DAB / T-DMB
Digital Standard for
R&S®Signal Generators
Operating Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMBV-K53/-K353/-K354
  1415.8154.xx, 1415.8702.02, 1415.8783.02

- R&S®SMU-K53/-K353/-K354
  1400.6209.02, 1408.8652.02, 1408.8717.02

- R&S®AMU-K53
  1402.9957.02

- R&S®SMATE-K53
  1400.6409.02

- R&S®SMJ-K53/-K353/-K354
  1400.6309.02, 1409.3525.02, 1409.3583.02

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

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 Digital Audio Broadcasting (DAB)/Terrestrial Digital Multimedia Broadcasting (T-DMB) 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.

The generated signals are compliant with ETSI EN 300 401 standard. Via the user-friendly graphical interface of R&S Signal Generator, you can adjust several DAB signal parameters. You are enabled to generate a signal corresponding to one of the four standard transport modes, Transmission Mode I, II, III or IV. You can also choose to enable or disable channel coding, time interleaving and/or pseudo noise scrambling.

The R&S Signal Generator allows you to choose between different data sources. You can either use some of the predefined data sources (two different pseudo noise sequences, fixed all "0", fixed all "1") or you can use your own ETI (Ensemble Transport Interface) compliant source file. To create an ETI compliant source file, you can for instance use the R&S STI Ensemble Mux DM001 or the R&S ETI Builder. However, the ETI source file must fulfill some prerequisites.

The DAB system is designed for delivery of high-quality digital audio programs and data services for mobile, portable and fixed reception from terrestrial or satellite transmitters in the Very High Frequency (VHF)/Ultra High Frequency (UHF) frequency bands as well as for distribution through cable networks.

The DAB system is designed to provide spectrum and power efficient techniques in terrestrial transmitter network planning, known as the Single Frequency Network (SFN) and the gap-filling technique. The DAB system is suitable for satellite as well as hybrid/mixed terrestrial/satellite broadcasting, using a simple, nearly omni-directional receiving antenna. The DAB system meets the required sharing criteria with other radio communication services.

2.1 DAB Network

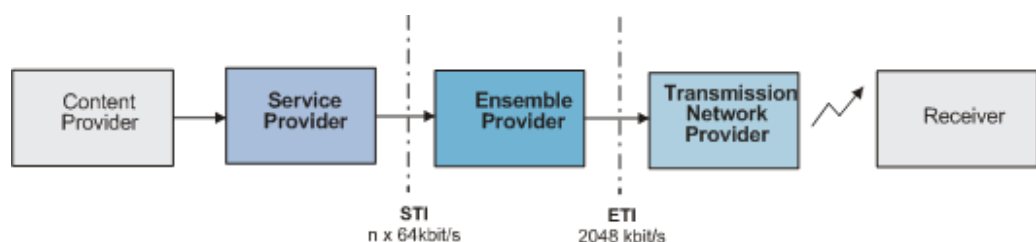The figure bellow illustrates the outline of a DAB network.

Fig. 2-1: DAB network

The DAB network has three main parts: the service or service component provider, the multiplex or ensemble provision and the transmission network provision.

The interfaces between these there blocks are scope of ETSI standards. The STI (Service Transport Interface) is defined to provide a standardized way of transporting DAB service components, service information and control messages in a DAB collection network.

The Ensemble Transport Interface (ETI) links the Multiplexer of the Ensemble Provider with the transmitters of the Transmission Network Provider.

2.2   DAB Transmission System

The following block diagramm shows the components of the DAB transmission system.
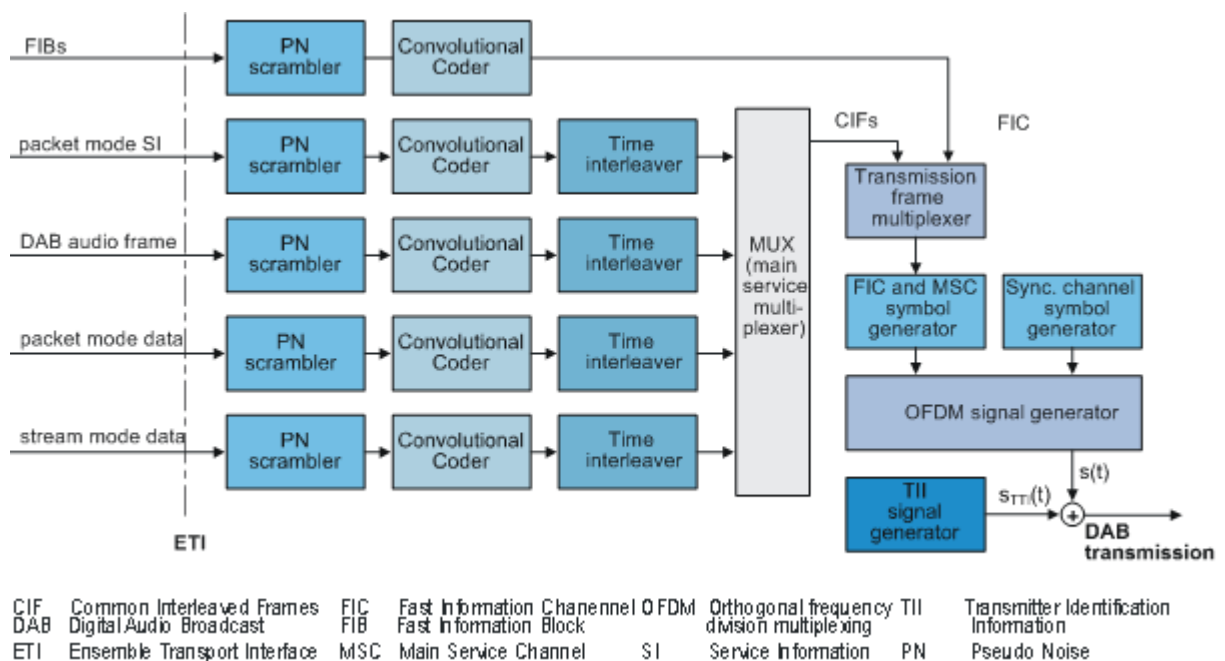
Fig. 2-2: Components of the Transmission System DAB

The DAB transmission signal is defined as the sum of two signals; the main signal s (t) and an optional signal sTII (t) as illustrated in the figure above.

2.3   Transport Mechanisms

The DAB system is designed to carry several digital audio signals together with data signals. Audio and data signals are considered to be service components which can be grouped together to form services.

The DAB system transmission frame consists of three different channels:

- Main Service Channel (MSC)

- Fast Information Channel (FIC)
- Synchronization Channel

2.3.1 Transmission channels

The MSC is a time-interleaved data channel used to carry the audio and data service components, together with possible supporting and additional data service components. The MSC is divided into a number of sub-channels. Each of the sub-channels is individually convolutionally coded with equal or unequal error protection. Each sub-channel may carry one or more service components.

The FIC is a non time-interleaved data channel with fixed equal error correction. FIC carries information about the organization of the MSC sub-channels, such as information on the multiplex structure and, when necessary, its reconfiguration. Optionally FIC may include service information, conditional access management information and data service.

The Synchronization Channel provides a phase reference and is used internally for demodulator functions such as transmission frame synchronization, automatic frequency control, transmitter identification, and channel state estimation.

The Synchronization channel, the Fast Information Channel and the Main Service Channel form a transmission frame (see figure 2-3). The MSC occupies the major part of the transmission frame.
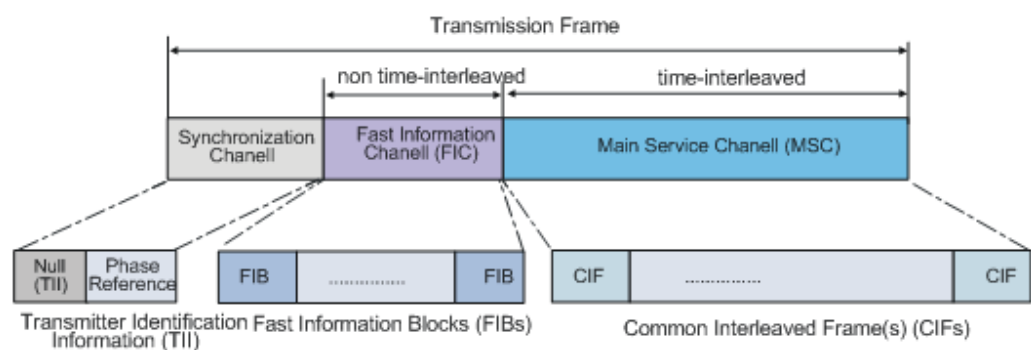
Fig. 2-3: DAB transmission frame

Each transmission frame is divided into a sequence of OFDM symbols, each symbol consisting of a number of carriers.

The Fast Information Block (FIB) and the Common Interleaved Frame (CIF) are introduced in order to provide transmission mode independent data transport packages associated with the FIC and MSC respectively.

The data, carried in the MSC, is divided at source into regular 24 ms bursts corresponding to the sub-channel data capacity of each CIF. The CIF contains 55 296 bits, divided at 864 capacity units, 64 bits each.

Fast Information Block (FIB) is a data burst of 256 bits. The sequence of FIBs is carried by the Fast Information Channel FIC. The structure of the FIB is common to all transmission modes.

The synchronization channel symbols comprise the null symbol and the phase reference symbol. The null symbols are also used to allow a limited number of OFDM carriers to convey the Transmitter Identification Information (TII).

2.3.2 Transport Modes

Transmission mode is specific set of transmission parameters (e.g. number of carriers, OFDM symbol duration). Four transmission modes (i.e. I, II, III and IV) are defined to allow the system to be used for different network configurations and a range of operating frequencies. Depending on the transport mode, the transmission frame has different organization and length, i.e. the transmission frame is specific to the four transmission modes.

The table below gives the transmission frame duration and the number of FIBs and CIFs which are associated with each transmission frame for the four transport modes.

Table 2-1: Transmission Mode Characteristics

Transport Mode	Duration of transmission frame	Number of FIBs per transmission frame	Number of CIFs per transmission frame	Number of carriers	Carrier Spacing
I	96 ms	12	4	1536	1 KHz
II	24 ms	3	1	384	4 KHz
III	24 ms	4	1	192	8 KHz
IV	48 ms	6	2	768	2 KHz

2.4 Pseudo Noise (PN) Scrambling

Prior to convolution encoding, the transmitted signal can be scrambled by a modulo-2 addition with a pseudo-random binary sequence (PRBS).

The PRBS polynomial is of degree 9 and specified as $P(X) = x^9 + x^5 + 1$.

The initialization word is applied in such a way that the first bit of the PRBS is obtained when the outputs of all shift register stages are set to value "1".

2.5 Convolutional Coding

The process of convolution coding is applied at the output of each PN scrambler. The channel encoding process is based on punctured convolutional coding, which allows both equal and unequal error protection. Unequal error protection (UEP) is designed for audio services, equal error protection (EEP) for audio and data services. The sampling frequency is respectively 48 kHz and 24 kHz.

The convolutional coder is a punctured convolution code, based on a mother convolutional code with constraint length 7 and rate 1/4.

The generator polynomials are G_1=(1,0,1,1,0,1,1), G_2=(1,1,1,1,0,0,1), G_3=(1,1,0,0,1,0,1) and G_4=(1,0,1,1,0,1,1).

To avoid the need for additional signaling overhead, the data in the FIC are encoded with fixed, equal channel coding, with a constant 1/3 coding rate.

The puncturing procedures applied for the coding in the MSC is a combination of protection profile and protection level. There are number of permissible protection profiles defined for each of the allowed bit rates. Each protection profile is associated with a protection level. Protection level 1 is the highest level within the same profile.

Error protection	Protection Profile	Bit rate	Protection Level	Code Rate
UEP	four different protection profiles	14 different bit rates	1, 2, 3, 4, 5	0,34..0,75 (64 different data rates - protection level combinations)
EEP	A	Multiples of 8 kbit/s	1-A	1/4
			2-A	3/8
			3-A	1/2
			4-A	3/4
	B	Multiples of 32 kbit/s	1-B	4/9
			2-B	4/7
			3-B	2/3
			4-B	4/5

2.6 Time Interleaving

Time interleaving is applied prior to block generation at the output of each convolutional encode contributing to the sub-channels in the MSC. It is not applied to the FIC.

The time interleaving process covers 16 CIFs, 24 ms each. This results in an overall processing delay of 384 ms.

3 DAB/T-DMB User Interface

► To access the DAB dialog, select "Baseband > DAB/T-DMB".

3.1 General Settings for DAB/T-DMB Signals

The dialog is split into three main sections for configuring the standard. The upper section is where the DAB digital standard is enabled and reset. In the Data Source section, the data source file and the ETI file can be selected and source file relevant parameters can be set. Further buttons open dialogs to configure the system and to set filter, trigger and clock parameters.
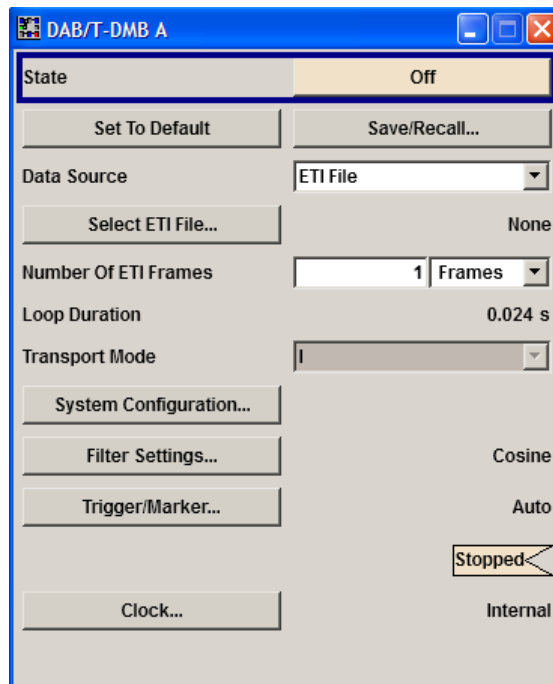
State

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

Remote command:

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

Set To Default

Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
State	Not affected by "Set to default"
Data Source	PN15
Transport Mode	I
Pseudo Noise Scrambler	On
Coder	On
Interleaver	On
Filter	Cosine
Sample Rate Variation	2.048 MHz
Trigger Mode	Auto
Marker Mode	Frame Start
Clock	Internal

Remote command:

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

Save/Recall...

Calls the Save/Recall menu.

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

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

The complete settings in the "DAB" menu are saved and recalled.

"Recall DAB Setting"
>Opens the "File Select" window for loading a saved DAB configuration.
>The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.

"Save DAB Setting"
>Opens the "File Select" window for saving the current DAB 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.

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

Remote command:

[:SOURce<hw>]:BB:DAB:SETTing:CATalog? on page 33

[:SOURce<hw>]:BB:DAB:SETTing:LOAD on page 33

[:SOURce<hw>]:BB:DAB:SETTing:STORe on page 34

[:SOURce<hw>]:BB:DAB:SETTing:DELete on page 33

Data Source

Selects the data source to be used to generate the modulation signal.

"All 0, All 1"   0 or 1 data is generated internally.

"PN15, PN23"   PRBS data in accordance with the IUT-T with period lengths between 2^9-1 and 2^{23}-1 are internally generated.

"ETI File"   Uses data from an ETI file. The ETI file can be selected via the Select ETI File button.

Remote command:

`[:SOURce<hw>]:BB:DAB:DATA` on page 30

Select ETI File

(Available if "Data Source" is set to "ETI File" only)

One of the following file types can be selected:

"DAB ETI (*.eti)"

ETI (Ensemble Transport Interface) files with extension `*.eti`

Note:

The ETI File must fulfill the following prerequisites:

- ETI file compliant with ETI (NI, G.703)
- Frame duration 24 ms (48 KHz sampling rate)
- Constant multiplex configuration
- Same stream configuration of all the frames
- 15 streams maximum.

"DAB Scrabbled ETI (*.xeti)"

A scrambled ETI file is an encrypted ETI file with an extension `*.xeti`.

"DAB+ (K353) ETI (*.dabp_c)"

R&S SMU, R&S SMJ, and R&S SMBV only

The processing of DAB+ transport stream files (`*.dabp_c`) requires option R&S SMx-K353.

DAB+ transport files are provided on a DVD. To access these files, use one of the following:

- Transfer the `*.dabp_c` files to the instrument, e.g. use USB stick or USB HDD, connect it to the instrument and store the files on the instrument's disc in the `transfer` directory.
- Store the `*.dabp_c` files in a network directory, connect the instrument to the LAN and process the files from the network directory.

For detailed description of the available files, refer to the manual "DAB+ Streams" included in the delivery of the option.

"DAB (K354) ETI (*.dab_c)"

         R&S SMU, R&S SMJ, and R&S SMBV only

         The processing of T-DMB/DAB stream files (`*.dab_c`) requires
         option R&S SMx-K354.

         DAB+ transport files are provided on a DVD. To access these files,
         use one of the options described above. For detailed description of
         the available files, refer to the manual "T-DMB/DAB Streams" inclu-
         ded in the delivery of the option.

Remote command:

`[:SOURce<hw>]:BB:DAB:DATA:DSELection` on page 31

Number of ETI Frames

This menu option is available only if the data source is set to ETI File. Enters the desired sequence lenght in form of frames.

Remote command:

`[:SOURce<hw>]:BB:DAB:EFRames` on page 31

Loop Duration

This menu option is available only if the data source is set to ETI File. Displays the sequence length.

Remote command:

`[:SOURce<hw>]:BB:DAB:LDURation?` on page 32

Transport Mode

Selects the transport mode. Selecting of transport mode is only enabled for data source other then ETI files. For ETI data source files this field is read only. The transport mode is read from the ETI file.

Remote command:

`[:SOURce<hw>]:BB:DAB:DATA` on page 30

`[:SOURce<hw>]:BB:DAB:TMODe` on page 35

System Configuration…

Calls the "System Configuration" menu for configuring the DAB system.

The menu is described in chapter 3.2, "System Configuration", on page 17.

Remote command:

n.a.

Filter …

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

The menu is described in chapter 3.3, "Filter Settings", on page 18

Remote command:

n.a.

Trigger/Marker/Clock

Accesses the dialog for selecting the trigger mode and trigger source, for configuring the marker signals, for setting the time delay of an external trigger signal and for selecting the clock source. This menu is described in chapter 3.4, "Trigger/Marker/ Clock Settings", on page 19.

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:DAB:TRIGger:EXECute on page 41

Arm

Stops signal generation manually. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.
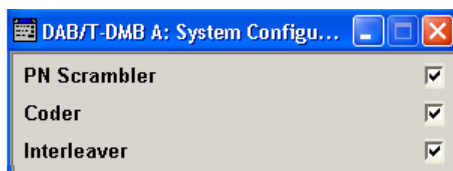
Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

Remote command:
[:SOURce<hw>]:BB:DAB:TRIGger:ARM:EXECute on page 40

3.2 System Configuration

The "System Configuration" menu allows configuration of the DAB system.

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. This feature is enabled for ETI data source files only.

Remote command:
[:SOURce<hw>]:BB:DAB:PNSCrambler[:STATe] on page 36

Coder

Activates/deactivates the coder. The coder applies a Reed-Solomon error correction code to the PRBS data stream. This feature is enabled for ETI data source files only. If the convolutional encoder is switched off, the number of bits delivered from the coder in enabled state is now fetched from the scrambler and therefore from data source. So please keep in mind that the data framing is not valid anymore.

Remote command:
[:SOURce<hw>]:BB:DAB:CODer[:STATe] on page 35

Interleaver

Activates/deactivates the convolutional interleaver.
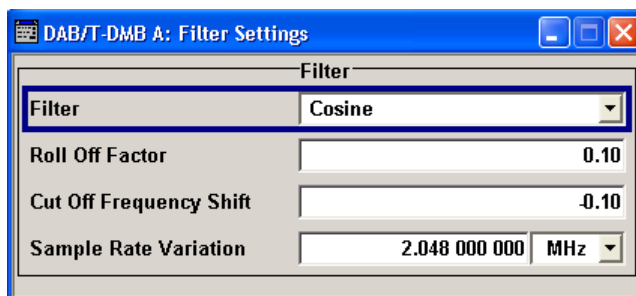
This feature is enabled for ETI data source files only.

After turning on the standard, the MSC values are not valid during the first 16 CIFs, because of the time interleaver's depth.

Remote command:
[:SOURce<hw>]:BB:DAB:ILEaver[:STATe] on page 36

3.3 Filter Settings

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

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

Filter

Selects the baseband filter.

Remote command:
[:SOURce<hw>]:BB:DAB:FILTer:TYPE on page 37

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:DAB:FILTer:PARameter:APCO25` on page 37

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:COSine` on page 37

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:RCOSine` on page 39

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:PGAuss` on page 39

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:GAUSs` on page 38

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:SPHase` on page 39

Cut Off Frequency Shift

(available for filter parameter Cosine only)

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

Remote command:

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:COSine:COFS` on page 37

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:DAB:FILTer:PARameter:LPASs` on page 38

`[:SOURce<hw>]:BB:DAB:FILTer:PARameter:LPASSEVM` on page 38
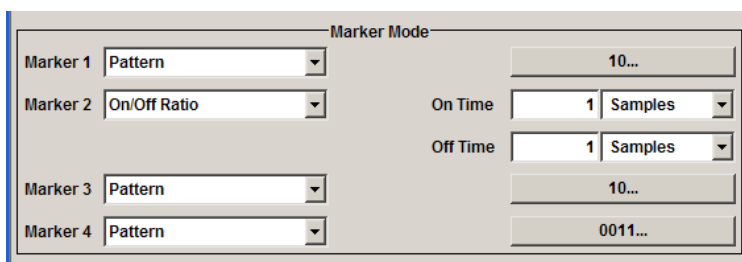
3.4 Trigger/Marker/Clock Settings

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.
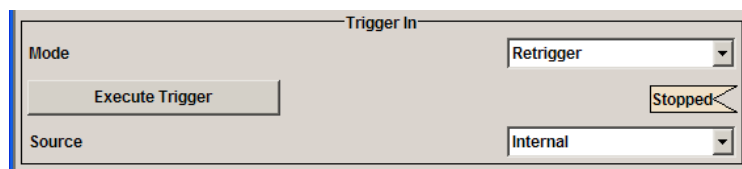

The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.

The "Marker" tab 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.
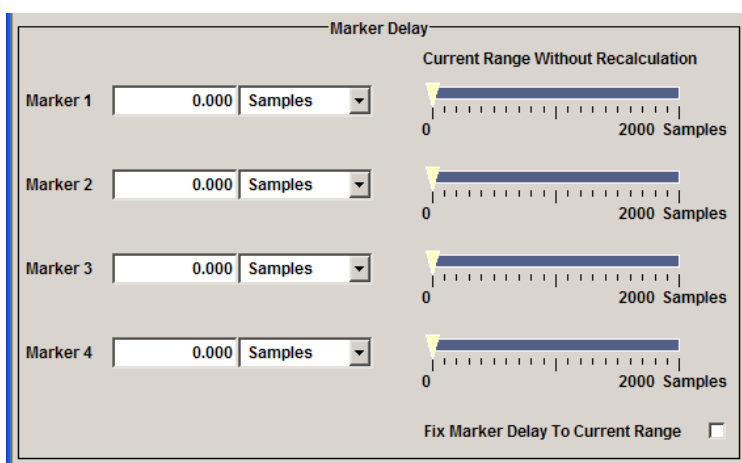
The "Clock Settings" section is where the clock source is selected and - in the case of an external source - the clock type.
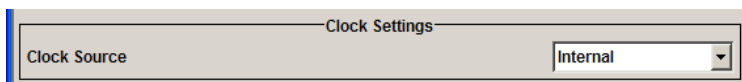
The buttons in the last section lead to submenu for general trigger, clock and mapping settings.

3.4.1 Trigger In

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

Trigger Mode

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

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

Remote command:
[:SOURce<hw>]:BB:DAB[:TRIGger]:SEQuence on page 45

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:DAB:TRIGger:SLENgth on page 43

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:DAB:TRIGger:RMODe? on page 42

Arm

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

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

Remote command:

[:SOURce<hw>]:BB:DAB:TRIGger:ARM:EXECute on page 40

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:DAB:TRIGger:EXECute on page 41

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

- "Internal"
  The trigger event is executed by "Execute Trigger".
- "Internal (Baseband A/B)"
  (two-path instruments)
  The trigger event is the trigger signal from the second path
- "External (Trigger 1/2)"
  The trigger event is the active edge of an external trigger signal, supplied at the TRIGGER 1/2 connector.
  Use the "Global Trigger/Clock Settings" dialog to define the polarity, the trigger threshold and the input impedance of the trigger signal.

Remote command:

[:SOURce<hw>]:BB:DAB:TRIGger:SOURce on page 43

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

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

For R&S SMBV instruments:

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

Table 3-1: Typical Applications

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

"On"   Corresponds to the default state of this parameter.
                The signal calculation starts simultaneously with the external trigger
                event but because of the instrument's processing time the first sam-
                ples are cut off and no signal is outputted. After elapsing of the inter-
                nal processing time, the output signal is synchronous to the trigger
                event.
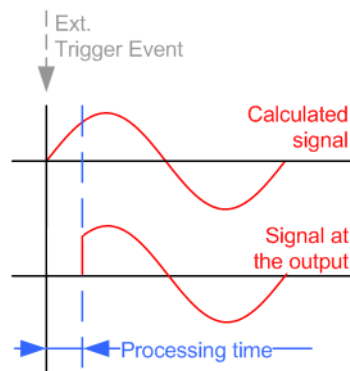
"Off"   The signal output begins after elapsing of the processing time and
                         starts with sample 0, i.e. the complete signal is outputted.
                         This mode is recommended for triggering of short signal sequences
                         with signal duration comparable with the processing time of the
                         instrument.
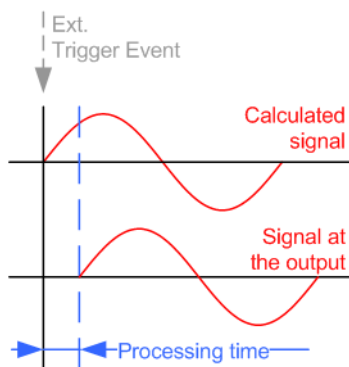
Remote command:
[:SOURce<hw>]:BB:DAB:TRIGger:EXTernal:SYNChronize:OUTPut
on page 41

Trigger Delay
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:DAB:TRIGger[:EXTernal<ch>]:DELay on page 44
[:SOURce<hw>]:BB:DAB:TRIGger:OBASeband:DELay on page 42

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:DAB:TRIGger[:EXTernal<ch>]:INHibit on page 44
[:SOURce<hw>]:BB:DAB:TRIGger:OBASeband:INHibit on page 42

3.4.2 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.

Frame Start   ▼
Restart
Frame Start
Pulse
Pattern
On/Off Ratio

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

"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:DAB:TRIGger:OUTPut<ch>:PULSe:DIVider on page 49
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:PULSe:FREQuency?
on page 49

"Pattern"   A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when pattern is selected.

Remote command:
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:PATTern on page 48

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

ON time	OFF time	ON time	OFF time

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.

On Time	1	Samples ▼
Off Time	1	Samples ▼

Remote command:
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:ONTime on page 48
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:OFFTime on page 48

Remote command:
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:MODE on page 47

3.4.3 Marker Delay

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

The R&S SMBV supports only two markers.

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

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

Remote command:
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:DELay on page 46

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:DAB:TRIGger:OUTPut<ch>:DELay:MINimum? on page 47
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:DELay:MAXimum? on page 46

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:DAB:TRIGger:OUTPut:DELay:FIXed on page 46

3.4.4 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.
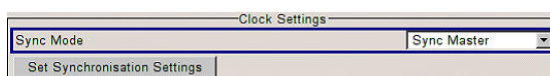
"Sync. Slave" The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

Remote command:
[:SOURce<hw>]:BB:DAB:CLOCk:SYNChronization:MODE on page 51

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:DAB:CLOCk:SYNChronization:EXECute on page 51

Clock Source
Selects the clock source.

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

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

Remote command:
[:SOURce<hw>]:BB:DAB:CLOCk:SOURce on page 51

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:DAB:CLOCk:MODE on page 50

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

Remote command:
[:SOURce<hw>]:BB:DAB:CLOCk:MULTiplier on page 50

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

Remote command:
CLOCk:INPut:FREQuency?

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

Conventions used in SCPI command descriptions

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

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
SOURce<hw>	[1]|2	available baseband signals
OUTPut<ch>	1 .. 4	available markers R&S SMBV supports two markers
EXTernal<ch>	1|2	external trigger connectors

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 DAB/T-DMB are described here:

4.1 General Commands

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

The commands for setting the system configuration and the TPS parameter bits are described in chapter 4.2, "System Configuration", on page 35.

[:SOURce<hw>]:BB:DAB:DATA <Data>

Sets the data source. To set the data source to ETI file, the existing of `*.eti` file is required, otherwise an error is returned. An ETI File is select using the command `BB:DATA:DSELection`.

Parameters:

<Data>   ALL0 | ALL1 | PN15 | PN23 | ETI

                                    ALL0, ALL1
                                    0 or 1 data is generated internally.

                                    PN15, PN23
                                    PRBS data in accordance with the IUT-T with period lengths
                                    between 29-1 and 223-1 are internally generated.

                                    ETI File
                                    Uses data from an ETI file. The ETI file can be selected via the
                                    Select ETI File button.

                                    *RST: PN15

Example: `BB:DAB:DATA PN15`
                                    selects PN15 as data source.
                                    `BB:DAB:DATA:DSELection 'test.eti'`
                                    selects the file 'test.eti' as data source.
                                    `BB:DAB:DATA ETI`
                                    sets the data source to ETI file.

Manual operation: See "Data Source" on page 15

[:SOURce<hw>]:BB:DAB:DATA:DSELection <DSelection>

Selects the file for the data source selection. For a detailed description on the available
types, refer to "Select ETI File" on page 15.

Parameters:

<DSelection>   string

Example: `MMEM:CDIR '<root>DAB'`
                                    selects the directory for the ETI files.
                                    `BB:DAB:DATA:DSEL 'test.eti'`
                                    selects the file `test.eti` as the data source. This file must be
                                    in the directory `<root>DAB` and have the file extension `*.eti`.
                                    `BB:DAB:DATA ETI`
                                    selects the ETI files as the data source.

Manual operation: See "Select ETI File" on page 15

[:SOURce<hw>]:BB:DAB:EFRames <EFrames>

Sets the desired sequence lenght in form of ETI frames. This command is enabled only
if the data source is set to ETI File.

The allowed minimum value of this parameter deppends on the transport mode of the
ETI file. For istanse, for transport mode I with 96 ms transmission frame duration, mini-
mum 4 frames must be selected.

Parameters:

<EFrames>	float
	Range: 1 to 10000
	Increment: 1

Example: `BB:DAB:DATA:DSEL 'test.eti'`
selects the file `'test.eti'` as the data source. This file must be in the directory `D:DAB` and have the file extension `*.eti`.
`BB:DAB:DATA ETI`
selects the ETI files as the data source.
`BB:DAB:EFR 50`
sets the number of the transmitted ETI-frames to 50.

Manual operation: See "Number of ETI Frames" on page 16

[:SOURce<hw>]:BB:DAB:ETI:CATalog?

Reads out the files with ETI File settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.eti` will be listed.

Return values:

<Catalog>	string

Example: `MMEM:CDIR '<root>DAB'`
sets the default directory to `<root>DAB`.
`BB:DAB:ETI:CAT?`
reads out all the files with ETI file settings in the default directory.
`Response: 'test.eti','dab.eti'`
the files `test.eti` and `dab.eti` are available.

Usage: Query only

[:SOURce<hw>]:BB:DAB:LDURation?

Queries the sequence length of ETI file (loop duration).

Return values:

<Lduration>	float

Example: `BB:DAB:LDUR?`
queries the loop duration.

Usage: Query only

Manual operation: See "Loop Duration" on page 16

[:SOURce<hw>]:BB:DAB: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:DAB:STATe`

Example: `SOURce1:BB:DAB:PRESet`

Usage: Event

Manual operation: See "Set To Default" on page 13

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

Reads out the files with DAB settings in the default directory. The default 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 files with the file extension `*.DAB` will be listed.

Return values:
<Catalog>   string

Example: `MMEM:CDIR '<root>DAB'`
                      sets the default directory to `<root>DAB`.
                      `BB:DAB:SETT:CAT?`
                      reads out all the files with DAB settings in the default directory.
                      `Response: 'DAB_1','DAB_2'`
                      the files `DAB_1` and `DAB_2` are available.

Usage: Query only

Manual operation: See "Save/Recall..." on page 14

[:SOURce<hw>]:BB:DAB:SETTing:DELete <File>

This command deletes the selected file with DAB 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 `*.DAB` will be deleted.

Setting parameters:
<File>   string

Example: `BB:DAB:SETT:DEL <root>DAB`
                      deletes the specified file with DAB settings.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 14

[:SOURce<hw>]:BB:DAB:SETTing:LOAD <Load>

This command loads the selected file with DAB 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 `*.DAB` will be loaded.

Setting parameters:

<Load>   string

Example: `BB:DAB:SETT:LOAD 'DAB_1'`
                        loads file `'DAB_1'`.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 14

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

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

Setting parameters:

<Store>   string

Example: `BB:DAB:SETT:STOR 'test.DAB'`
                        stores the current DAB settings into file 'test'.

Usage: Setting only

Manual operation: See "Save/Recall..." on page 14

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

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

Note: This function is not affected by the "Preset" function.

Parameters:

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

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

Manual operation: See "State" on page 13

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

Selects the transport mode. Depending on the transport mode selected, signal with different sequence length will be generated.

Transport mode selection is not enabled for ETI data source files; transport mode is a read only field for these files. The transport mode is read from the ETI file.

Parameters:

<Tmode>	I | II | III | IV
	I
	transport mode I, i.e. sequence length 96 ms.
	II
	transport mode II, i.e. sequence length 24 ms.
	III
	transport mode III, i.e. sequence length 24 ms.
	IV
	transport mode IV, i.e. sequence length 48 ms.
	*RST: I
Example:	`BB:DAB:DATA PN15`
	selects PN15 as data source.
	`BB:DAB:TMOD II`
	sets the transport mode to Tx Mode II, i.e. sequence length 24ms.
Manual operation:	See "Transport Mode" on page 16

4.2 System Configuration

This subsystem contains commands regarding the system configuration of the DAB standard.

[:SOURce<hw>]:BB:DAB:CODer[:STATe] <State>

Activates/deactivates the coder.. This feature is enabled for ETI data source files only.

Parameters:

<State>	0 | 1 | OFF | ON
	*RST: 1
Example:	`BB:DAB:CODer:STATe OFF`
	deactivates the coder. The number of bits is now fetched from the scrambler and therefore from data source. So please keep in mind that the data framing is not valid anymore.

Manual operation: See "Coder" on page 18

[:SOURce<hw>]:BB:DAB:ILEaver[:STATe] <State>

Activates/deactivates the interleaver. This feature is enabled for ETI data source files only.

Parameters:

<State>   0 | 1 | OFF | ON

                          *RST: 0

Example: BB:DAB:ILE:STAT ON

                          activates the outer interleaver. After turning on the standard, the MSC values are not valid during the first 16 CIFs, because of the time interleaver's depth.

Manual operation: See "Interleaver" on page 18

[:SOURce<hw>]:BB:DAB:PNSCrambler[:STATe] <State>

Activates/deactivates the PN scrambler. This feature is enabled for ETI data source files only.

Parameters:

<State>   0 | 1 | OFF | ON

                          *RST: 0

Example: BB:DAB:PNSC:STAT 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 17

4.3 Filter Settings

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

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 (if layer mode OFDM), COSine (if layer mode CCK or PBCC)

Example: BB:DAB:FILT:TYPE RCOS

sets the filter type RCOSine.

Manual operation: See "Filter" on page 18

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

Sets the roll-off factor for filter type APCO25.

Parameters:

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

Example: BB:DAB: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 18

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

Sets the roll-off factor for the Cosine filter type.

Parameters:

<Cosine>	float
	Range: 0 to 1
	Increment: 0.01
	*RST: 0.1

Example: BB:DAB: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 18

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

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:DAB:FILT:PAR:COS:COFS 0.35

                         sets the "cut of frequency shift' value to 0.35.

Manual operation: See "Cut Off Frequency Shift" on page 19

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

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:DAB: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 18

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

Sets the cut off frequency factor for the Lowpass filter (ACP Opt.) type.

Parameters:

<LPass>   float

                         Range: 0.05 to 2.0
                         Increment: 0.01
                         *RST: 0.5

Example: BB:DAB:FILT:PAR:LPAS 0.5

                         the cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 19

[:SOURce<hw>]:BB:DAB:FILTer:PARameter:LPASSEVM <LPassevm>

Sets the cut off frequency factor for the Lowpass filter (EVM Opt.) type.

Parameters:

<LPassevm>   float

                         Range: 0.05 to 2.0
                         Increment: 0.01
                         *RST: 0.5

| **Example:** | `BB:DAB:FILT:PAR:LPASSEVM 0.5` |
| | the cut of frequency factor is set to 0.5. |

Manual operation: See "Cut Off Frequency Factor" on page 19

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

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:DAB: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 18

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

Sets the roll-off factor for the Root Cosine filter type.

Parameters:

<RCosine>   float

Range: 0 to 1
Increment: 0.01
*RST: 0.22

| **Example:** | `BB:DAB: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 18

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

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

| **Example:** | `BB:DAB: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 18

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

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: 4E2 to 3E6
	Increment: 0.001
	*RST: 2.048E6

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

4.4 Trigger Settings

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

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

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

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

Usage:	Event

Manual operation:	See "Arm" on page 17

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

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

Example:	BB:DAB:TRIG:SOUR INT sets internal triggering. BB:DAB:TRIG:SEQ RETR sets Retrigger mode, i.e. every trigger event causes signal generation to restart. BB:DAB:TRIG:EXEC executes a trigger.
Usage:	Event
Manual operation:	See "Execute Trigger" on page 17

[:SOURce<hw>]:BB:DAB: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. For two or more R&S SMBVs configured to work in a master-slave mode for synchronous signal generation, enable this parameter in the slave instruments, in case the master instrument provides the slaves with its internal trigger signal. **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. While working in a master-slave mode and a common external trigger event is provided for the master and the slave instruments, disable this parameter in the slave instruments *RST: 1
Example:	BB:DAB:TRIG:SOUR EXT sets external triggering. BB:DAB:TRIG:EXT:SYNC:OUTP ON enables synchrounous output to external trigger

Manual operation: See "Sync. Output to External Trigger" on page 22

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

Specifies the trigger delay (expressed as a number of samples) for external triggering.

Parameters:

<Delay>   float

                      Range: 0 to 65535
                      *RST: 0

Example: `BB:DAB:TRIG:SOUR EXT`

                      sets an external trigger.
                      `BB:DAB:TRIG:DEL 50`
                      sets a delay of 50 symbols for the trigger.

Manual operation: See "Trigger Delay" on page 24

[:SOURce<hw>]:BB:DAB: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 2^32-1 samples
                      Increment: 1 sample
                      *RST: 0 samples

Example: `BB:DAB:TRIG:SOUR OBAS`

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

Manual operation: See "Trigger Inhibit" on page 24

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

Queries the current status of signal generation for all trigger modes with DAB 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:DAB:TRIG:ARM:EXECute` (armed trigger modes only).

Example:　　　　　　　　`BB:DAB:TRIG:SOUR EXT`

sets external triggering.

`BB:DAB:TRIG:MODE ARET`

selects the Armed_Retrigger mode

`BB:DAB: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 21

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

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

Parameters:

<SLength>　　　　　　　　integer

Range:　　1 to 10000
*RST:　　　1

Example:　　　　　　　　`BB:DAB:SEQ SING`

sets trigger mode Single.

`BB:DAB: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 21

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

Manual operation: See "Trigger Source" on page 22

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

Specifies the trigger delay (expressed as a number of samples) for external triggering.

Parameters:

<Delay>   float

Range: 0.0 to 65535.0
Increment: 0.01
*RST: 0.0

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

Manual operation: See "Trigger Delay" on page 24

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

Parameters:

<Inhibit>   integer

Range: 0 to 67108863
*RST: 0

Example: `BB:DAB:TRIG:SOUR EXT1`
selects an external trigger via the TRIGGER 1 connector.
`BB:DAB:TRIG:INH 200`
sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "Trigger Inhibit" on page 24

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

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:DAB: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:DAB: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:DAB:TRIG:SLEN`). Every subsequent trigger event causes a restart.
Signal generation is stopped with command
`SOUR:BB:DAB:TRIG:ARM:EXEC` and started again when a trigger event occurs.

*RST: AUTO

Example: `BB:DAB: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 21

4.5 Marker Settings

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

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

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.

The numeric suffix in OUTPut has no significance for this command, since the setting always affects every marker.

Parameters:

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

Example: BB:DAB: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 26

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

Defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of samples.

Command :BB:DAB:TRIGger:OUTPut:DELay:FIXed can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Parameters:

<Delay>	float
	Range: 0 to 2^32-1samples
	*RST: 0

Example: BB:DAB:TRIG:OUTP:DEL 16000
sets a delay of 16000 samples.

Manual operation: See "Marker x Delay" on page 26

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

Queries the maximum marker delay for setting :BB:DAB:TRIG:OUTP:DEL:FIX ON.

Return values:

| <Maximum> | float |

Example:	BB:DAB:TRIG:OUTP:DEL:FIX ON
	restricts the marker signal delay setting range to the dynamic range.
	BB:DAB: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 26

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

Queries the minimum marker delay for setting :BB:DAB:TRIGger:OUTPut:DELay:
FIXed ON.

Return values:

<Minimum>	float
Example:	BB:DAB:TRIG:OUTP:DEL:FIX ON
	restricts the marker signal delay setting range to the dynamic range.
	BB:DAB:TRIG:OUTP:DEL:MIN?
	queries the minimum of the dynamic range.
	Response: "0"
	the minimum for the marker delay setting is 0 symbols.
Usage:	Query only
Manual operation:	See "Current Range without Recalculation" on page 26

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

Defines the signal for the selected marker output.

Parameters:

<Mode>   RESTart | 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.

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: FRAMe

Example: BB:DAB:TRIG:OUTP:MODE FRAME

selects the frame for the correspondent marker signal .

Manual operation: See "Marker Mode" on page 25

[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:OFFTime <OffTime>
[:SOURce<hw>]:BB:DAB:TRIGger:OUTPut<ch>:ONTime <OnTime>

Sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting SOURce:BB:DAB:TRIGger:OUTPut:MODE RATio on the marker outputs is ON.

Parameters:

<OnTime>   integer

Range: 1 to 16777215
*RST: 1

Example: BB:DAB:TRIG:OUTP2:ONT 2000

sets an ON time of 2000 samples for marker 2.

Manual operation: See "Marker Mode" on page 25

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

Defines the bit pattern used to generate the marker signal.

Parameters:

<Pattern>   64 bits

Example: `BB:DAB:TRIG:OUTP:PATT #H39FE0000,32`
sets the bit pattern.
`BB:DAB:TRIG:OUTP:MODE PATT`
activates the marker signal according to a bit pattern of the cor-
respondent marker.

Manual operation: See "Marker Mode" on page 25

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

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

Parameters:

<Divider>   integer

                   Range: 2 to 1024
                   *RST: 2

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

Manual operation: See "Marker Mode" on page 25

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

Queries the pulse frequency of the pulsed marker signal in the set-
ting `:BB:DAB:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by
dividing the symbol rate by the divider. The divider is defined with com-
mand `:BB:DAB:TRIG:OUTP:PULS:DIV`.

Return values:

<Frequency>   float

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

Usage: Query only

Manual operation: See "Marker Mode" on page 25

4.6 Clock Settings

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

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

Enters the type of externally supplied clock (`BB:DAB:CLOCk:SOURce EXTernal`). When MSAM mode 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:DAB: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>	SAMPle | MSAMple
	*RST: SAMPle

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

Manual operation:	See "Clock Mode" on page 27

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

Specifies the multiplier for clock type "Multiple Sample" (`BB:DAB:CLOCk:MODE MSAMp`) in the case of an external clock source.

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

Parameters:

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

Example:	`BB:DAB:CLOC:SOUR EXT`
	selects the external clock source.
	`BB:DAB: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:DAB:CLOC:MULT 12`
	the multiplier for the external clock rate is 12.

Manual operation:	See "Clock Multiplier" on page 27

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

Selects the clock source.

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

Parameters:

<Source>   INTernal | EXTernal

          INTernal
          The internal clock reference is used.

          EXTernal
          The external clock reference is supplied to the CLOCK connector. Commands `:BB:DAB:CLOCk:MODE` and `:MULTiplier` are used to enter the type of the external clock.

          *RST: INTernal

Example: `BB:DAB:CLOC:SOUR EXT`
          selects the external clock source. The clock is supplied via the CLOCK connector.
          `BB:DAB: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:DAB:CLOC:MULT 12`
          the multiplier for the external clock rate is 12.

Manual operation: See "Clock Source" on page 27

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

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

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

Usage: Event

Manual operation: See "Set Synchronization Settings" on page 27

[:SOURce<hw>]:BB:DAB: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 syn-
chronisation (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:DAB:CLOC:SYNC:MODE MAST
the instrument is configured to work as a master one.

Manual operation: See "Sync. Mode" on page 26

List of Commands

Index