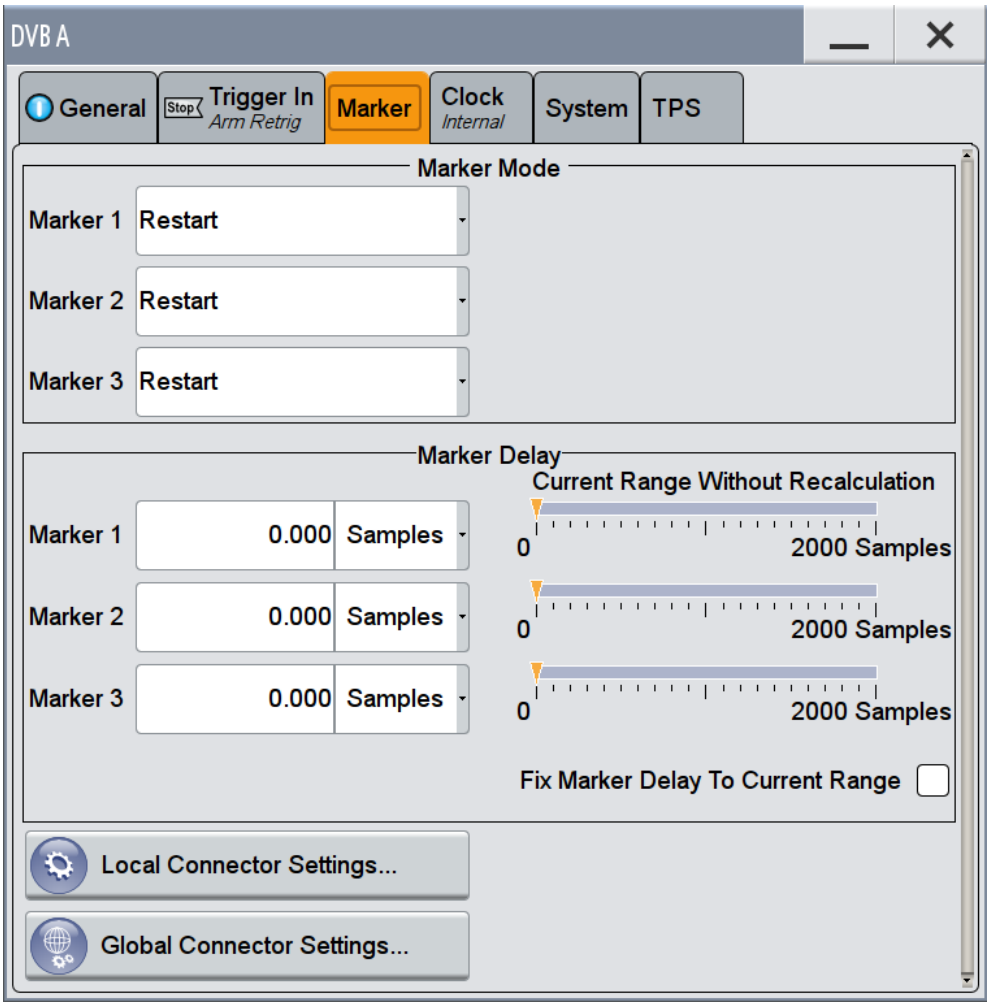
Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger[:EXTernal]:DELay` on page 58
`[:SOURce<hw>]:BB:DVB:TRIGger:OBASeband:DELay` on page 55

4.3 Marker Settings

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

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

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



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

Routing and Enabling a Marker

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

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

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

Marker Mode

Marker configuration for up to 3 marker channels. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode; the settings are self-explanatory.

"Restart" A marker signal is generated at the start of 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 63
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 63

"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 62

"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 62
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:OFFTime` on page 62

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:MODE` on page 61

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

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:DELay` on page 60

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

Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:DELay:MINimum?` on page 61
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut<ch>:DELay:MAXimum?` on page 60

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

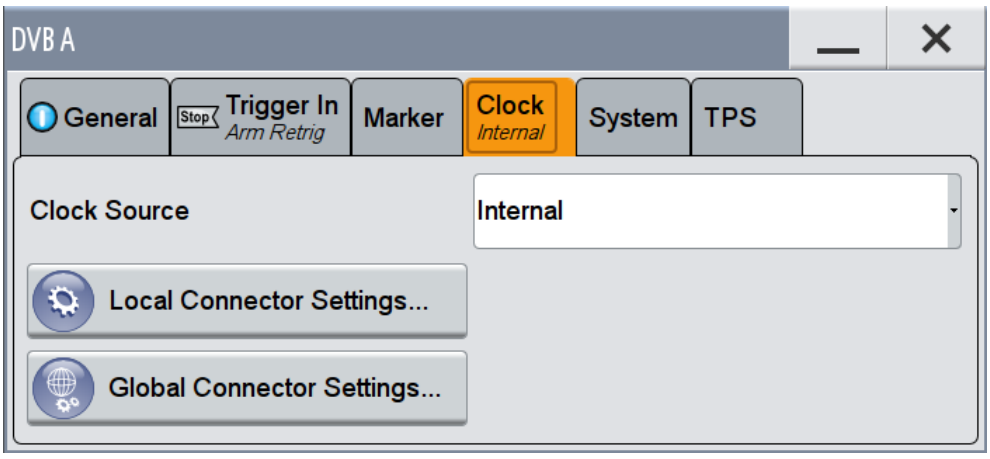
Remote command:
`[:SOURce<hw>]:BB:DVB:TRIGger:OUTPut:DELay:FIXed` on page 60

4.4 Clock Settings

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

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

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



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

Defining the Clock

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

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

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

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

Clock Source

Selects the clock source.

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

Remote command:

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

Clock Mode

Enters the type of externally supplied clock.

Remote command:

`[:SOURce<hw>]:BB:DVB:CLOCk:MODE` on page 64

Clock Multiplier

Enters the multiplication factor for clock type "Multiple".

Remote command:

`[:SOURce<hw>]:BB:DVB:CLOCk:MULTiplier` on page 64

Measured External Clock

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

Remote command:

`CLOCk:INPut:FREQuency?`

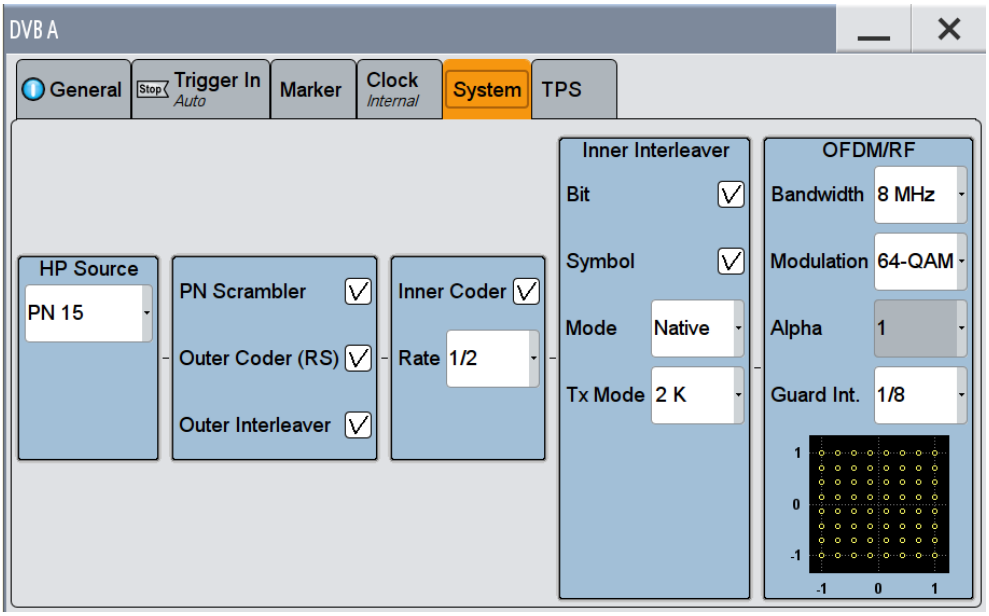
4.5 Local and Global Connector Settings

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

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

4.6 System Configuration

► To access this dialog select "Baseband > DVB > System".



This dialog comprises the settings to configure the DVB system. The DVB system is displayed in form of a block diagram including all parameters necessary to configure the system.

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 66
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:DATA:DSELection` on page 67

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 3.1.1, "Pseudo Noise Scrambler", on page 10.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:PNSCrambler[:STATe]`
on page 68

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 3.1.2, "Outer Coder", on page 11.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:OCODer[:STATe] on page 68

Outer Interleaver
Activates/deactivates the outer convolutional interleaver. For details, refer to chapter 3.1.3, "Outer Interleaver", on page 11.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:OINTerleaver[:STATe]
on page 68

Inner Coder
Activates/deactivates the inner coder. The inner coder is a punctured convolutional error-correcting coder. For details, refer to chapter 3.1.4, "Inner Coder", on page 11.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT[:HP|LP]:ICODer[:STATe] on page 67

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 3.1.4, "Inner Coder", on page 11.

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 67

Inner Bit Interleaver
Activates/deactivates the inner bit interleaver. For details, refer to chapter 3.1.5, "Inner Interleaver", on page 12.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:BIT[:STATe]
on page 68

Inner Symbol Interleaver
Activates/deactivates the inner symbol interleaver. For details, refer to chapter 3.1.5, "Inner Interleaver", on page 12.

Remote command:
[:SOURce<hw>]:BB:DVB:DVBH|DVBT:IINTerleaver:SYMBol[:STATe]
on page 69

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 3.1.5, "Inner Interleaver", on page 12.

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

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 3.1.5, "Inner Interleaver", on page 12.

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

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

OFDM/RF Bandwidth
Selects the system Bandwidth.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:BWIDth` on page 70

OFDM/RF Modulation
Selects the constellation for the OFDM modulation. For details, refer to chapter 3.1.6, "Mapper", on page 13.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:MODulation` on page 70

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 3.1.6, "Mapper", on page 13.

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.

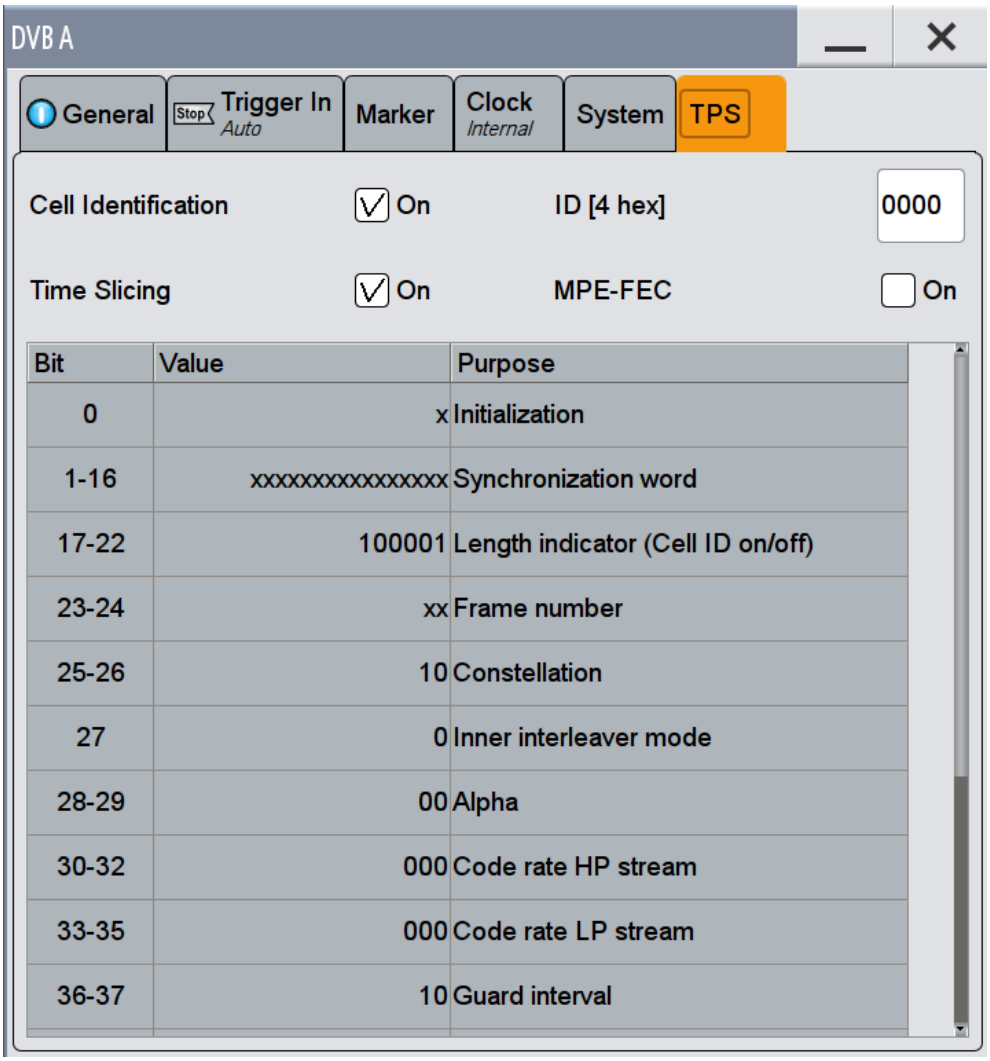
Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:OFDM:ALPHa` on page 69

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 70

4.7 TPS Settings

► To access this dialog select "Baseband > DVB > TPS".



This 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 71

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 71

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 3.2.2, "Time-Slicing", on page 16.

Remote command:
`[:SOURce<hw>]:BB:DVB:DVBH|DVBT:TPS:TSLicing[:STATe]?` on page 71

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 3.2.3, "Forward Error Correction for Multiprotocol Encapsulated Data (MPE-FEC)", on page 18.

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

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

Bit	Value	Purpose
0	x	Initialization
1-16	xxxxxxxxxxxxxxxx	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	00	Transmission mode
40-47	xxxxxxxx	Cell identifier
48	1	Time slicing
49	0	MPE-FEC
50-53	0000	Reserved
54-67	xxxxxxxxxxxxxx	BCH error protection

Table 4-1: 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
	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

Bit number	Format	Purpose
	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
	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

Bit number	Format	Purpose
	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

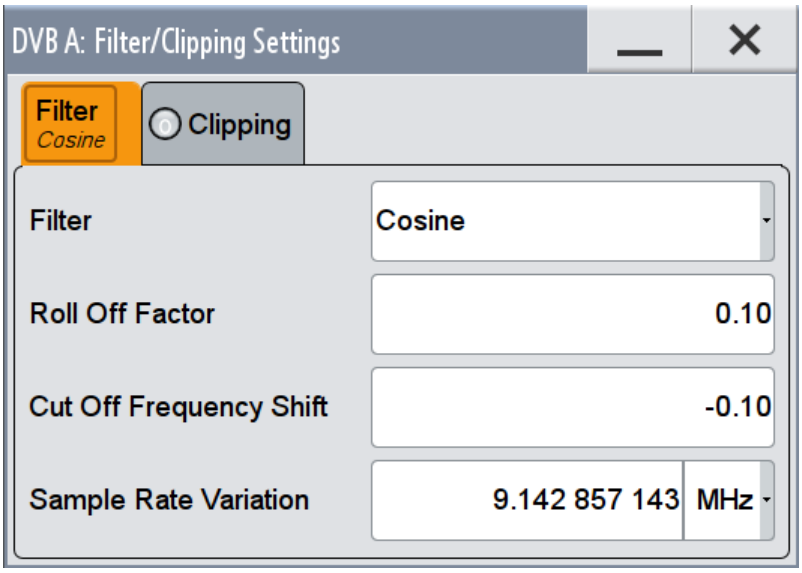
4.8 Filter / Clipping Settings

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

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

4.8.1 Filter Settings

► To access this dialog, select "Filter".



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

Filter
Selects the baseband filter.

Remote command:
[:SOURce<hw>]:BB:DVB:FILTer:TYPE on page 52

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 49
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:COSine on page 49
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:GAUSs on page 50
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:PGAuss on page 51
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:RCOSine on page 51
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:SPHase on page 51

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 50

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.

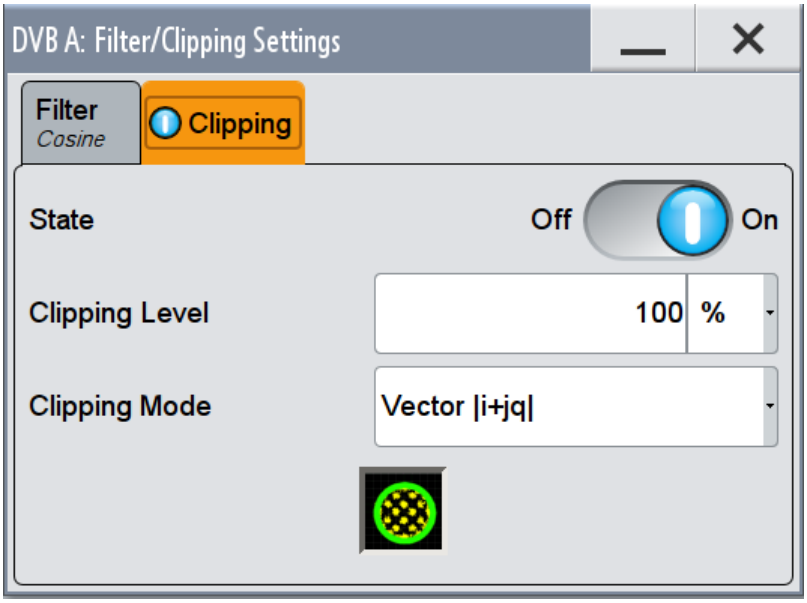
Remote command:
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:LPASs on page 50
[:SOURce<hw>]:BB:DVB:FILTer:PARameter:LPASSEVM on page 50

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 52

4.8.2 Clipping Settings

► To access this dialog, select "Clipping".



The dialog comprises the settings, necessary to configure the clipping.

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.

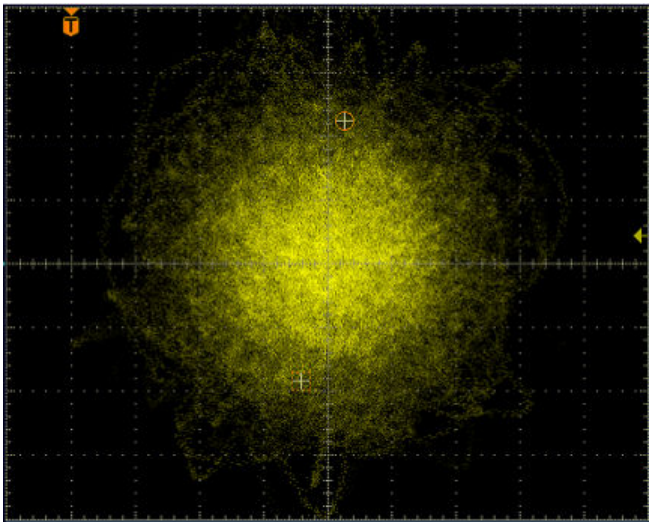


Fig. 4-1: Constellation diagram of the signal without clipping, shows the level mapping

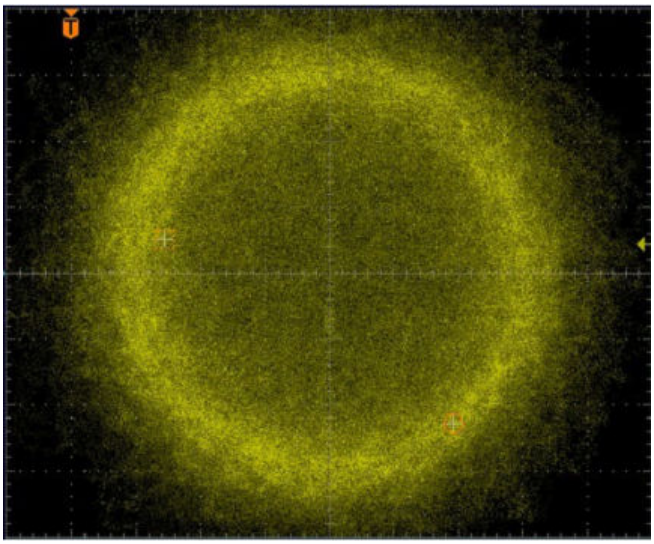


Fig. 4-2: Constellation diagram with clipping level 10 %, vector mode (|i+jq|)

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 53

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 52

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 53

5 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 SMW has already been set up for remote operation in a network as described in the R&S SMW documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

Conventions used in SCPI command descriptions

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

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
`ENTity<ch>`	1 .. 4	entity in a multiple entity configuration with separate baseband sources `ENTity3|4` require option R&S SMW-K76
`SOURce<hw>`	[1]|4	available baseband signals only `SOURce1` possible, if the keyword `ENTity` is used
`OUTPut<ch>`	1 .. 3	available markers

Using SCPI command aliases for advanced mode with multiple entities

You can address multiple entities configurations by using the SCPI commands starting with the keyword `SOURce` or the alias commands starting with the keyword `ENTity`.

Note that the meaning of the keyword `SOURce<hw>` changes in the second case.

For details, see section "SCPI Command Aliases for Advanced Mode with Multiple Entities" in the R&S SMW user manual.

The following commands specific to the DVB are described here:

5.1 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.

5.1.1 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 '/var/user/temp/DVB'`
sets the default directory to `/var/user/temp/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 '/var/user/temp/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: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 22

[: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 '/var/user/temp/waveform'`
sets the default directory to `/var/user/temp/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 22

[: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 "Sample Rate / 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 "Number of Samples / 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 / Duration" 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 / Data 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

5.1.2 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 40

[: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 40

[: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 40

[: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 40

[: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 40

[: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 40

[: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 40

[: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 40

[: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 40

[: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 40

[: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 40

5.1.3 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 42

[: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 43

[: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 42

5.1.4 Trigger Settings

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

[: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 25

[: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 25

[: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.

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 26

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

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

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 0.01
*RST: 0

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

Manual operation: See "Trigger Delay" on page 27

[: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 "External Trigger Inhibit" on page 27

[: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 25

[: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 25

[: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 "Trigger Signal Duration" on page 25

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

Selects the trigger signal source and determines the way the triggering is executed. Provided are internal triggering by means of a command, external trigger singnal via one of the provided local or global connectors and and triggering by a signal from the other paths.

Parameters:

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

INTernal
Internal

INTA | INTB
Internal trigger from the other baseband

EGT1 | EGT2
External global trigger

EGC1 | EGC2
External global clock

ELTRigger
External local trigger

ELCLock
External local clock

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

*RST: INTernal

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

Manual operation: See "Trigger Source" on page 25

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

Sets the trigger delay.

Parameters:
<Delay> float

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

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

Manual operation: See "Trigger Delay" on page 27

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

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

Parameters:
<Inhibit> integer

Range: 0 to 21.47*sampRate
*RST: 0

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

Manual operation: See "External Trigger Inhibit" on page 27

[: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 24

5.1.5 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 "Marker x Delay" on page 30

[: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 30

[: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 "Marker x Delay" on page 30

[: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 "Marker x Delay" on page 30

[: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

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.

*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 29

[: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 29

[: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 29

[: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 29

[: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 29

5.1.6 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`.

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 31

[: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.

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

Example: `SOURce1:BB:DVB:CLOCk:SOURce EGC1`
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 31

[: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; selecting AINTernal is only possible for path B.

Parameters:

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

INTernal
The instrument uses its internal clock reference

EGC1|EGC2
External global clock

ELCLock
External local clock

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

*RST: INTernal

Example: `BB:DVB:CLOC:SOUR INT`
selects the internal clock source.
`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 31

5.2 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 22

[: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 32

[: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 '/var/user/temp/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 32

[: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 33

[: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 33

[: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 33

[: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 33

[: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 32

[: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 33

[: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 34

[: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 34

[: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 33

[: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 34

[: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 34

[: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 34

[: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 34

5.3 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 36

[: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 35

[: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 36

[: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 36

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