R&S®SMCVB-K164
DVB-T2
User Manual

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Version 06

ROHDE&SCHWARZ
Make ideas real

This document describes the following software options:

- R&S®SMCVB-K164 DVB-T2 (1434.3890.xx)

This manual describes firmware version FW 5.30.175.xx and later of the R&S®SMCV100B.

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Throughout this document, R&S® is indicated as R&S.

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1 Welcome to the DVB-T2 option

The R&S SMCVB-K164 is a firmware application that adds functionality to generate signals in accordance with the DVB-T2 digital standard.

Key features

The R&S SMCVB-K164 option features:

- DVB-T2 signal generation

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 SMCV100B user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMCV100B

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMCV100B service manual.

1.1 Accessing the DVB-T2 dialog

To open the dialog with DVB-T2 settings

► In the block diagram of the R&S SMCV100B, select "Baseband > DVB-T2".

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".

1.2 What's new

This manual describes firmware version FW 5.30.175.xx and later of the R&S®SMCV100B.

Compared to the previous version, it provides the new features listed below:

- Troubleshooting for external input signals added, see Chapter 4.3, "Troubleshooting external input signal warnings", on page 78.
- Editorial changes

1.3 Documentation overview

This section provides an overview of the R&S SMCV100B user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/smcv100b

1.3.1 Getting started manual

Introduces the R&S SMCV100B and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.3.2 User manuals and help

Separate manuals for the base unit and the software options are provided for download:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S SMCV100B is not included.

The contents of the user manuals are available as help in the R&S SMCV100B. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

All user manuals are also available for download or for immediate display on the internet.

1.3.3 Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.3.4 Instrument security procedures

Deals with security issues when working with the R&S SMCV100B in secure areas. It is available for download on the internet.

1.3.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.3.6 Specifications and product brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S SMCV100B. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smcv100b

1.3.7 Calibration certificate

The document is available on https://gloris.rohde-schwarz.com/calcert. You need the device ID of your instrument, which you can find on a label on the rear panel.

1.3.8 Release notes and open source acknowledgment

The release notes list new features, improvements and known issues of the current software version, and describe the software installation.

The software uses several valuable open source software packages. An open source acknowledgment document provides verbatim license texts of the used open source software.

www.rohde-schwarz.com/firmware/smcv100b

1.3.9 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

For some application sheets, see also:

www.rohde-schwarz.com/application/smcv100b

1.3.10 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

1.4 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, it includes:

- Managing settings and data lists, like saving and loading settings, creating and accessing data lists, or accessing files in a particular directory.
- Information on regular trigger, marker and clock signals and 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 SMCV100B user manual.

1.5 Notes on screenshots

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

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 About the DVB-T2 option

The transmission standard complies with the specification ETSI EN 302 755 and ETSI TS 102 773. A subset of all possible parameters found in the specification can be set on the R&S SMCV100B.

2.1 Required options

The equipment layout for generating DVB-T2 signals includes:

- Base unit
- Option Enable Broadcast Standard (R&S SMCVB-K519)
- Option DVB-T2 (R&S SMCVB-K164)

3 DVB-T2 configuration and settings

This section provides an overview on the DVB-T2 settings.

Access:

► Select "Baseband" > "DVB-T2".

The remote commands required to define these settings are described in Chapter 5, "Remote-control commands", on page 80.

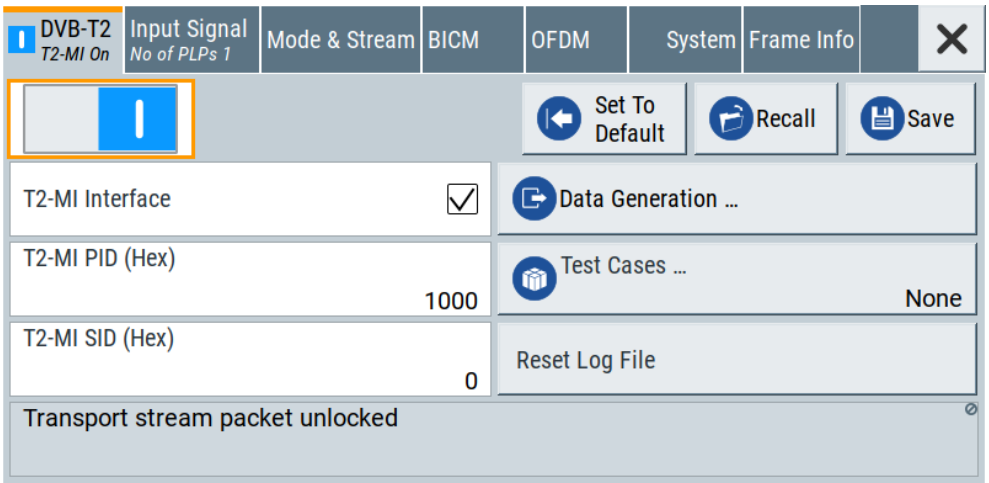
Settings:

- General settings....12
- Input signal settings....15
- Mode & Stream settings....29
- BICM settings....34
- OFDM settings....38
- System settings....42
- SFN settings....49
- Frame info....53
- Data generation settings....57
- Global connector settings....58
- TS player....58
- Local IP data network settings....68

3.1 General settings

Access:

► Select "Baseband" > "DVB-T2".



The tab provides default settings, save and recall settings and settings to configure T2-MI interface parameters.

The remote commands required to define these settings are described in Chapter 5.1, "General commands", on page 81.

Settings:

State....13
Set To Default....13
Save/Recall....13
T2-MI Interface....14
T2-MI PID (Hex)....14
T2-MI SID (Hex)....14
Data Generation....14
Test Cases....14
└ Filter Test Cases....14
Reset Log File....14
Status Info....15

State

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

Remote command:
`[:SOURce<hw>]:BB:T2DVb:STATe` on page 81

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 the "Set To Default"

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PRESet` on page 81

Save/Recall

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

The settings are saved in a file with predefined extension. You can define the filename and the directory, in that you want to save the file.

See also, chapter "File and Data Management" in the R&S SMCV100B user manual.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:SETTing:CATalog?` on page 82
`[:SOURce<hw>]:BB:T2DVb:SETTing:DELete` on page 82
`[:SOURce<hw>]:BB:T2DVb:SETTing:LOAD` on page 82
`[:SOURce<hw>]:BB:T2DVb:SETTing:STORe` on page 82

T2-MI Interface
Activates the T2-MI modulator interface.

"On"	Uses the incoming T2-MI stream to configure the modulator.
"Off"	Uses the incoming MPEG transport stream directly as payload for single PLP transmission.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:INTerface` on page 85

T2-MI PID (Hex)
Requires "T2-MI Interface > On".

Sets the PID.

The PID belongs to MPEG transport stream packets, that contain T2-MI data.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:PID` on page 85

T2-MI SID (Hex)
Requires "T2-MI Interface > On".

Sets the T2-MI transport SID.

Use the SID, when transmitting a composite signal, in accordance with annex I of the specification ETSI EN 302 755.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:SID` on page 86

Data Generation
Accesses the "DVB-T2 Data Generation" dialog.

See Chapter 3.9, "Data generation settings", on page 57.

Test Cases
Accesses a standard file-select dialog to select DVB-T2 test cases.

For available test cases, see Chapter A, "DVB-T2 test cases", on page 144.

Filter Test Cases ← Test Cases
Filters the list of available test cases.

Reset Log File
Requires "T2-MI Interface" > "On".

Resets the log file.

Status information of the T2-MI analyzer as displayed in "Status Info" is saved to a log file. The log file `DVBT2_T2MI_Status_Info_TX.txt` is saved to the directory `var/user/log`.

See also, chapter "File and Data Management" in the R&S SMCV100B user manual.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:RESetlog` on page 86

Status Info
Displays the status of the T2-MI analyzer by an error message. "No Error" implies correct behavior of the analyzer. Status information of the T2-MI analyzer is saved to a log file, see "Reset Log File" on page 14.

To ensure correct behavior, fix occurring errors successively.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:ANALyzer?` on page 85

3.2 Input signal settings

Access:

► Select "Baseband" > "DVB-T2" > "Input Signal".

The dialog provides settings to configure the input signal.

Input signal tasks

The settings allow you to perform the following tasks:

- Selecting an MPEG TS or T2-MI source
- Displaying information about the selected stream (e.g. data rate)
- Configuring the internal MPEG TS test packets

How to: Chapter 4.1, "Configuring the input signal", on page 71

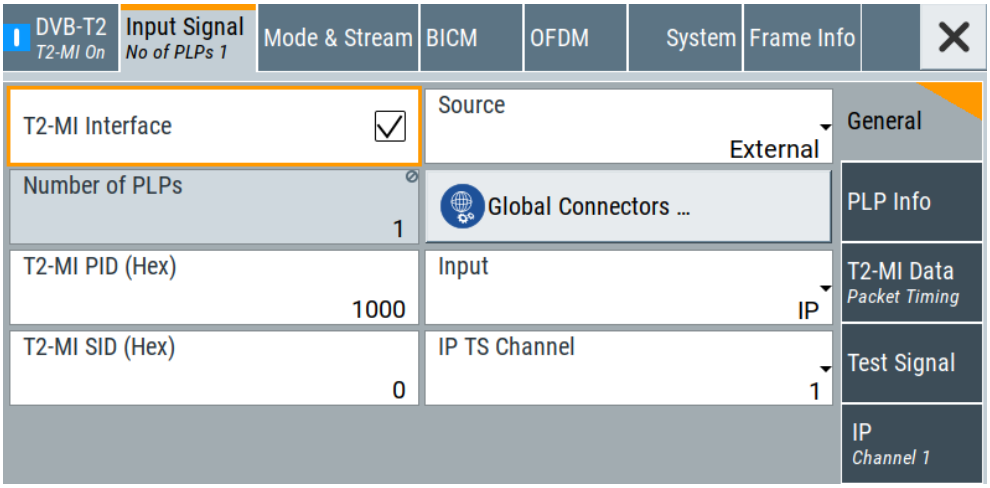
Settings:

- General settings.....16
- PLP info.....19
- T2-MI data packet timing settings.....21
- Test signal settings.....24
- IP channel x settings.....26

3.2.1 General settings

Access:

► Select "Input Signal" > "General".



The tab provides general settings to configure the input signal.

Settings:

T2-MI Interface....16
Source....16
Number of PLPs....17
Input....17
Input Format....17
IP TS Channel....18
T2-MI PID (Hex)....18
T2-MI SID (Hex)....18
Stuffing....18
Test Signal....18

T2-MI Interface
Activates the T2-MI modulator interface.

"On" Uses the incoming T2-MI stream to configure the modulator.

"Off" Uses the incoming MPEG transport stream directly as payload for single PLP transmission.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:INTerface` on page 85

Source
Sets the modulation source for the input signal.

"External" Uses a transport stream, that is input at the "TS IN"/"IP Data" interface.

For more information about connecting to the interfaces, see also:
- "TS IN" interface: Section "Configuring the Global Connectors" in the R&S SMCV100B user manual.
- "IP Data" interface: Chapter 3.12, "Local IP data network settings", on page 68.

"TS Player" Uses an internal transport stream with TS packet data played from a file. The player requires no option.
Playing encrypted files with extension `_c` requires a stream library option R&S SMCVB-KSx.

See also:
- Chapter 3.11, "TS player", on page 58
- Supported TS player file types

"Test Signal" Requires "T2-MI Interface" > "Off".
Uses an internal test signal as specified in Chapter 3.2.4, "Test signal settings", on page 24.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:SOURce` on page 84

Number of PLPs
Displays the number of PLPs.

The available number of PLPs depends on the setting of "T2-MI Interface":
- If "T2-MI Interface" > "Off", the number of PLPs is "1" (single PLP).
- If "T2-MI Interface" > "On", maximum "1 to 20" PLPs are supported.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:NPLP?` on page 88

Input
Requires "Source" > "External".

Sets the external input interface.

"TS IN" Input for serial transport stream data. The signal is input at the "User 1" connector.

"IP" Input for IP-based transport stream data (TSoverIP). The signal is input at the "IP Data" connector.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut` on page 84

Input Format
Requires "Source" > "External" and "Input" > "TS IN".

Sets the format of the input signal.

"ASI" ASI format

"SMPTE 310" SMPTE 310 format

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:FORMat` on page 85

IP TS Channel
Requires "Source" > "External" and "Input" > "IP".

Selects the IP-based transport stream (TS) channel. You can select 1 out of 4 IP TS channels as input at the "IP Data" interface.

To configure a particular channel, see Chapter 3.2.5, "IP channel x settings", on page 26.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:TSCHannel` on page 86

T2-MI PID (Hex)
Requires "T2-MI Interface > On".

Sets the PID.

The PID belongs to MPEG transport stream packets, that contain T2-MI data.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:PID` on page 85

T2-MI SID (Hex)
Requires "T2-MI Interface > On".

Sets the T2-MI transport SID.

Use the SID, when transmitting a composite signal, in accordance with annex I of the specification ETSI EN 302 755.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:SID` on page 86

Stuffing
Requires "External/TS Player" and "T2-MI Interface > Off".

Activates stuffing.

"On" Inserts null packets and corrects the PCR values.

"Off" The data rate of the transport stream source must match the data rate required for the current modulation parameters.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:STUFfing` on page 89

Test Signal
Requires "T2-MI Interface" > "Off" and "Source" > "Test Signal".

Defines the test signal data.

"Test TS Packet"
Standardized packet data used as modulation data in the transport stream. To configure the packet structure, select the side tab "Test Signal > Test TS Packet".
Uses a null packet as the test signal. To configure the null packet, see Chapter 3.2.4, "Test signal settings", on page 24.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:TESTsignal` on page 93

3.2.2 PLP info

Access:

► Select "Input Signal" > "PLP Info".

	PLP 0
PLP Input Format	TS
Useful Data Rate / Mbit/s	0.000

The tab displays the "PLP <num>" table, that contains individual PLP information of up to 20 PLPs.
The information comprises input parameters for each PLP.

Settings:

PLP <num> table 19
└ PLP Input Format 19
└ Packet Length 19
└ Stuffing 20
└ Max. Useful Data Rate / Mbit/s 20
└ Measured Data Rate / Mbit/s 20
└ Useful Data Rate / Mbit/s 20

PLP <num> table
Displays individual parameters for each PLP `<num>`. The table displays information of up to 20 PLPs with `<num>` ranging from 0 to 19.

PLP Input Format ← PLP <num> table
Displays the input format of each PLP `<num>` for all input sources.

"GFPS/GCS/GSE" require "T2-MI Interface" > "On".

To edit the input format, select "Input Signal" > "General" > "Input Format".

"TS"	Transport stream
"GFPS"	Generic fixed-length packetized stream
"GCS"	Generic continuous stream
"GSE"	Generic stream encapsulation

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:FORMat` on page 88

Packet Length ← PLP <num> table
Requires "T2-MI Interface" > "Off" and "Source" > "External".

Displays the packet length of the external transport stream in bytes.

If the packet length does not match the specified length, the output signal is erroneous. "Packet Length > Invalid" is displayed.

"188" 188 byte packets specified for serial input ("Input > TS IN") and parallel input ("Input > IP").

"Invalid" Packet length ≠ 188 bytes, i.e. the length is not a specified length.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:PACKetlength?` on page 89

Stuffing ← PLP <num> table
Requires "External/TS Player" and "T2-MI Interface > Off".

Activates stuffing.

"On" Inserts null packets and corrects the PCR values.

"Off" The data rate of the transport stream source must match the data rate required for the current modulation parameters.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:STUFfing` on page 89

Max. Useful Data Rate / Mbit/s ← PLP <num> table
Requires "T2-MI Interface" > "Off" and "Source" > "External" or "TS Player".

Displays the maximum data rate, that is derived from the current modulation parameter settings.

The value is the optimal value at the TS input interface, that is necessary for the modulator.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:USEFul[:RATE]:MAX?` on page 90

Measured Data Rate / Mbit/s ← PLP <num> table
Requires "T2-MI Interface" > "Off" and "Source" > "External".

Displays the measured value of the data rate r_{meas} of one of the following:

- External transport stream including null packets input at "User 1" connector
- External transport stream including null packets input at "IP Data/LAN" connector (TSoverIP)

The value r_{meas} equals the sum of useful data rate r_{useful} and the rate of null packets r_0:

$r_{meas} = r_{useful} + r_0$

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>[:INPut]:DATarate?` on page 90

Useful Data Rate / Mbit/s ← PLP <num> table
Requires "Source" > "External" or "TS Player".

Displays the data rate of useful data r_{useful} of the external transport stream. The data rate is measured at the input of the installed input interface.

The value is measured or computed depending on the setting of "T2-MI Interface":

- If "T2-MI Interface" > "Off" and "Source" > "External" or "TS Player", the value is measured.
- If "T2-MI Interface" > "On", the value is computed.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:USEFul[:RATE]?` on page 89

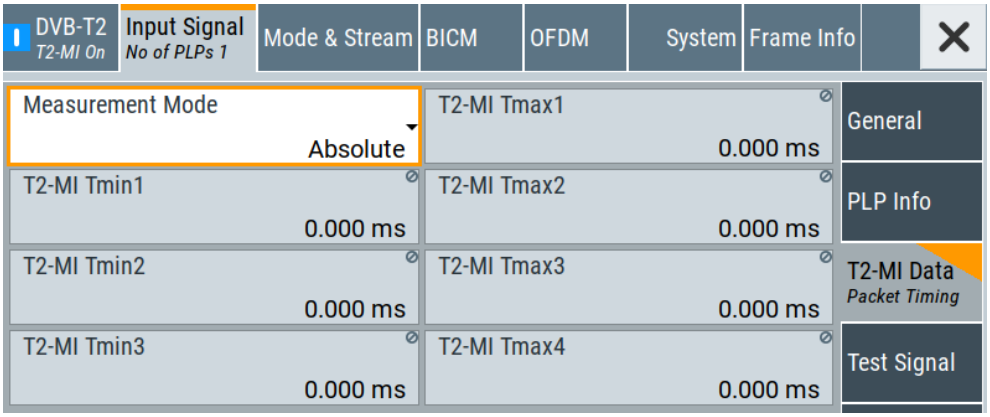
3.2.3 T2-MI data packet timing settings

Access:

1. Select "Input Signal" > "T2-MI Interface" > "On".

   The "T2-MI Data Packet Timing" side-tab appears.

2. Select "Input Signal" > "T2-MI Data Packet Timing"



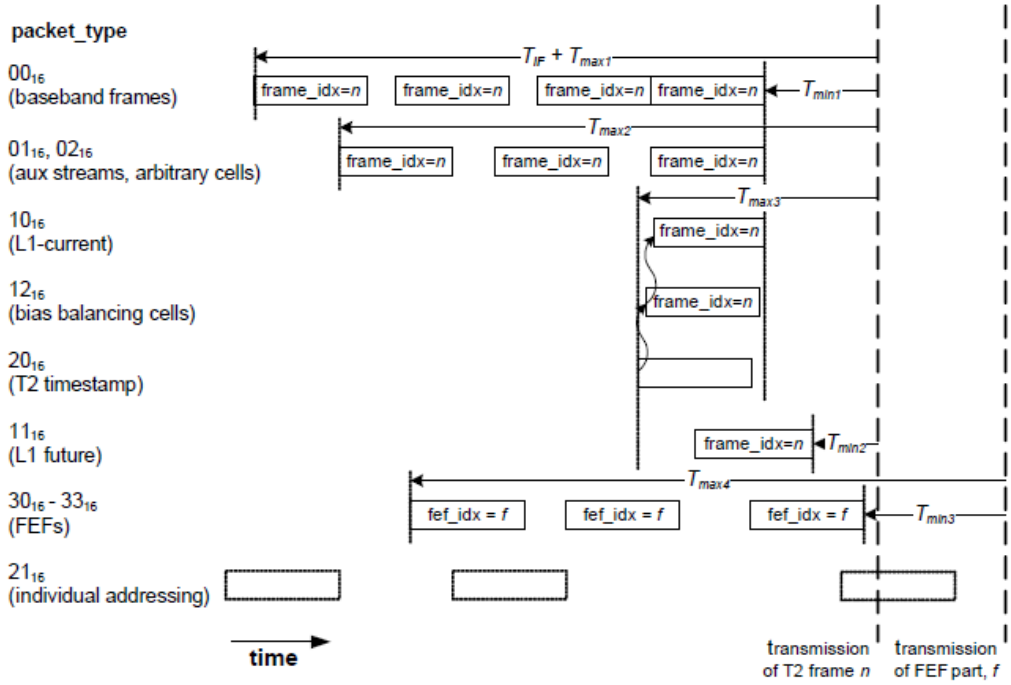
The tab provides packet timing settings for data input at the T2-MI interface.

All operations on frame_idx are modulo N_{T2}.

Individual addressing functions (packet_type 21_{16}) can be sent at any time.

The T2 timestamp refers to the transmission time of the super frame, although it is sent at any time.

The figure below shows a single PLP. If using multiple PLPs, the interleaving frame duration T_{IF} and hence the timing requirements for the type 00_{16} packets can be different for different PLPs.



Settings:

All following settings require "T2-MI Interface" > "On".

Measurement Mode 22
T2-MI T_{min1} 22
T2-MI T_{min2} 23
T2-MI T_{min3} 23
T2-MI T_{max1} 23
T2-MI T_{max2} 23
T2-MI T_{max3} 24
T2-MI T_{max4} 24

Measurement Mode

Specifies the measurement mode to configure the evaluation of T2-MI timing parameters.

"Absolute" Displays the absolute values of the measured T2-MI timing parameters.

"Delta" Displays the measured delta values of two consecutive T2-MI packets for each T2-MI timing parameter.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MEASuremode` on page 91

T2-MI T_{min1}

Displays the current value of T_{min1}.

T2-MI packets arrive at the modulator not later than T_{min1} before starting transmission of the corresponding T2 frame, if:

- T2-MI packets are of type: 00_{16}, 01_{16}, 02_{16}, 10_{16}, 12_{16}, 20_{16}
- `frame_idx` is given

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T1?` on page 91

T2-MI T_{min2}

Displays the current value of T_{min2}.

T2-MI packets arrive at the modulator not later than T_{min2} before starting transmission of the corresponding T2 frame, if:

- T2-MI packets are of type: 11_{16}
- `frame_idx` is given

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T2?` on page 91

T2-MI T_{min3}

Displays the current value of T_{min3}.

T2-MI packets arrive at the modulator not later than T_{min3} before starting transmission of the corresponding FEF part, if:

- T2-MI packets are of type: 30_{16}, 31_{16}, 32_{16}, 33_{16}
- `fef_idx` is given

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T3?` on page 91

T2-MI T_{max1}

Displays the current value of T_{max1}.

T2-MI packets arrive at the modulator not earlier than $T_{IF} + T_{max1}$ before starting transmission of the corresponding T2 frame, if:

- T2-MI packets are of type: 00_{16} type
- `frame_idx` is given

T_{IF} is the duration of one interleaving frame for the corresponding PLP.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T1?` on page 92

T2-MI T_{max2}

Displays the current value of T_{max2}.

T2-MI packets arrive at the modulator not earlier than T_{max2} before starting transmission of the corresponding T2 frame, if:

- T2-MI packets are of type: 01_{16}, 02_{16}
- `frame_idx` is given

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T2?` on page 92

T2-MI T_{max3}

Displays the current value of T_{max3}.

T2-MI packets arrive at the modulator not earlier than T_{max3} before starting transmission of the corresponding T2 frame, if:

- T2-MI packets are of type: 10_{16}, 11_{16}, 12_{16}, 20_{16}
- `frame_idx` is given

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T3?` on page 92

T2-MI T_{max4}

Displays the current value of T_{max4}.

T2-MI packets arrive at the modulator not earlier than T_{max4} before starting transmission of the corresponding FEF part, if:

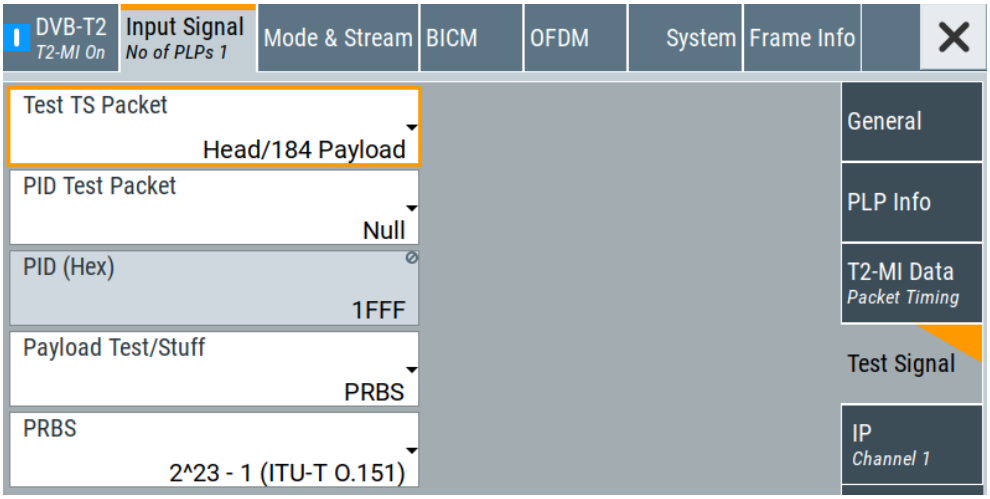
- One of the following types: 30_{16}, 31_{16}, 32_{16}, 33_{16}
- Given fef_idx

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T4?` on page 92

3.2.4 Test signal settings

Access:

► Select "Input Signal" > "Test Signal".



The tab provides settings to configure the test signal.

Settings:

Test TS Packet..... 25
PID Test Packet..... 25
PID (Hex)..... 25
Payload Test/Stuff..... 25
PRBS..... 25

Test TS Packet
Specifies the structure of the test transport stream packet that is fed to the modulator.

"Head/184 Payload"
A sync byte (0x47) followed by three header bytes and 184 payload bytes.

"Sync/187 Payload"
A sync byte (0x47) followed by 187 payload bytes.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:TSPacket` on page 94

PID Test Packet
If a header is present in the test packet ("Test TS Packet > Head/184 Payload"), you can specify a fixed or variable packet identifier (PID).

"Null" The header of the test transport stream packets has a fixed setting of null packet header 1FFF (hex).

"Variable" Uses the header value defined with "PID (Hex)" on page 25.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PIDTestpack` on page 93

PID (Hex)
Sets the PID.

If "PID Test Packet" > "Null", "PID (Hex) = 1FFF" is fixed.

If "PID Test Packet" > "Variable", you can edit the value.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PID` on page 93

Payload Test/Stuff
Defines the payload area content of the TS packet.

You can select PRBS or exclusively data in hexadecimal format as payload.

For "Source" > "Test Signal", the packet is a test packet.

For "Stuffing" > "On", the packet is a null packet. Null packets are inserted into the external transport stream to adapt the stream data rate. See also "Measured Data Rate / Mbit/s" on page 20

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PAYLoad` on page 93

PRBS
Sets the length of the PRBS sequence.

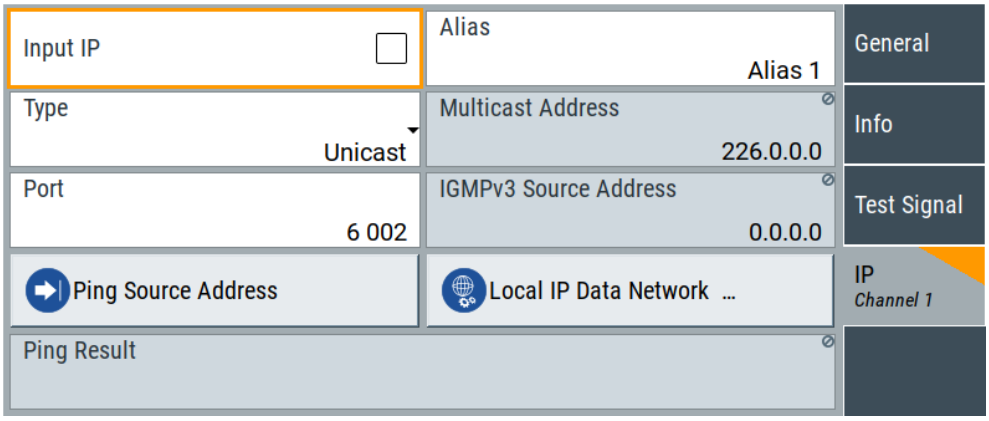
You can select a PRBS 15 or a PRBS 23 sequence as specified by ITU-T O.151.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PRBS[:SEQuence]` on page 94

3.2.5 IP channel x settings

Access:

1. Select "Input Signal > General".
2. Select "Source > External"
3. Select "Input > IP"
4. Select "Input Signal > IP Channel x"



The tab provides settings to configure IP channel `x`.

You can configure settings for 4 IP channels `x = 1 to 4` individually, see also "Input Signal > General > IP TS Channel".

IP channel settings affect input IP data of the local IP data network. The settings are independent from the used broadcast standard configuration.

Saving/recalling a certain IP channel or local IP data network configuration is not possible via the broadcast standard-specific functionality.

Use the global save or recall functionality instead, see section "Saving and recalling settings" in the R&S SMCV100B user manual.

The table below shows the availability of the tab in the broadcast standard configuration.

Table 3-1: IP channel configuration support in broadcast standards

Baseband standard	"IP Channel x"	Baseband standard	"IP Channel x"
"ATSC/ATSC-M/H"	Yes	"DVB-S"	Yes
"ATSC 3.0"	No	"DVB-S2"	Yes
"DTMB"	Yes	"DVB-C"	Yes
"DVB-T"	Yes	"J.83/B"	Yes
"DVB-T2"	Yes	"DRM"	No
"ISDB-T"	Yes	"Audio AM"	No
"T-DMB/DAB"	Yes	"Audio FM"	No

See also:

- Chapter 4.1.1, "How to apply an external IP input signal", on page 71
- Chapter 3.12, "Local IP data network settings", on page 68

Requirements

At your IP source, set the "transport stream packets per internet protocol packet" (TP per IP) parameter as follows:

- If TP packet length = 188 bytes: Set TP per IP to *7* or *6*.
- If TP packet length = 204/208 bytes: Set TP per IP to *6*.

We recommend that you use a separate LAN infrastructure to stream the transport streams via IP to the IP connector of the baseband board. Also, avoid TS packet losses during IP transmission.

Settings:

Input IP....27
Alias....27
Type....28
Multicast Address....28
Port....28
IGMPv3 Source Address....28
Ping Source Address....28
Ping Result....28
Local IP Data Network....29

Input IP

Activates/deactivates the IP input.

Remote command:

`[:SOURce<hw>]:BB:INPut:IP<ch>[:STATe]` on page 95

Alias

Sets a unique name for the IP connection.

The definition of a name is optional but facilitates identification in the measurement views. The name input fits maximum 16 characters in ASCII format.

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:ALIas` on page 96

Type
Sets the input signal type.

"Unicast" Analyzes all unicast IP packets that arrive at the specified "Port".

"Multicast" When an IP address is in the multicast address range, an attempt is made to join a multicast group using IGMP.
Set "Multicast Address" and "Port".

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:TYPE` on page 96

Multicast Address
Editing requires "Type > Multicast".

Sets the destination IP address (IPv4) of the IP connection.

You can set addresses from "224.0.0.0" to "239.255.255.255".

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:MULticast:ADDRess` on page 97

Port
Sets the destination UDP port.

Due to UDP/RTP autosensing, we recommend that you set a port offset of at least 6 between neighboring IP TS channels.

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:PORT` on page 96

IGMPv3 Source Address
Requires "Type > Multicast".

Sets the IGMPv3 source address.

If you need to filter the data sent to the multicast address, specify the source address. A source address different from "0.0.0.0" accepts only data originating from the specified IP address.

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:ADDRess` on page 97

Ping Source Address
Clicking "Ping Source Address" triggers pinging of the IGMPv3 source address.

If you set a different value from "IGMPv3 Source Address = 0.0.0.0" and click the button, the software checks if the address is reachable.

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:PING` on page 97

Ping Result
Displays the result after pinging the source address.

If "Ping Result > Ping: Successful", the source address is available in the network.

If "Ping Result > Ping: Transmit Failed. xxx", the source address is not available in the network. "xxx" can be, e.g. "General Failure". Try another "IGMPv3 Source Address".

Remote command:
`[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:RESult?` on page 97

Local IP Data Network
Accesses local IP data network settings, see Chapter 3.12, "Local IP data network settings", on page 68.

3.3 Mode & Stream settings

Access:

► Select "Baseband" > "DVB-T2" > "Mode & Stream".

The tab provides settings to configure mode and stream adaptation parameters.

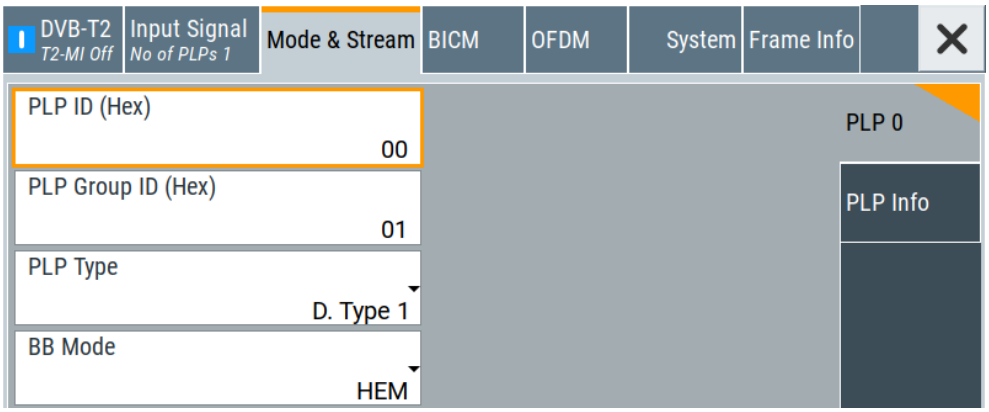
Settings:

- PLP 0 settings.....29
- PLP info.....31

3.3.1 PLP 0 settings

Access:

► Select "Mode & Stream" > "PLP 0".



The tab provides settings to configure mode and stream parameters of "PLP 0".

Editing "PLP 0" settings requires "T2-MI Interface" > "Off".

Settings:

PLP ID (Hex)..... 30
PLP Group ID (Hex)..... 30
PLP Type..... 30
BB Mode..... 30

PLP ID (Hex)
Sets the PLP ID. The PLP ID has to be unique.

You can set the PLP ID in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ID` on page 101

PLP Group ID (Hex)
Sets the PLP group ID for multi-PLP, i.e. the number of PLPs is greater than 1.

Multi-PLP requires number of PLPs > 1, see "Number of PLPs" on page 17.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:GROup` on page 100

PLP Type
Sets the PLP type.

The type depends on the number of PLPs in the setup.

"Common"	Requires a multi-PLP setup. Common PLP of the PLP Group.
"D. Type 1"	Data type 1. Fixed for a single-PLP setup. Configurable for a multi-PLP stream.
"D. Type 2"	Requires a multi-PLP setup. Data type 2.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TYPE` on page 103

BB Mode
Defines the baseband mode.

"HEM"	High efficiency mode.
"NM"	Normal mode.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BB_Mode` on page 99

3.3.2 PLP info

Access:

► Select "Mode & Stream" > "PLP Info".

	PLP 0
PLP ID (Hex)	00
PLP Group ID (Hex)	01
PLP Type	D. Type 1
BB Mode	HEM
ISSY	Off
Null Packet Deletion	Off
In-Band Signaling	Off
Other In-Band PLPs	0
CM Type	CCM

The tab displays the "PLP <num>" table, that contains individual PLP information of up to 20 PLPs.
The information comprises mode and stream parameters for each PLP.

To configure "PLP Info" "Mode & Stream" parameters

1. Select "DVB-T2" > "T2-MI Interface" > "Off".
2. Select "Mode & Stream" > "PLP 0".

   You can configure the parameters only for "PLP 0".

Settings:

PLP <num> table 32
└ PLP ID (Hex) 32
└ PLP Group ID (Hex) 32
└ PLP Type 32
└ BB Mode 32
└ ISSY 32
└ Null Packet Deletion 33
└ In-Band Signaling 33
└ In-Band Signaling A 33
└ In-Band Signaling B 33
└ Other In-Band PLPs 33
└ CM Type 33
└ Static Flag 34
└ Static Padding Flag 34

PLP <num> table
Displays individual parameters for each PLP `<num>`. The table displays information of up to 20 PLPs with `<num>` ranging from 0 to 19.

Note: Numbering in remote control commands.
The suffix `PLP<ch>` ranges from 1 to 20, the PLP number `num` ranges from 0 to 19.
See "Common suffixes" on page 80.

How to: "To configure "PLP Info" "Mode & Stream" parameters" on page 31

PLP ID (Hex) ← PLP <num> table
Sets the PLP ID. The PLP ID has to be unique.

You can set the PLP ID in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ID` on page 101

PLP Group ID (Hex) ← PLP <num> table
Sets the PLP group ID for multi-PLP, i.e. the number of PLPs is greater than 1.

Multi-PLP requires number of PLPs > 1, see "Number of PLPs" on page 17.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:GROup` on page 100

PLP Type ← PLP <num> table
Sets the PLP type.

The type depends on the number of PLPs in the setup.

"Common"	Requires a multi-PLP setup. Common PLP of the PLP Group.
"D. Type 1"	Data type 1. Fixed for a single-PLP setup. Configurable for a multi-PLP stream.
"D. Type 2"	Requires a multi-PLP setup. Data type 2.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TYPE` on page 103

BB Mode ← PLP <num> table
Defines the baseband mode.

"HEM"	High efficiency mode.
"NM"	Normal mode.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BB_Mode` on page 99

ISSY ← PLP <num> table
Displays the ISSY state.

"OFF"	ISSY is not active. ISSY indicator field is 0.
"Short"	ISSY is active. ISSY indicator field is 1. The synchronizer uses a short ISCR.

"Long" ISSY is active. ISSY indicator field is 1. The synchronizer uses a long ISCR.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ISSY?` on page 102

Null Packet Deletion ← PLP <num> table
Displays the null packet deletion state.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:NPD?` on page 102

In-Band Signaling ← PLP <num> table
Requires "System" > "L1" > "L1 T2 Version" = "1.1.1", see "L1 T2 Version" on page 46.

Displays the in-band signaling state.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS?` on page 100

In-Band Signaling A ← PLP <num> table
Requires "System" > "L1" > "L1 T2 Version" ≠ "1.1.1", see "L1 T2 Version" on page 46.

Displays the in-band signaling type A state.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS:A?` on page 101

In-Band Signaling B ← PLP <num> table
Requires "System" > "L1" > "L1 T2 Version" ≠ "1.1.1", see "L1 T2 Version" on page 46.

Displays the in-band signaling type B state.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS:B?` on page 101

Other In-Band PLPs ← PLP <num> table
Displays the number of other PLPs signaled within the in-band signaling of the PLP for multi-PLP.

Multi-PLP requires number of PLPs > 1, see "Number of PLPs" on page 17.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:OIBPlp?` on page 102

CM Type ← PLP <num> table
Displays the CM type for multi-PLP.

Multi-PLP requires number of PLPs > 1, see "Number of PLPs" on page 17.

Displays the CM type for multi-PLP (number of PLPs > 1).

"CCM" Constant coding and modulation.

The setting implies identical settings for all PLPs of the following parameters:

- "FEC Frame" on page 35
- "Code Rate" on page 35
- "Constellation" on page 36
- "Const. Rotation" on page 36

"ACM" Variable coding and modulation.
The term ACM is retained for compatibility with DVB-S2 specified in ETSI EN 302 307. Not all PLPs use the same coding and modulation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CMTYpe?` on page 99

Static Flag ← PLP <num> table
Indicates if the scheduling for the current PLP varies from T2 frame to T2 frame or remains static.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:STAFlag?` on page 103

Static Padding Flag ← PLP <num> table
Indicates if BBFrame padding other than for in-band signaling is used for the current PLP.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:PADFlag?` on page 103

3.4 BICM settings

Access:

► Select "Baseband" > "DVB-T2" > "BICM".

The tab provides settings to configure bit-interleaved coding and modulation (BICM) parameters.

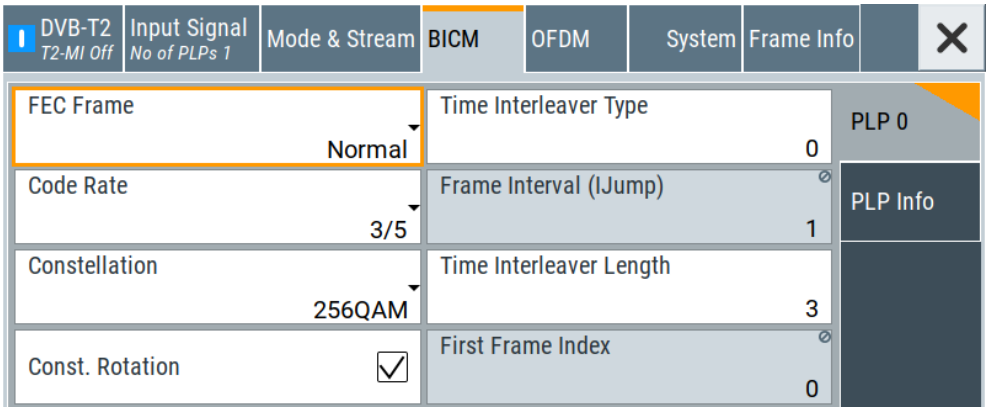
Settings:

- PLP 0 settings 35
- PLP Info 37

3.4.1 PLP 0 settings

Access:

► Select "BICM" > "General".



The tab provides settings to configure BICM parameters of "PLP 0".

Settings:

FEC Frame....35
Code Rate....35
Constellation....36
Const. Rotation....36
Time Interleaver Type....36
Frame Interval (I_{Jump})....36
Time Interleaver Length....36
First Frame Index....36

FEC Frame

Editing the parameter requires "T2-MI Interface > Off".

Sets the FEC frame.

"Normal" N_{LDPC} = 64800

"Short" N_{LDPC} = 16200

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FECFrame` on page 106

Code Rate

Editing the parameter requires "T2-MI Interface > Off".

Sets the code rate.

"1/3"/"2/5" Code rates not available for "System" > "Network" > "Transmission System" > "SISO" or "MISO".
See "Transmission System" on page 44.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:RATE` on page 107

Constellation
Editing the parameter requires "T2-MI Interface > Off".

Defines the constellation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CONStel` on page 105

Const. Rotation
Editing the parameter requires "T2-MI Interface > Off".

Sets the constellation rotation state.

"On"	Transmits the constellation rotated, i.e. the Q path is delayed vs. the I path. For each constellation, there is a different (but fixed) angle of rotation.
"Off"	Transmits non-rotated constellation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CROTation` on page 105

Time Interleaver Type
Editing the parameter requires "T2-MI Interface > Off".

Defines the time interleaver type.

"0"	Maps each interleaving frame directly to a T2 frame.
"1"	Maps each interleaving frame to more than one T2 frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:TYPE` on page 107

Frame Interval (I_{Jump})
Defines the time interleaver frame interval (I_{Jump}).

"1"	Used if the PLP appears in each frame. Fixed setting for single PLP.
"2" to "255"	Requires a multi-PLP setup. If frame interval is 2, for example, an interleaving frame is distributed among two successive T2 frames with an even frame index. For limitations, see specification ETSI EN 302 755.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:FINT` on page 107

Time Interleaver Length
Defines the time interleaver length within the time interleaving frame.

If a length of "0" is set and if "Time Interleaver Type" = "0", time interleaving is disabled.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:LENGth` on page 107

First Frame Index
Displays the index of the first frame of the super frame, in that the current PLP occurs.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FRAMeindex` on page 106

3.4.2 PLP Info

Access:

► Select "BICM" > "PLP Info".

FEC Frame	Normal
Code Rate	3/5
Constellation	256QAM
Const. Rotation	On
Time Interleaver Type	0
Frame Interval (IJump)	1
Time Interleaver Length	3
First Frame Index	0
FEC Blocks per IF	0
Max. Number of Blocks	0

The tab displays the "PLP <num>" table, that contains individual PLP information of up to 20 PLPs.
The information comprises BICM parameters for each PLP.

To configure "PLP Info" BICM parameters

1. Select "DVB-T2" > "T2-MI Interface" > "Off".
2. Select "BICM" > "PLP 0".

   You can configure the parameters only for "PLP 0".

Settings:

PLP <num> table 37
└ FEC Blocks per IF 37
└ Max. Number of Blocks 38

PLP <num> table
Displays individual parameters for each PLP `<num>`. The table displays information of up to 20 PLPs with `<num>` ranging from 0 to 19.

Note: Numbering in remote control commands.
The suffix `PLP<ch>` ranges from 1 to 20, the PLP number `num` ranges from 0 to 19.
See "Common suffixes" on page 80.

How to: "To configure "PLP Info" BICM parameters" on page 37

FEC Blocks per IF ← PLP <num> table
Displays the number of FEC blocks per interleaving frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BLOCks?` on page 105

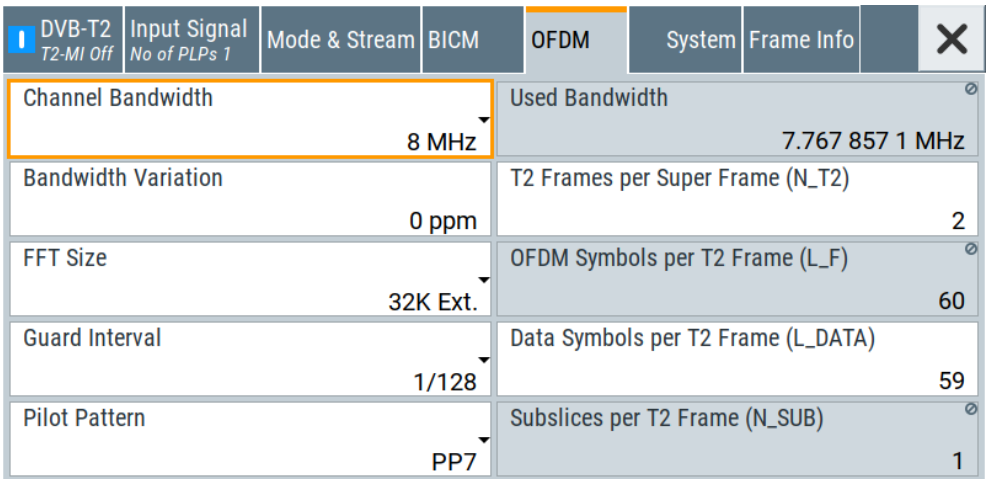
Max. Number of Blocks ← PLP <num> table
Displays the maximum number of FEC blocks per interleaving frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:MAXBlocks?` on page 106

3.5 OFDM settings

Access:

► Select "Baseband" > "DVB-T2" > "OFDM".



The dialog provides settings to configure OFDM settings.

Settings:

Channel Bandwidth....38
Used Bandwidth....39
Bandwidth Variation....40
FFT Size....40
Guard Interval....40
Pilot Pattern....40
T2 Frames per Super Frame (N_T2)....41
OFDM Symbols per T2 Frame (L_F)....41
Data Symbols per T2 Frame (L_DATA)....41
Subslices per T2 Frame (N_SUB)....41

Channel Bandwidth
Selects the channel bandwidth.

The channel bandwidth correlates with the used bandwidth, that is smaller. See Table 3-2.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:CHANnel[:BANDwidth]` on page 109

Used Bandwidth

Displays the used bandwidth.

The used bandwidth depends on the channel bandwidth, the FFT size and the carrier mode as described in Table 3-2.

You can set the carrier mode via "FFT Size", e.g. "32K Ext." means 32K FFT size using extended carrier mode.

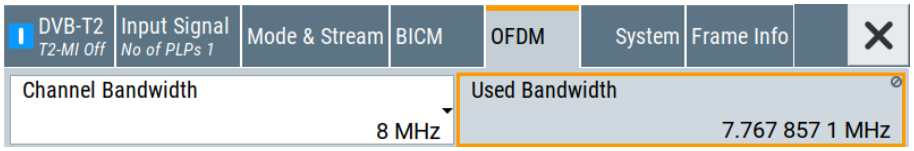
Table 3-2: Dependencies of the used bandwidth

"Channel Bandwidth"	Elementary frequency	"Used Bandwidth" Normal carrier mode	"Used Bandwidth" Extended carrier mode
1.7 MHz	131/71 MHz	1.535156 MHz	1.567589 MHz
5 MHz	40/7 MHz	4.754464 MHz	4.854911 MHz
6 MHz	48/7 MHz	5.705357 MHz	5.825893 MHz
7 MHz	56/7 MHz	6.656250 MHz	6.796875 MHz
8 MHz	64/7 MHz	7.607143 MHz	7.767857 MHz

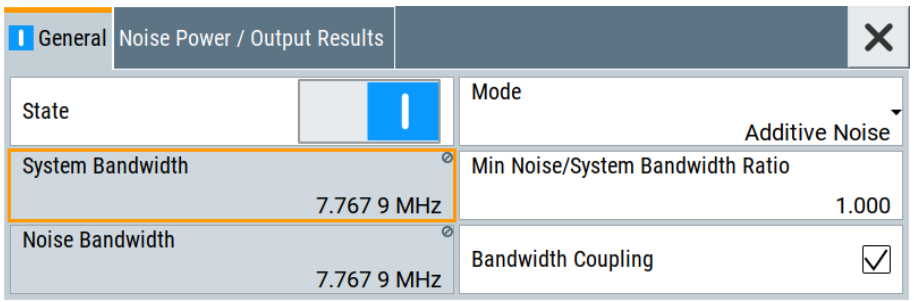
Example: Bandwidth coupling (R&S SMCVB-K62)

This example assumes an R&S SMCV100B equipped with the white gaussian noise (AWGN) option R&S SMCVB-K62 additional to the basic equipment, see Chapter 2.1, "Required options", on page 11.

In the OFDM settings tab, set the channel bandwidth as needed. The corresponding "Used Bandwidth" is displayed.



If you activate "Bandwidth Coupling" to couple bandwidths of the AWGN signal with the DVB-T2 baseband signal, the AWGN "System Bandwidth" adapts to the set "Used Bandwidth".



For more information, see chapter "AWGN settings" in the R&S SMCV100B base unit user manual.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:USED[:BANDwidth]?` on page 111

Bandwidth Variation
Requires "T2-MI Interface" > "Off".

Changes the used bandwidth in the range of ±1000 ppm.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:BANDwidth:VARiation` on page 109

FFT Size
Editing the parameter requires "T2-MI Interface > Off".

Defines the FFT size.

Note:
Not all possible combinations of the FFT size with the following parameters are allowed:
- "Guard Interval" on page 40
- "Pilot Pattern" on page 40

"1K"/"2K"/"4K"/"8K"/"16K"/"32K"
1K/2K/4K/8K/16K/32K FFT size using normal carrier mode

"8K Ext."/"16K Ext."/"32K Ext."
8K/16K/32K FFT size using extended carrier mode

Remote command:
`[:SOURce<hw>]:BB:T2DVb:FFT:MODE` on page 109

Guard Interval
Editing the parameter requires "T2-MI Interface > Off".

Sets the guard interval length.

The length Δ is expressed in fractions of the active OFDM symbol duration T_U, e.g. $\Delta / T_U = 19/256$

Note:
Not all possible combinations of the guard interval with the following parameters are allowed:
- "FFT Size" on page 40
- "Pilot Pattern" on page 40

Remote command:
`[:SOURce<hw>]:BB:T2DVb:GUARd:INTerval` on page 110

Pilot Pattern
Editing the parameter requires "T2-MI Interface > Off".

Sets the pilot pattern.

You can select pattern "PP1" to "PP8".

Note:
Not all possible combinations of the pilot pattern with the following parameters are allowed:
- "FFT Size" on page 40
- "Guard Interval" on page 40

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PILot` on page 111

T2 Frames per Super Frame (N_T2)
Editing the parameter requires "T2-MI Interface > Off".

Sets the number of T2 frames per super frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:NT2Frames` on page 111

OFDM Symbols per T2 Frame (L_F)
Displays the computed number of OFDM symbols per T2 frame L_F.

L_F equals the sum of number of data symbols per T2 frame L_{Data} plus the number of P2 symbols L_{P2}:

$L_F = L_{Data} + L_{P2}$

The sum constitutes the number of P2 symbols and the data symbols without the P1 symbol. The number of P2 symbols in a T2 frame depends on the "FFT Size".

Remote command:
`[:SOURce<hw>]:BB:T2DVb:LF?` on page 110

Data Symbols per T2 Frame (L_DATA)
Editing the parameter requires "T2-MI Interface > Off".

Sets the number of data symbols per T2 frame.

L_{Data} equals the difference of number of OFDM symbols per T2 frame L_F minus the number of P2 symbols L_{P2}:

$L_{Data} = L_F - L_{P2}$

Note:
The value of L_{Data} depends on the following parameters:
- "Guard Interval" on page 40
- "FFT Size" on page 40
- "T2 Frame Duration (T_F)" on page 54
  The maximum allowed T2 frame duration is 250 ms

The number of P2 symbols in a T2 frame depends on the "FFT Size".

Remote command:
`[:SOURce<hw>]:BB:T2DVb:LDATa` on page 110

Subslices per T2 Frame (N_SUB)
Sets the number of subslices per T2 frame.

The number of subslices is "1" for "T2-MI Interface > Off".

The set value depends on the constellation and the FEC type of all data type 2 PLPs.

"1"	Fixed setting for single PLP.
"1" to "6480"	Configurable setting for multi-PLP.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:NSUB` on page 110

3.6 System settings

Access:

► Select "Baseband" > "DVB-T2" > "System".

The dialog provides settings to configure DVB-T2 system parameters.

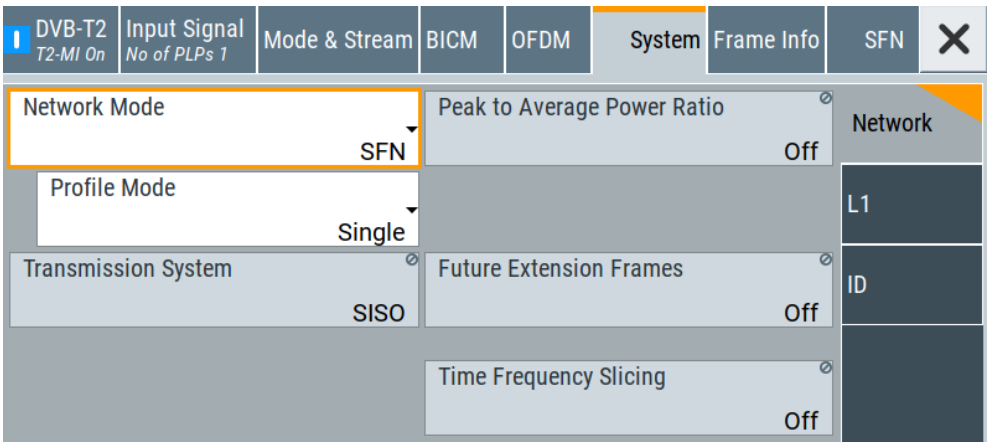
Settings:

- Network settings....42
- L1 settings....46
- ID settings....48

3.6.1 Network settings

Access:

► Select "System" > "Network".



The tab provides network settings.

Settings:

Network Mode....43
└ Profile Mode....43
Transmission System....44
└ MISO Group Mode....44
└ MISO Group....44
Peak To Average Power Ratio....44
Future Extension Frames....45
└ FEF Type (Hex)....45
└ FEF Length....45

└ FEF Interval..... 45
└ FEF Payload..... 45
Time Frequency Slicing.....45

Network Mode
Sets the network mode.

Note: GPS receiver required.
Correct SFN synchronization requires a GPS receiver:

- Connect the 1PPS output of the GPS receiver to the "User 2" connector of the R&S SMCV100B.
- Connect the 10 MHz output of the GPS receiver to the "Ref. In" connector of the R&S SMCV100B.
  At the R&S SMCV100B, set "RF" > "Reference Frequency" > "Reference Frequency" > "Source" > "External".

"SFN" In SFN mode, all transmitters in a network are tuned to the same frequency and have frequency coupling (based on the 10 MHz reference output of a GPS receiver). Also, compensate any signal delays that occur in the program data supply. This involves the use of a GPS receiver, see also "GPS receiver required" on page 43, and timestamps inserted into the T2-MI transport stream. The maximum delay in the network is set on the T2 gateway. It represents the maximum delay which can occur in the program data supply at the most remote transmitter in the network.
If a timestamp was received at the SFN transmitter, its modulator measures the dynamic delay regarding its own received seconds pulse from the local GPS receiver. From this information, together with the processing delay (of the modulator), the RF delay (from modulator to antenna) and the optional static delay, it computes the local delay. The supplied transport stream must undergo the computed local delay value to attain data synchronicity in the network. Note, that it is critical for the incoming transport stream to be identical for all the transmitters in the network, i.e. it may not be changed in any way. See also "Total Delay" on page 51.

"MFN" In MFN mode, there is no mandatory coupling between an individual transmitter and the incoming transport stream (based on the seconds pulse from a GPS receiver). In addition, the transmitters are not synchronized with one another based on a common reference and output frequency. You can select the modulation parameters of the transmitters involved in the network. In addition, the incoming transport stream can be adapted to the data rate requirements of the modulation parameter settings.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:NETWorkmode` on page 115

Profile Mode ← Network Mode
Requires "Network Mode" > "SFN".

Sets the profile mode.

If the modulator operates in a multiple profile environment and is used to generate an RF combined T2 base/T2 lite composite signal, can be used to mute P1FEF.

"Single" Modulator operates in normal mode. P1FEF is generated according to DVB-T2 specification ETSI EN 302 755.

"Multi" Modulator operates in multiple profile environment mode. P1FEF is muted to allow T2 base/T2 lite signal overlay on RF level.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PROFile` on page 116

Transmission System
Editing the parameter requires "T2-MI Interface > Off".

Sets the transmission system.

"SISO" Enables the SISO transmission.

"MISO" Enables the MISO transmission.

"Non-T2" Enables the non-T2 transmission.

"T2 Lite SISO" Enables the T2-Lite SISO transmission.

"T2 Lite MISO" Enables the T2-Lite MISO transmission.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:TXSYs` on page 116

MISO Group Mode ← Transmission System
Requires "Transmission System" > "MISO"/"T2 Lite MISO".

Sets the MISO group mode, that allows to set the MISO group of the modulator manually.

"Manual" Fixed MISO group mode. Allows manual setting of the "MISO Group".

Remote command:
`[:SOURce<hw>]:BB:T2DVb:MISO:MODE?` on page 115

MISO Group ← Transmission System
Requires "Transmission System" > "MISO"/"T2 Lite MISO".

Sets the MISO group.

"1" Modulator transmits with MISO group 1.

"2" Modulator transmits with MISO group 2.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:MISO[:GROup]` on page 115

Peak To Average Power Ratio
Editing the parameter requires "T2-MI Interface > Off".

Sets the technique to reduce the peak to average power ratio.

The current firmware does not support ACE.

"Off" Technique disabled.

"TR" Tone reservation enabled. I/Q values of the TR carriers are set to zero.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:PAPR` on page 115

Future Extension Frames
Enables/disables FEF.

"Off"	Disables FEF.
"On"	Requires "T2-MI Interface" > "On". Enables FEF and shows the following subparameters.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:FEF` on page 113

FEF Type (Hex) ← Future Extension Frames
Displays the type of the associated FEF part.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:FEF:TYPE` on page 115

FEF Length ← Future Extension Frames
Displays the length of the associated FEF part as the number of elementary periods T. The length is measured from the start of the P1 symbol of the FEF part to the start of the P1 symbol of the next T2 frame.

The FEF length is "0" for "T2-MI Interface" > "Off" because FEF is only supported for "T2-MI Interface" > "On". FEF is enabled or disabled by the information received from the T2-MI stream.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:FEF:LENGth` on page 114

FEF Interval ← Future Extension Frames
Displays the number of T2 frames between two FEF parts. The specification ETSI EN 302 755 states, that the T2 frame is the first frame in a T2 super frame which contains both FEF parts and T2 frames.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:FEF:INTerval` on page 113

FEF Payload ← Future Extension Frames
Sets the FEF payload.

"Null"	I/Q values of the FEF payload are set to zero.
"Noise"	I/Q values of the FEF payload are modulated in the frequency domain using a PRBS and transformed into the time domain by IFFT. The technique allows generating payload with a power level equal to the T2 frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:FEF:PAYLoad` on page 114

Time Frequency Slicing
Displays that time frequency slicing (TFS) is disabled.

The current firmware does not support TFS.

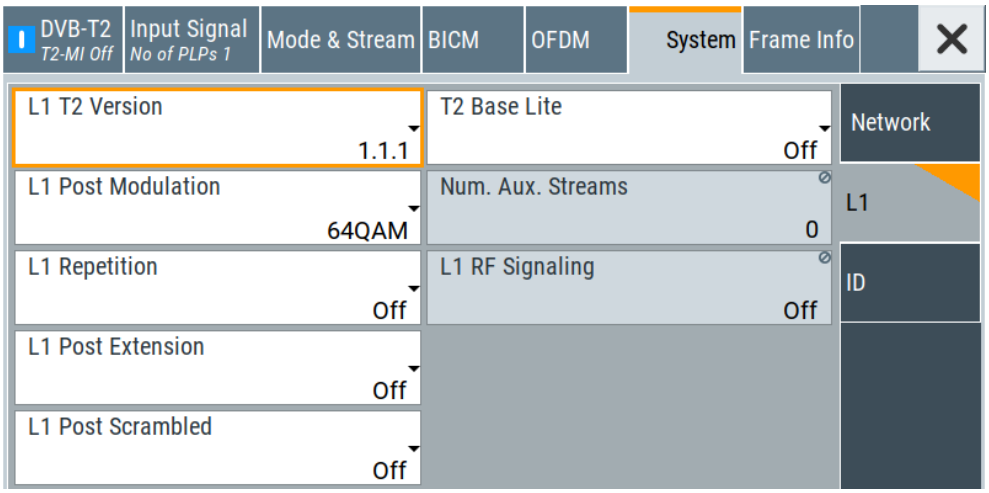
"Off" Fixed setting.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:TFS` on page 116

3.6.2 L1 settings

Access:

► Select "System" > "L1".



The tab provides common layer 1 (L1) settings.

Settings:

L1 T2 Version....46
L1 Post Modulation....47
L1 Repetition....47
L1 Post Extension....47
L1 Post Scrambled....47
T2 Base Lite....47
Num. Aux. Streams....47
L1 RF Signaling....48
└ Frequency....48

L1 T2 Version

Editing the parameter requires "T2-MI Interface > Off".

Sets the version of T2 specification ETSI EN 302 755, that is used for transmission.

"1.1.1"/"1.2.1"/"1.3.1"
Version V1.1.1/V1.2.1/V1.3.1

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:T2Version` on page 120

L1 Post Modulation
Editing the parameter requires "T2-MI Interface > Off".

Sets the modulation of the L1 post signal.

You can select between constellations BPSK/QPSK/16QAM/64QAM.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:CONStel` on page 118

L1 Repetition
Editing the parameter requires "T2-MI Interface > Off".

Enables/disables L1 repetition.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:REPetition` on page 118

L1 Post Extension
Displays the L1 post extension state.

The current firmware does not support L1 post extension.

"Off" Fixed setting.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:EXTension` on page 118

L1 Post Scrambled
Editing the parameter requires "T2-MI Interface > Off".

Enables/disables L1 post scrambling according to T2 version 1.3.1 of specification ETSI EN 302 755.

See also "L1 T2 Version" on page 46.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:SCRambled` on page 119

T2 Base Lite
Editing the parameter requires "T2-MI Interface > Off".

Enables/disables T2 base lite signaling according to T2 version 1.3.1 of specification ETSI EN 302 755.

See also "L1 T2 Version" on page 46.

"Off" Disables the T2 base lite signaling.

"On" Requires "T2-MI Interface" > "On".
Enables the T2 base lite signaling.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:T2Baselite` on page 120

Num. Aux. Streams
Displays the number of auxiliary streams.

The current firmware does not support auxiliary streams.

"0" Fixed setting.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:NAUX` on page 120

L1 RF Signaling
Displays the RF signaling state in L1.

The setting depends on the setting of the "T2-MI Interface".

"Off" Requires "T2-MI Interface" > "Off".
Transmitted frequency: 0x0000 0000

"On" Requires "T2-MI Interface" > "On".
The frequency is received from the T2-MI stream. The value is displayed under "Frequency" on page 48.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:RFSignalling` on page 119

Frequency ← L1 RF Signaling
Requires "T2-MI Interface" > "On".

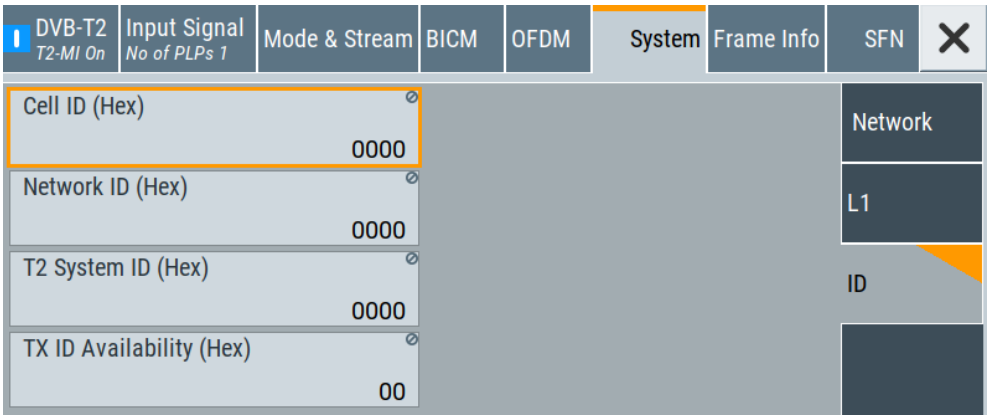
Displays the signaled frequency in the L1 signaling.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:L:RFSignalling:FREQuency?` on page 119

3.6.3 ID settings

Access:

► Select "System" > "ID".



The tab system ID settings.

Settings:

Cell ID (Hex).....49
Network ID (Hex).....49
T2 System ID (Hex).....49
TX ID Availability (Hex).....49

Cell ID (Hex)
Editing the parameter requires "T2-MI Interface > Off".

Sets the cell identification (ID).

The cell ID is a 16-bit value in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:ID:CELL` on page 121

Network ID (Hex)
Editing the parameter requires "T2-MI Interface > Off".

Sets the network identification.

The network ID is a 16-bit value in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:ID:NETWork` on page 121

T2 System ID (Hex)
Editing the parameter requires "T2-MI Interface > Off".

Sets the T2 system identification.

The T2 system ID is a 16-bit value in hexadecimal representation.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:ID:T2SYstem` on page 122

TX ID Availability (Hex)
Displays if transmitter identification signals are available within the current geographic cell. The parameter is an 8-bit value in hexadecimal representation.

If no transmitter identification signals are used, the parameter is "0x00". All other bit combinations are reserved for future use.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:ID:TXID:AVAil` on page 122

3.7 SFN settings

Access:

1. Select "Baseband" > "DVB-T2".
2. Select "T2-MI Interface" > "On".
3. Select "System" > "Network Mode" > "SFN".
4. Select "SFN".

The tab provides settings to configure SFN parameters.

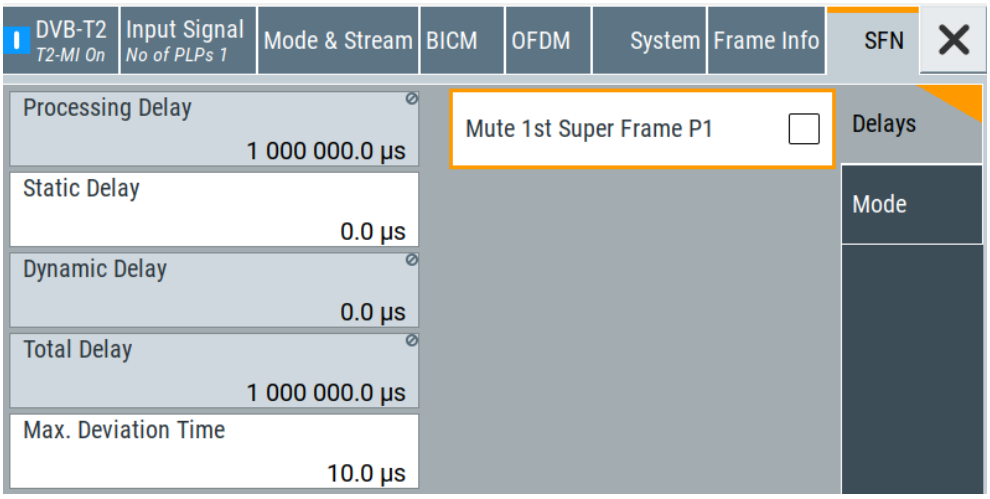
Settings:

- Delays 50
- Mode 51

3.7.1 Delays

Access:

► Select "SFN" > "Delays".



The tab provides settings to configure the SFN delay parameters.

Settings

Processing Delay 50
Static Delay 50
Dynamic Delay 50
Total Delay 51
Max. Deviation Time 51
Mute 1st Super Frame P1 51

Processing Delay
Displays the delay from the modulator input up to the SFN delay (FIFO).

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:PROCess?` on page 124

Static Delay
Sets the delay to shift the time of transmission positively or negatively.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:STATic` on page 125

Dynamic Delay
Displays the transmission delay currently generated by the SFN delay (FIFO).

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:DYNamic?` on page 124

Total Delay
Displays the sum of all individual delays.

"Total Delay" = "Process Delay" + "Static Delay" + "Dynamic Delay"

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TOTal?` on page 125

Max. Deviation Time
Sets the maximum permissible delay.

The delay Δt_{max} depends on the time of emission $TOE_{timestamp}$ from timestamp, the static delay t_{static} and the actual time of emission TOE_{actual} as follows:

$\Delta t_{max} = TOE_{timestamp} + t_{static} - TOE_{actual}$

If the above sum is greater than the "Max. Deviation Time", the SFN delay (FIFO) restarts. The transmit signal is reset and transmission is restarted.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:DEViation` on page 123

Mute 1st Super Frame P1
Activates muting the P1 symbol of the first T2 frame in a super frame. To mute the P1 symbol, the symbol is set to zero.

Activate muting, e.g., to synchronize different modulators in the same SFN, using an oscilloscope.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:MUTep1` on page 124

3.7.2 Mode

Access:

► Select "SFN" > "Mode".

The tab provides settings to configure the SFN mode parameters.

Settings:

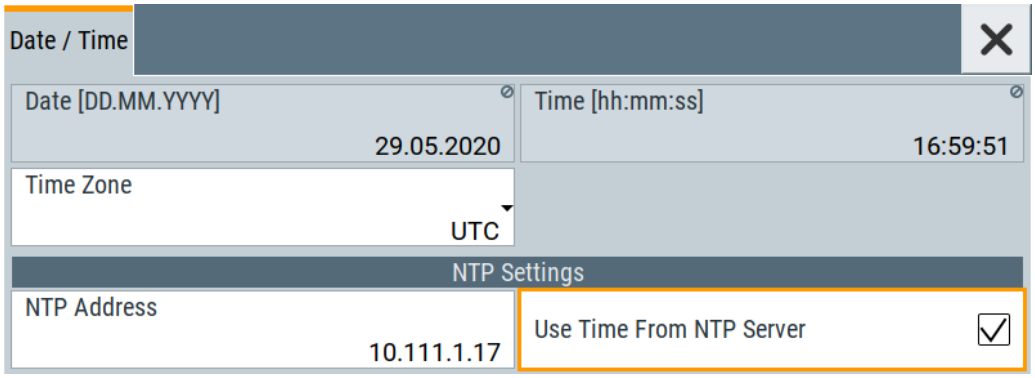
Timestamp Mode....51
Update Timestamp....52
UTC Date....52
UTC Time....52
Offset....52
Seconds Since 2000....53

Timestamp Mode
Displays the type of the currently received T2-MI timestamps.

Note:
If you use T2-MI timestamp packets with absolute time information for SFN operation, make sure that the following prerequisites are met:

- The R&S SMCV100B is connected to an NTP time server for time synchronization.
- The R&S SMCV100B uses the automatic time synchronization of the Linux operation system.

For automatic time synchronization, access "System Configuration" > "Setup" > "Maintenance" > "Date/Time". In the "NTP Settings" panel, enter the NTP address and enable "Use Time From NTP Server".



"Relative" Received T2-MI stream has T2-MI packets with relative timestamps.

"Absolute" Received T2-MI stream has T2-MI packets with absolute timestamps. If received, the following subparameters are displayed.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TSP:MODE?` on page 126

Update Timestamp
Clicking the button triggers an update of the UTC time and date reference.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TSP:UPDate` on page 127

UTC Date
Displays the UTC date from the last UTC reference update.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TSP:DATE?` on page 125

UTC Time
Displays the UTC time from the last UTC reference update.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TSP:TIME?` on page 127

Offset
Modifies the UTC/GPS leap seconds offset.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TSP:OFFSet` on page 126

Seconds Since 2000
Displays the elapsed time in seconds since 2000. The value is based on the value of the last UTC reference update.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:DELay:TSP:SEConds?` on page 126

3.8 Frame info

Access:

► Select "Baseband" > "DVB-T2" > "Frame Info".

The tab provides information on frame and symbol duration parameters.

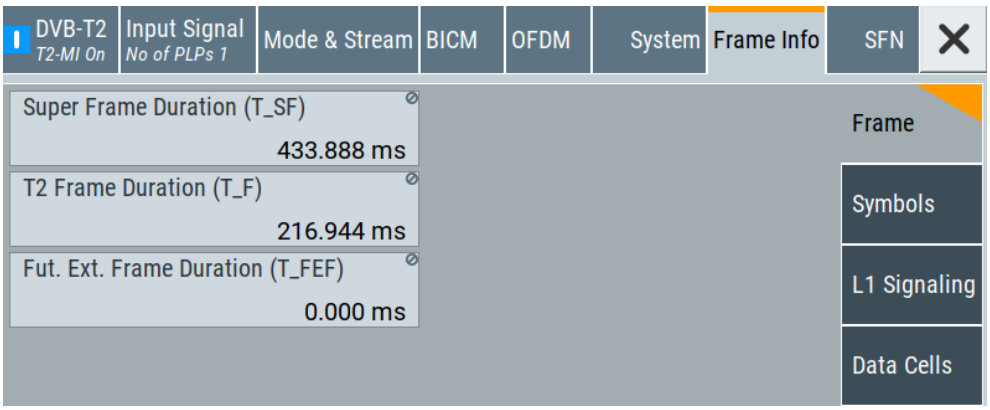
Settings:

- Frame....53
- Symbols....54
- L1 signaling....55
- Data cells....56

3.8.1 Frame

Access:

► Select "Frame Info" > "Frame".



The tab displays frame duration parameters.

Settings:

Super Frame Duration (T_SF)....54
T2 Frame Duration (T_F)....54
Future Extension Frame Duration (T_FEF)....54

Super Frame Duration (T_SF)
Displays the super frame duration.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:TSF?` on page 129

T2 Frame Duration (T_F)
Displays the T2 frame duration.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:TF?` on page 128

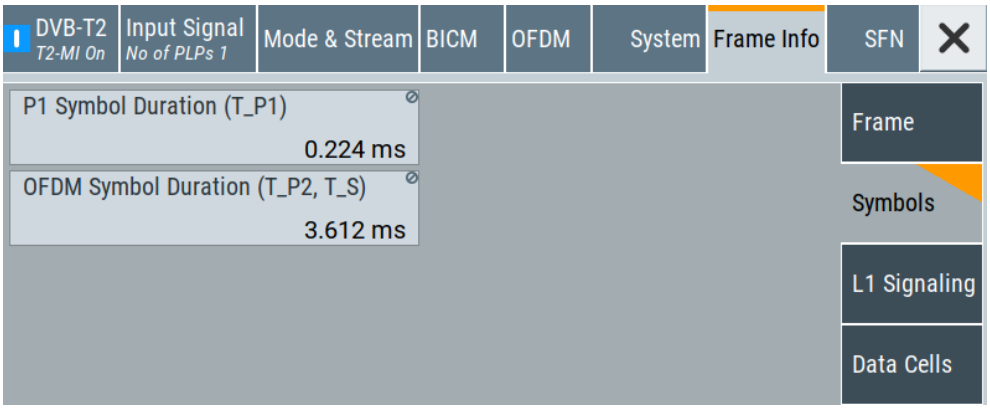
Future Extension Frame Duration (T_FEF)
Displays the future extension frame duration.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:TFEF?` on page 128

3.8.2 Symbols

Access:

► Select "Frame Info" > "Symbols".



The tab displays symbol duration parameters.

Settings:

P1 Symbol Duration (T_P1)..... 54
OFDM Symbol Duration (T_P2, T_S)..... 54

P1 Symbol Duration (T_P1)
Displays the P1 symbol duration.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:TP1?` on page 129

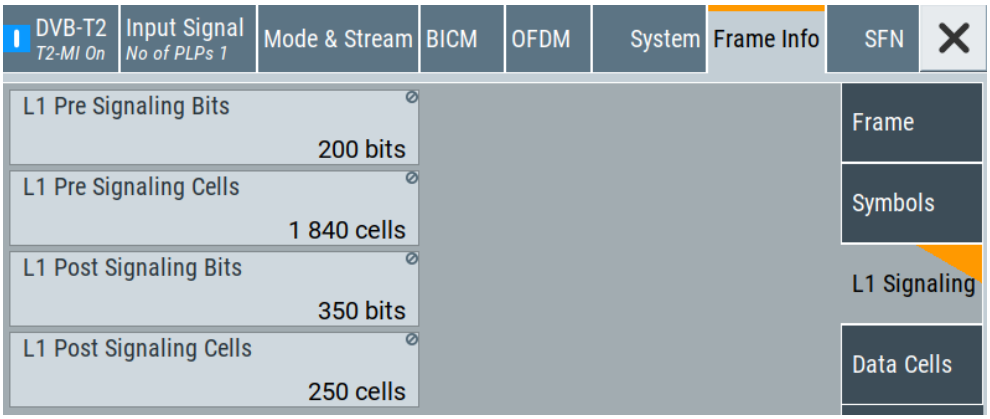
OFDM Symbol Duration (T_P2, T_S)
Displays the P2 and OFDM data symbol duration.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:TP2|TS?` on page 129

3.8.3 L1 signaling

Access:

► Select "Frame Info" > "L1 Signaling".



The tab displays L1-pre signaling and L1-post signaling parameters.

Settings:

L1 Pre Signaling Bits.....55
L1 Pre Signaling Cells.....55
L1 Post Signaling Bits.....55
L1 Post Signaling Cells.....55

L1 Pre Signaling Bits
Displays the L1-pre signaling length in bits.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:PREBits?` on page 131

L1 Pre Signaling Cells
Displays the L1-pre signaling length in cells.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:PRECells?` on page 131

L1 Post Signaling Bits
Displays the L1-post signaling length in bits.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:POSBits?` on page 130

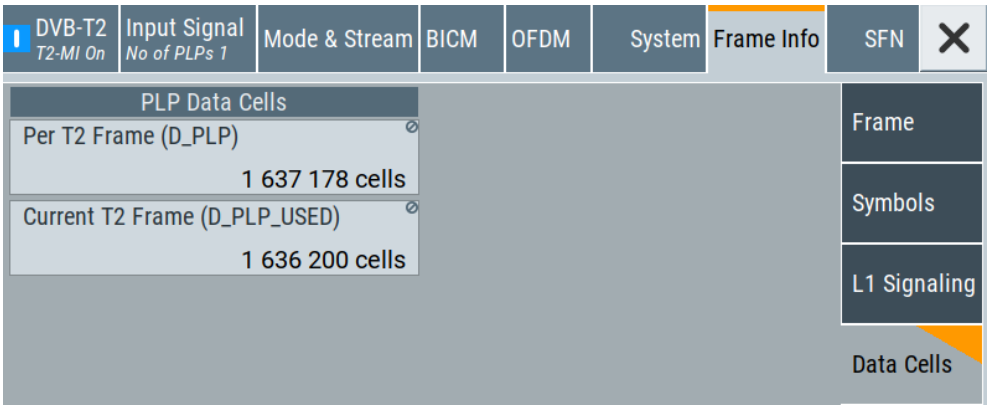
L1 Post Signaling Cells
Displays the L1-post signaling length in cells.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:POSCells?` on page 131

3.8.4 Data cells

Access:

► Select "Frame Info" > "Data Cells".



The tab displays payload information of the PLP data cells.

Settings:

PLP Data Cells.....56
└ Per T2 Frame (D_PLP).....56
└ Current T2 Frame (D_PLP_USED).....56

PLP Data Cells
Displays information on PLP data cells.

Per T2 Frame (D_PLP) ← PLP Data Cells
Displays the possible number of PLP data cells per T2 frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:DP?` on page 132

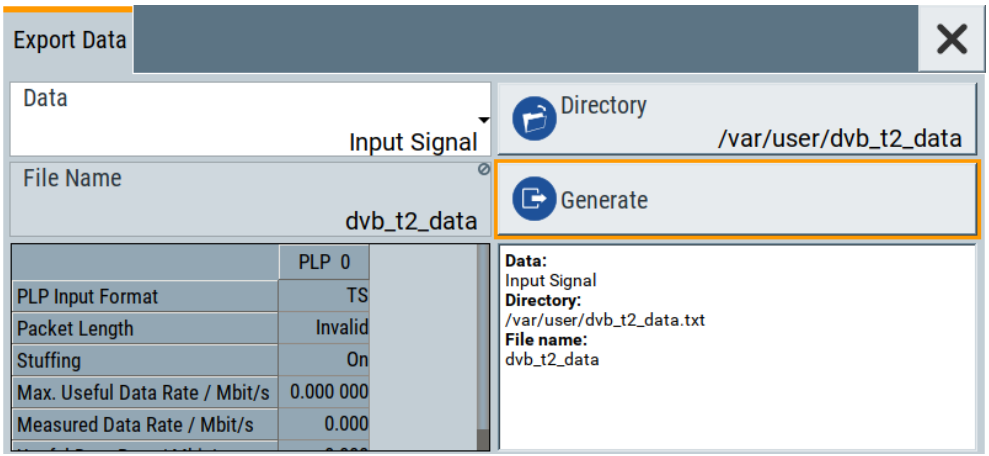
Current T2 Frame (D_PLP_USED) ← PLP Data Cells
Displays the current number of PLP data cells in the T2 frame.

Remote command:
`[:SOURce<hw>]:BB:T2DVb:INFO:DPUSed?` on page 132

3.9 Data generation settings

Access:

► Select "Baseband" > "DVB-T2" > "Data Generation".



The "Export Data" tab provides settings to generate data of the DVB-T2 signal characteristics. You can generate data from the input signal, Mode & Stream and BICM and export the data to a file.

Settings:

Data....57
File Name....57
Directory....57
Generate....58
File Info panel....58
PLP <num> table....58

Data
Sets the data source, for that the data is generated.

The table displays information on the PLPs for each data source "Input Signal"/"Mode & Stream"/"BICM".

Remote command:
n.a.

File Name
Displays the file name, for that the data is generated.

Remote command:
n.a.

Directory
Accesses the directory of the export data.

A standard "File Select" dialog opens.

Remote command:
n.a.

Generate
Triggers export data generation.

Remote command:
n.a.

File Info panel
Displays information on the selected file, such as data source, directory and filename.

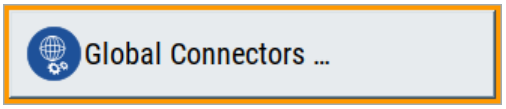
PLP <num> table
Displays individual parameters for each PLP `<num>`. The table displays information of up to 20 PLPs with `<num>` ranging from 0 to 19.

3.10 Global connector settings

Opens a dialog to configure global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs of baseband signal configuration dialogs that you can open via the "Baseband" block in the block diagram. These tabs are available, for example, for "ARB" baseband signals.
- "Input Signal" tab of configuration dialogs for broadcast digital baseband signals. Open these tabs, also via the "Baseband" block in the block diagram.



See also chapter "Global connector settings" in the user manual.

3.11 TS player

The "TS Player" application allows you to play stream files for simulation of dedicated transport stream (TS) scenarios. Also, the R&S SMCV100B offers stream libraries containing stream files with a wide range of ready-made signals for testing systems with different transmission parameters. For supported file types, see Table 3-3.

Key features

The key features for playing stream files with "TS Player" application are:

- Support of numerous broadcast transmission standards
- Streaming of high-quality video contents

- Streaming of high-quality audio contents
- Efficient use with dedicated streams

Required options

The equipment layout for processing files of waveform libraries includes:

- R&S SMCV100B base unit (64 MSample ARB memory, 60 MHz RF bandwidth)
- Broadcast standard option for the "TS Player" application (R&S SMCVB-Kxxx)
- Enable Broadcast Standards option (R&S SMCVB-K519)
- Stream library option (R&S SMCVB-KSxx)

For more information, refer to the specifications document.

To access and download a stream library file

The steps to access a stream library and to download stream library files is analogous as for waveform libraries. See chapter "Installation" in the user manual of the stream library at:

www.rohde-schwarz.com/manual/smcv100b/ksxx-kvxx-stream-and-waveform-libraries-user-manuals-manuals-gb1_78701-972224.html

To access the "TS Player" application

1. Select "Baseband > DVB-T2 > Input Signal".
2. Select "Source > TS Player".
3. Select "TS Player" button.

   Opens the TS player dialog, where you can load files.

Support in broadcast standard configuration

Various broadcast baseband standards of the R&S SMCV100B support the "TS Player" application. For an overview, see the table below.

Baseband standard	"Source > TS Player"	Baseband standard	"Source > TS Player"
"ATSC/ATSC-M/H"	Yes	"DVB-S"	Yes
"ATSC 3.0"	Yes	"DVB-S2"	Yes
"DTMB"	Yes	"DVB-C"	Yes
"DVB-T"	Yes	"J.83/B"	Yes
"DVB-T2"	Yes	"DRM"	No
"ISDB-T"	Yes	"Audio AM"	No
"T-DMB/DAB"	Yes	"Audio FM"	No

The remote commands required to define these settings are described in Chapter 5.9, "TSGen subsystem", on page 132.

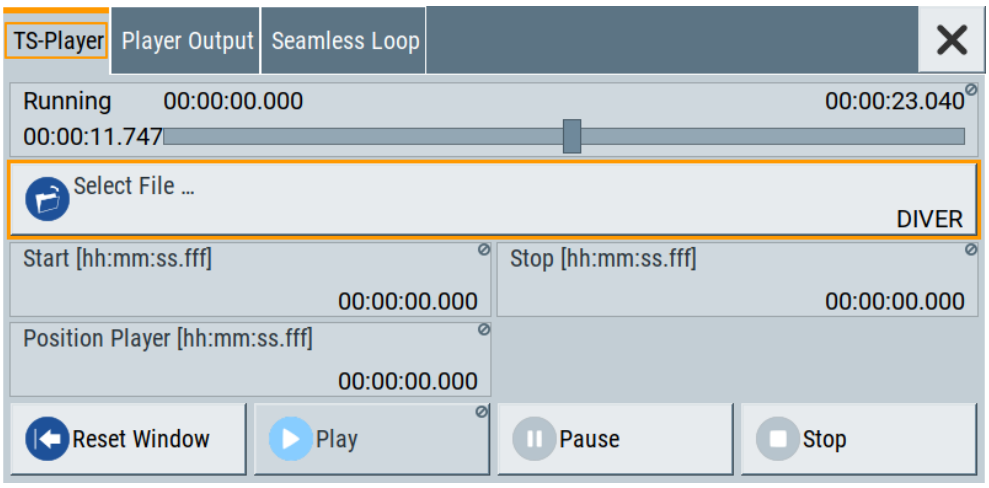
Settings:

- TS Player settings.....60
- Player output settings.....63
- Seamless loop settings.....66

3.11.1 TS Player settings

Access:

1. Follow the steps in "To access the "TS Player" application" on page 59.
2. Select "TS Player > TS-Player".



The tab provides settings to configure the general settings of the TS player application.

Settings:

Running/Position Player [hh:mm:ss:fff].....60
Select File.....61
Start [hh:mm:ss.fff].....62
Position Player [hh:mm:ss.fff].....62
Stop [hh:mm:ss.fff].....62
Reset Window.....62
Play.....62
Pause.....62
Stop.....62

Running/Position Player [hh:mm:ss:fff]
Displays the current position in time, while playing the file.

You can set an individual position via Position Player [hh:mm:ss.fff].

Remote command:
`:TSGen:CONFigure:SEEK:POSition` on page 137

Select File

Provides access to the standard "File Select" function of the instrument. The provided navigation possibilities in the dialog are self-explanatory.

See also, chapter "File and Data Management" in the R&S SMCV100B User Manual.

The dialog allows you to select user-defined, predefined and recent files. Table 3-3 lists file extensions of supported files.

Table 3-3: Supported TS player file types

File extension	Stream libraries	Remark	Option
`*.atsc_c`	ATSC/ATSC & Mobile DTV	Encrypted	R&S SMCVB-KS13
`*.dab`	T-DMB/DAB	Unencrypted	-
`*.dab_c`	T-DMB/DAB	Encrypted	R&S SMCVB-KS10
`*.dabp_c`	DAB+	Encrypted	R&S SMCVB-KS11
`*.eti`	T-DMB/DAB	Unencrypted	-
`*.xeti`	T-DMB/DAB	Unencrypted	-
`*.emc_c`	EMC	Encrypted	R&S SMCVB-KS15
`*.isdbt_c`	ISDB-T	Encrypted	R&S SMCVB-KS12
`*.pcap`	-	Captured IPv4 stream for ATSC 3.0 player	-
`*.t2mi`[1)]	-	Unencrypted	-
`*.t2mi_c`	DVB-T2 MI	Encrypted	R&S SMCVB-KS14
`*.t2trp_c`	DVB-T2 MI	Encrypted	R&S SMCVB-KS14
`*.trp`	-	Unencrypted	-
`*.trp_c`	-	Encrypted Included in various stream libraries	R&S SMCVB-KS12 R&S SMCVB-KS17 R&S SMCVB-KS18 R&S SMCVB-KS19 R&S SMCVB-KS20
`*.bin`	-	Unencrypted	-
`*.ts`	-	Unencrypted	-
`*.mpg`	-	Unencrypted	-
`*.t10`	-	-	-

[1)] For T2MI stream files, the data rate of a T2MI file is determined automatically, if the following applies:

- Data rate is not part of the TRP file header information.
- PCR information is not available.
- T2MI TRP file is not encrypted, that means not of type `*.t2mi_c`.
- TRP file has the `*.t2mi` file extension.

Remote command:
`:TSGen:CONFigure:PLAYfile` on page 136
`:TSGen:READ:PLAYfile:LENGth?` on page 140
`:TSGen:READ:FMEMory` on page 139

Start [hh:mm:ss.fff]
Sets the start position in the loaded player file. Data which chronologically precedes the start position is not replayed by the player.

The entered time stamp must chronologically always precede the entry under Stop.

Remote command:
`:TSGen:CONFigure:SEEK:STARt` on page 138

Position Player [hh:mm:ss.fff]
Displays the current play position in the file.

Remote command:
`:TSGen:CONFigure:SEEK:POSition` on page 137

Stop [hh:mm:ss.fff]
Sets the end position in the player file. Data which chronologically follows the end position is not replayed by the player.

When the player reaches the "Stop" position, it returns to the "Start" position (continuous play).

The entered time stamp must chronologically always follow the entry under Play.

Remote command:
`:TSGen:CONFigure:SEEK:STOP` on page 138

Reset Window
Resets "Start/Stop/Position Player" parameters.

Remote command:
`:TSGen:CONFigure:SEEK:RESet` on page 137

Play
Plays the selected file.

For supported file types, see Table 3-3.

Remote command:
`:TSGen:CONFigure:COMMand` on page 134

Pause
Pauses the player.

After pausing, you can resume playing the file by clicking "Play" again.

Remote command:
`:TSGen:CONFigure:COMMand` on page 134

Stop
Stops the player and returns to the start position.

Remote command:
`:TSGen:CONFigure:COMMand` on page 134

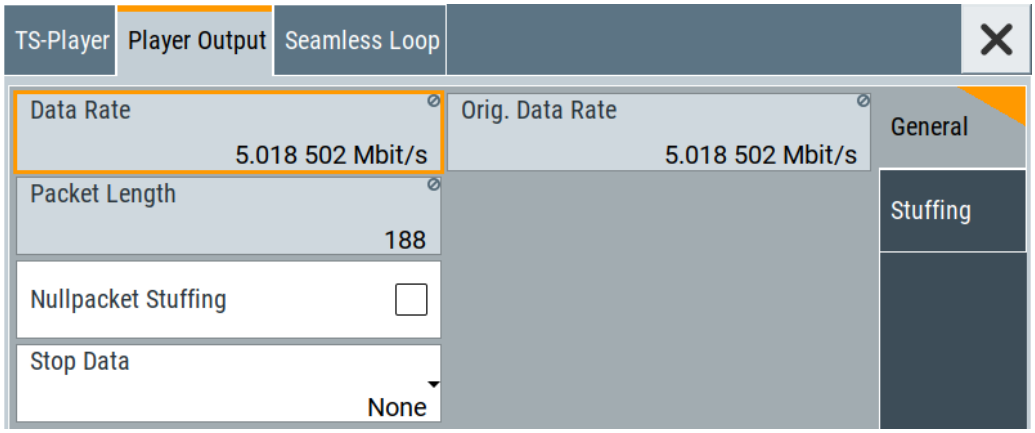
3.11.2 Player output settings

Access:

► Select "TS Player > Player Output".

The tab provides settings to configure the output of the TS player.

3.11.2.1 General settings



The tab provides settings to configure general player output properties.

Data Rate 63
Orig. Data Rate 63
Packet Length 64
Nullpacket Stuffing 64
Stop Data 64

Data Rate
Sets the output data rate of the player.

Note: If "Nullpacket Stuffing > Off", we recommend that you set the output data rate equal to the original data rate.

If you want to use a different data rate, activate "Nullpacket Stuffing". The function ensures that the data stream is replayed in the same way as it was recorded. The time references in the tables of the TS stream are also correct during replay.

Remote command:
`:TSGen:CONFigure:TSRate` on page 139

Orig. Data Rate
Displays the calculated original TS data rate.

Remote command:
`:TSGen:READ:ORIGtsrate` on page 140

Packet Length
Requires a `*.trp`, `*.trp_c`, `*.emc` or `*.emc_c` file loaded into the "TS Player" dialog. `*.trp` files are previously recorded files.

Displays the packet length of the loaded TS player file.

Remote command:
`:TSGen:CONFigure:PLENgth` on page 136

Nullpacket Stuffing
Requires a `*.trp`, `*.trp_c`, `*.emc` or `*.emc_c` file loaded into the "TS Player" dialog. `*.trp` files are previously recorded files.

Activates nullpacket stuffing.

By default nullpacket stuffing is deactivated. The output data rate of the TS player equals the original data rate as defined in the TS player file. Equal rates ensure that the time references in the tables of the played TS stream are correct during replay.

"On"	Activate stuffing, if you need a higher rate than the original data rate. Null packets are inserted into the data stream. To ensure correct time references in the stream tables, activate program clock reference correction. See "PCR, DTS/PTS" on page 67.
"Off"	Deactivate stuffing, if you want to use the same data rate as the original data rate.

Remote command:
`:TSGen:CONFigure:STUFfing` on page 138

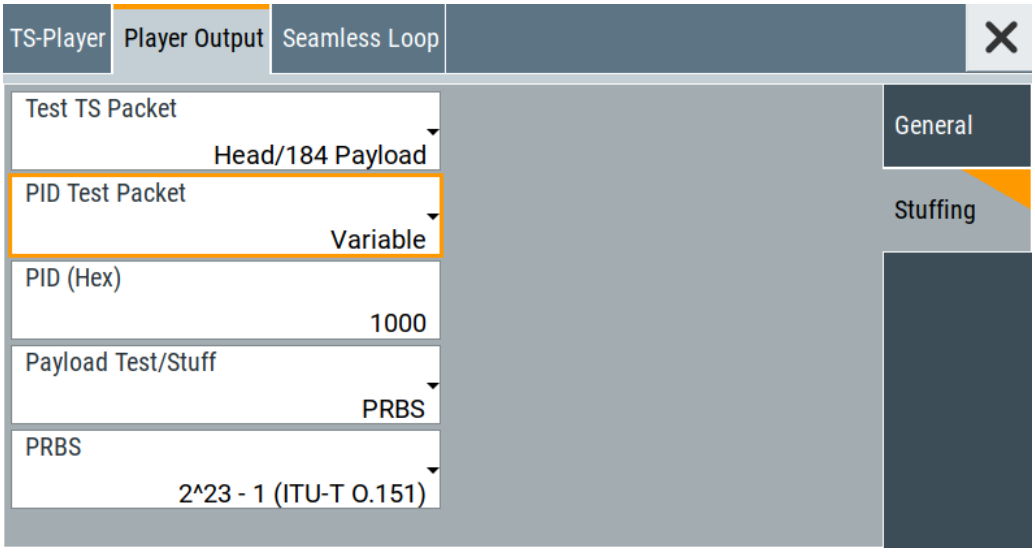
Stop Data
Requires a `*.trp`, `*.trp_c`, `*.emc` or `*.emc_c` file loaded into the "TS Player" dialog. `*.trp` files are previously recorded files.

Ensures that a standardized TS data stream is always output at the TS output at the rear of the R&S SMCV100B.

In pause or stop status, the TS generator generates "test packets", which have data and header parts that can be configured using the Test TS Packet.

Remote command:
`:TSGen:CONFigure:STOPdata` on page 138

3.11.2.2 Stuffing settings



The tab provides settings to configure stuffing.

Settings

Test TS Packet.....65
PID Test Packet.....66
PID (Hex).....66
Payload Test/Stuff.....66
PRBS.....66

Test TS Packet

Specifies the structure of the test transport stream packet that is fed to the modulator.

"Head/184 Payload"
A sync byte (0x47) followed by three header bytes and 184 payload bytes.

"Sync/187 Payload"
A sync byte (0x47) followed by 187 payload bytes.

"Head/200 Payload"
A sync byte (0x47) followed by three header bytes and 200 payload bytes.

"Sync/203 Payload"
A sync byte (0x47) followed by 203 payload bytes.

"Head/204 Payload"
A sync byte (0x47) followed by three header bytes and 204 payload bytes.

"Sync/207 Payload"
A sync byte (0x47) followed by 207 payload bytes.

Remote command:
`:TSGen:CONFigure:TSPacket` on page 139

PID Test Packet
If a header is present in the test packet ("Test TS Packet > Head/184 Payload"), you can specify a fixed or variable packet identifier (PID).

"Null"	The header of the test transport stream packets has a fixed setting of null packet header 1FFF (hex).
"Variable"	Uses the header value defined with PID (Hex).

Remote command:
`:TSGen:CONFigure:PIDTestpack` on page 135

PID (Hex)
Sets the PID.

If "PID Test Packet > Null", "PID (Hex) = 1FFF" is fixed.

If "PID Test Packet > Variable", you can edit the value.

Remote command:
`:TSGen:CONFigure:PID` on page 135

Payload Test/Stuff
Defines the payload area content of the TS packet.

"PRBS"	PRBS data in accordance with ITU-T O.151 See also section "About data signals" in the R&S SMCV100B user manual.
"0x00"	Exclusively 00 (hex) data
"0xFF"	Exclusively FF (hex) data

Remote command:
`:TSGen:CONFigure:PAYLoad` on page 135

PRBS
Sets the length of the PRBS sequence.

You can select a PRBS 15 or a PRBS 23 sequence as specified by ITU-T O.151.

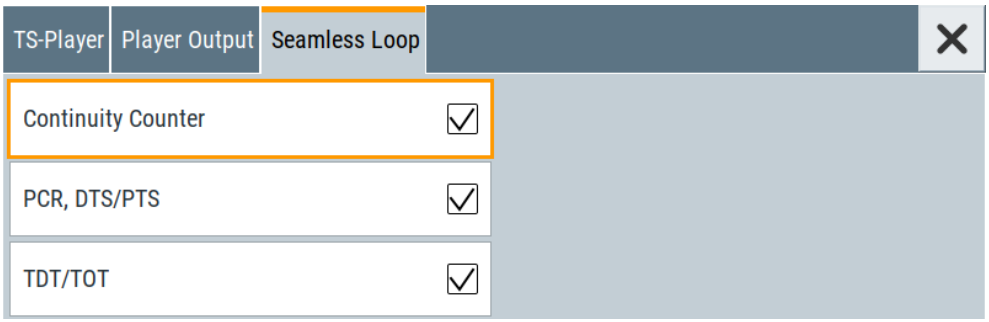
Remote command:
`:TSGen:CONFigure:PRBS[:SEQuence]` on page 136

3.11.3 Seamless loop settings

Displaying the tab requires a `*.trp`, `*.trp_c`, `*.emc` or `*.emc_c` file loaded into the "TS Player" dialog. `*.trp` files are previously recorded files.

Access:

► Select "TS Player > Seamless Loop".



The tab provides settings to configure settings for playing the file in a loop.

Settings:

Continuity Counter 67
PCR, DTS/PTS 67
TDT/TOT 67

Continuity Counter
Activates the correction of the continuity counters in the replayed TS data stream. The correction allows you to decode the stream without interruption when the play file is looping.

Remote command:
`:TSGen:CONFigure:SEAMless:CC` on page 136

PCR, DTS/PTS
Activates the correction of time stamps in the replayed TS data stream. The correction allows you to decode the stream without interruption when the play file is looping.

If you set "Nullpacket Stuffing = On" and "PCR, DTS/PTS = On", the time stamps in the streams are corrected when nullpackets are inserted into the stream.

Remote command:
`:TSGen:CONFigure:SEAMless:PCR` on page 137

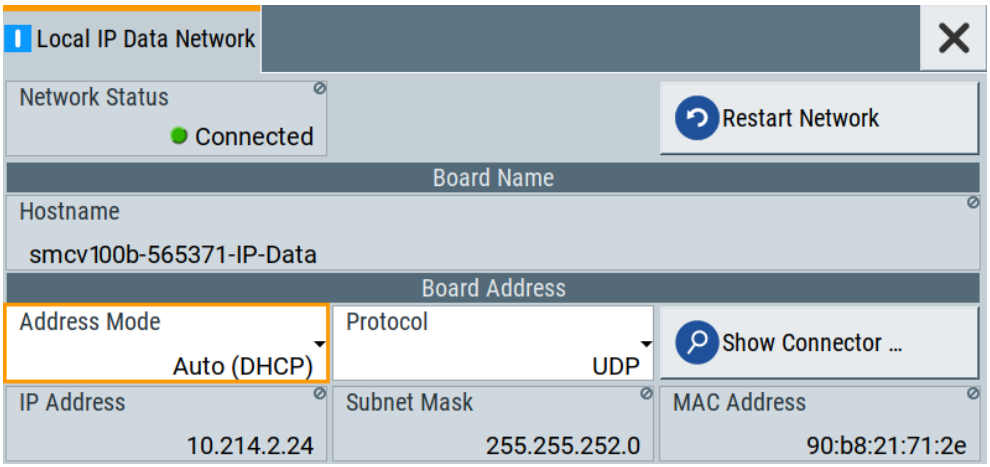
TDT/TOT
Activates the correction of the time and date table in the replayed TS data stream. The correction allows you to decode the stream without interruption when the play file is looping.

Remote command:
`:TSGen:CONFigure:SEAMless:TT` on page 137

3.12 Local IP data network settings

Access:

1. Select "Input Signal > General > Source > External".
2. Select "Input Signal > General > Input > IP"
3. Select "Input Signal > IP Channel x > Local IP Data Network".



The tab provides access to local IP data settings to configure the board address.

The remote commands to configure local IP data network settings are described in Chapter 5.10, "BCIP subsystem", on page 140.

How to: Chapter 4.1.1, "How to apply an external IP input signal", on page 71

Settings:

Network Status....68
Restart Network....69
Hostname....69
Address Mode....69
IP Address....69
Protocol....70
Subnet Mask....70
Show Connector....70
MAC Address....70

Network Status

Indicates that the instrument is connected to the network.

If the instrument is disconnected, try "Restart Network".

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:STATus` on page 143

Restart Network
Terminates the network connection of the instrument and sets it up again later. You can use this function to fix network problems.

Note: This function restarts only the connection of the instrument to the network. It does not impact the network itself.

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:RESTart` on page 143

Hostname
Displays the hostname.

Displayed is the board name that is the name of the IP data board of the R&S SMCV100B. For example, the hostname can be `SMCV100B-123456-IP-Data`.

Each instrument is delivered with an assigned hostname, a logical name which can be used instead of the IP address. With the default network settings, the IP address is allocated by the DHCP server. This address can change each time the instrument is reconnected. Unlike the IP address, the hostname name does not change.

Note:
This function is password-protected. Unlock the protection level 1 to access it.

We recommend that you do not change the default network settings or the hostname to avoid problems with the network connection.

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:COMMon:HOSTname` on page 141

Address Mode
Selects the mode for assigning the IP address.

"Auto (DHCP)"
Assigns the IP address automatically, provided the network supports DHCP.

"Static"
Enables you to assign the IP address manually.

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress:MODE` on page 142

IP Address
Displays the IP address of the instrument in the local IP data network.

By default, the R&S SMCV100B is configured to use dynamic TCP/IP configuration and to obtain the whole address information automatically.

If the network does not support DHCP or the attempt does not succeed, the instrument tries to obtain the IP address via Zeroconf (APIPA) protocol. IP addresses assigned via Zeroconf start with the number blocks `169.254.*.*`.

Note: An IP address that is assigned via the Zeroconf protocol although the network requires an IP address assigned via the DHCP server can cause network connection failures.

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress` on page 142

Protocol
Sets the protocol type of the input IP data.

The current firmware supports UDP and UDP/RTP.

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:PROTocol` on page 142

Subnet Mask
Displays the bit group of the subnet in the host identifier.

To assign the subnet mask manually, select "Address Mode > Static".

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress:SUBNet:MASK` on page 142

Show Connector
Accesses a dialog that displays the physical location of the selected connector on the front/rear panel of the instrument.

MAC Address
Displays the MAC address, a unique identifier of the network adapter in the R&S SMCV100B.

Remote command:
`:SYSTem:COMMunicate:BCIP<hw>:NETWork:MACaddress` on page 142

4 Performing DVB-T2 signal generation tasks

This section provides information to configure the R&S SMCV100B to generate signals for simple receiver tests. Also, it provides information on troubleshooting warning messages for external input signals.

- Configuring the input signal....71
- Monitoring the input signal....76
- Troubleshooting external input signal warnings....78

4.1 Configuring the input signal

This chapter provides an overview of the different input signals that the R&S SMCV100B uses as modulation data.

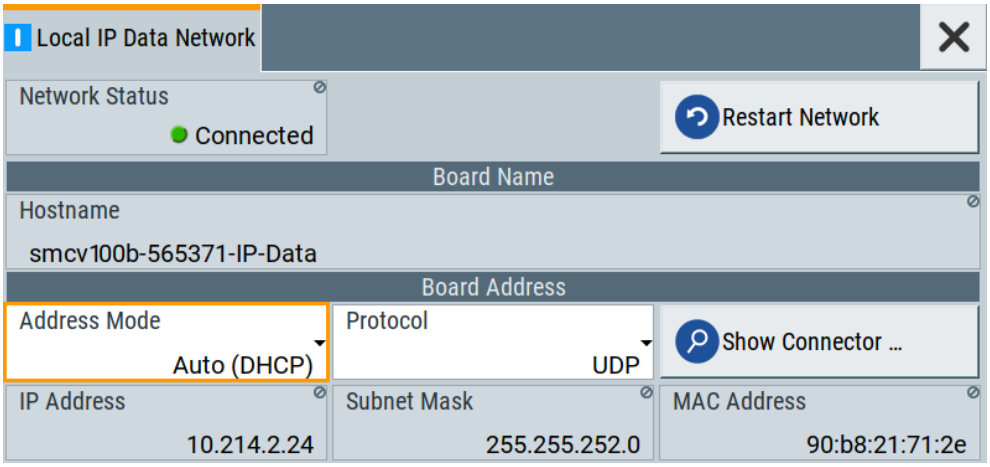
- How to apply an external IP input signal....71
- How to apply an external TS input signal....74
- How to generate an internal TS signal....75

4.1.1 How to apply an external IP input signal

To connect the R&S SMCV100B to local IP data network

1. Connect the IP source to the "IP Data" connector of the R&S SMCV100B.
   See section "To connect to IP Data interface" in the R&S SMCV100B user manual.
2. Select "Input Signal" > "General" > "Source" > "External".
3. Select "Input Signal" > "General" > "Input" > "IP".
4. In the "IP Channel x" side tab, select "Local IP Data Network".

   By default, the R&S SMCV100B assigns the IP address automatically using DHCP ("Address Mode" > "Auto (DHCP)").
5. If the network status displays "Disconnected", try "Restart Network".



The R&S SMCV100B is connected to the local IP data network.

6. If DHCP does not assign an IP address, assign the IP address manually.
   See chapter "How to assign the IP address" in the R&S SMCV100B user manual.

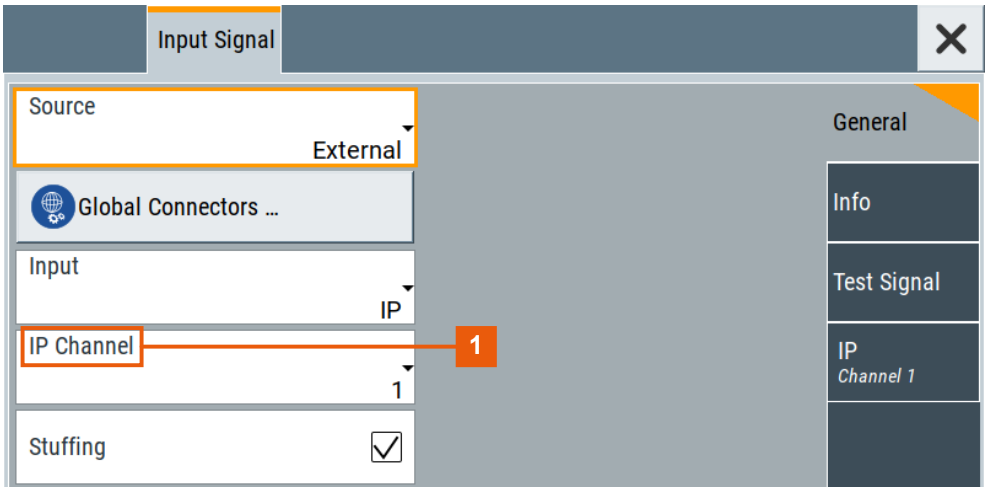
7. Specify the protocol type of the input IP data.
   The current firmware supports UDP and UDP/RTP.

To configure an external IP input signal

The R&S SMCV100B is connected to a local IP data network, see "To connect the R&S SMCV100B to local IP data network" on page 71.

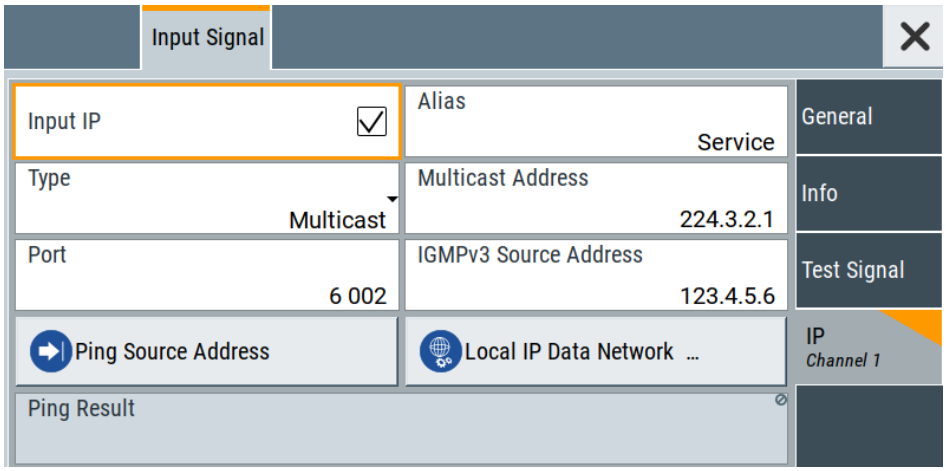
1. Specify general IP input signal properties:
   a) Select "Input Signal" > "General" > "Source" > "External".
   b) Select "Input" > "IP".
   c) Specify the IP TS Channel, e.g. "IP TS Channel" > "1".

   The "IP Channel 1" side tab appears, where you can configure the IP connection for channel 1 and channel-independent local IP network settings.



1 = IP channel notation: IP TS Channel

2. Optionally, if supported, activate "Stuffing" to adjust the TS data rate.
3. Specify IP TS channel properties, e.g. for "IP TS Channel" > "1":
   a) Define the input type, e.g. "Type" > "Multicast".
   b) Specify the "Multicast Address" that is the destination IPv4 address of the IP connection.
      Note: Use the destination address also in the IP data source, e.g. a stream program.
   c) Specify the port that is the destination port of the IP connection.
      Note: Use the destination port also in the IP data source.
   d) Specify the IGMPv3 source address that is the source IPv4 address of the IP connection.
      A source address different from "0.0.0.0" accepts only data originating from the specified IP address.
   e) Optionally, to check the availability of the "IGMPv3 Source Address", click "Ping Source Address"
      - If "Ping Result" > "Ping: Successful", the source address is available.
      - If "Ping Result" > "Ping: Transmit Failed. Destination Host Unreachable", try another address.
   f) Optionally, specify a name for the IP connection, e.g. "Alias" > "Service".
   g) Select "Input IP" > "On", to activate the IP channel.



   The R&S SMCV100B is prepared for receiving IP TS data that is input at the "IP Data" connector.

Monitor IP data stream properties in the "Info" side tab, see Chapter 4.2.1, "How to monitor external IP input data", on page 77.

4.1.2 How to apply an external TS input signal

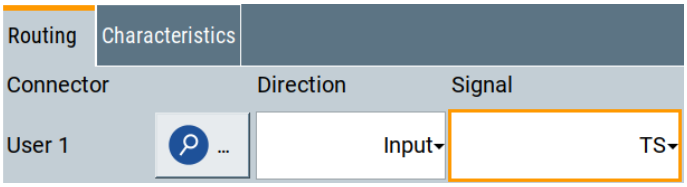
To connect to the external TS input interface

1. Use a double-shielded 75 Ω BNC cable for connection between R&S SMCV100B and the external MPEG TS data source.
   See also section "Cable selection and electromagnetic interference (EMI)" in the R&S SMCV100B user manual.
2. At the R&S SMCV100B, connect the cable to the "User 1" connector.
   The connector is on the rear panel of the R&S SMCV100B.
   How to: Section "To connect to pluggable connectors" in the R&S SMCV100B user manual.

To specify the TS input interface at the R&S SMCV100B

The R&S SMCV100B is connected to an MPEG TS data source via the "User 1" connector.

1. Select "Input Signal" > "General" > "Source" > "External".
2. Select "General" > "Global Connectors".
3. In the "Global Connectors" dialog, configure the "User 1" connector for a TS input signal:
   a) Select "Direction" > "Input".
   b) Select "Signal" > "TS".

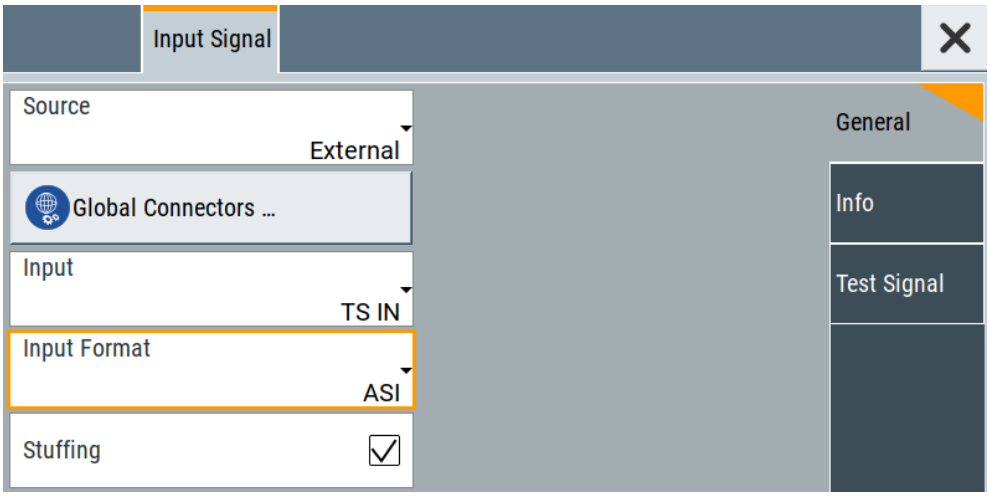


To configure an external TS input signal

The R&S SMCV100B is prepared for receiving a TS input signal at the "User 1" connector.

1. Specify general TS input signal properties:
   a) Select "Input Signal" > "General" > "Source" > "External".
   b) Select "Input" > "TS IN".
   c) Specify the format of the input signal:
      - Select "ASI", if you have a source supporting ASI format.
      - Select "SMPTE 310", if you have a source supporting SMPTE 310 format.
2. Optionally, activate "Stuffing" to adjust the TS data rate.

You can further specify the payload of the stuffing data, see "Test Signal" > "Payload Test/Stuff."



The R&S SMCV100B is prepared for receiving TS data that is input at the "User 1" connector.

Monitor TS data stream properties in the "Info" side tab, see Chapter 4.2.2, "How to monitor an external TS input signal", on page 77.

4.1.3 How to generate an internal TS signal

To play a TS file with the "TS Player"

1. Select "Input Signal" > "Source" > "TS Player".

   The "TS Player" button appears below.

2. Click "TS Player".

   The "TS Player" dialog for playing TS data files opens.

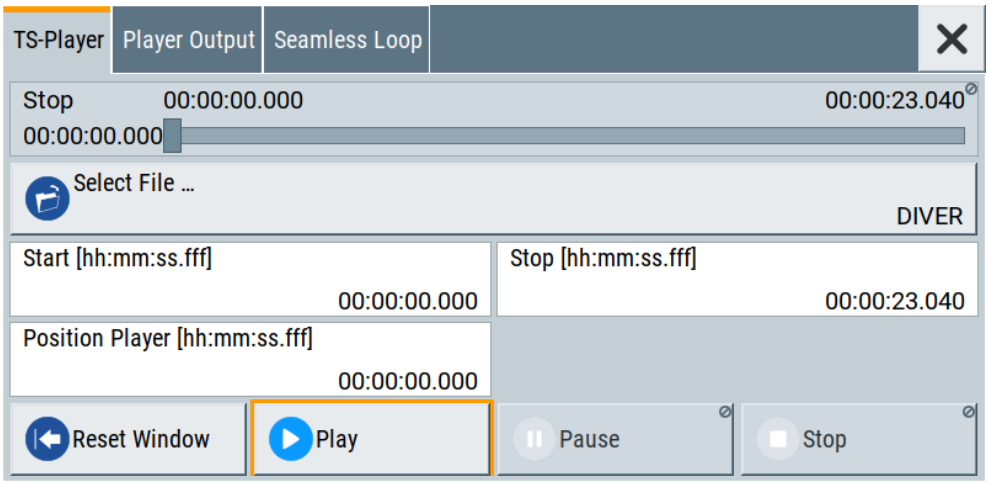
3. Click "Play" to play the default file `DIVER.trp`.
   Playing the file requires no option.

To load and play a stream library file

1. Load the file from its storage location:
   - External storage device (HDD, memory stick): Load the file from the `/usb/` directory.
   - Internal memory (SSD): Load the file from the user directory `/var/user/`

   Note: Library files are encrypted files. Loading the library file at the R&S SMCV100B requires installation of the corresponding library option. See "Required options" on page 59.

2. To load the file at the R&S SMCV100B, open the "TS Player" application in digital broadcast standard ("<Broadcast_Standard>") dialogs:
   a) Select "Baseband" > "<Broadcast_Standard>" > "Input Signal".
   b) Select "Source" > "TS Player".
   c) Select "TS Player" button.
   d) Select "Select File".
3. To select the file, navigate to the storage location (1).
4. Select "TS-Player" > "Play".



   The R&S SMCV100B processes the stream file.
5. Select "<Broadcast_Standard>" > "State" > "On", to activate the baseband signal.
6. In the block diagram, select "RF" > "On".

   The stream file is modulated onto the RF carrier and output at the "RF 50 Ω" connector.

4.2 Monitoring the input signal

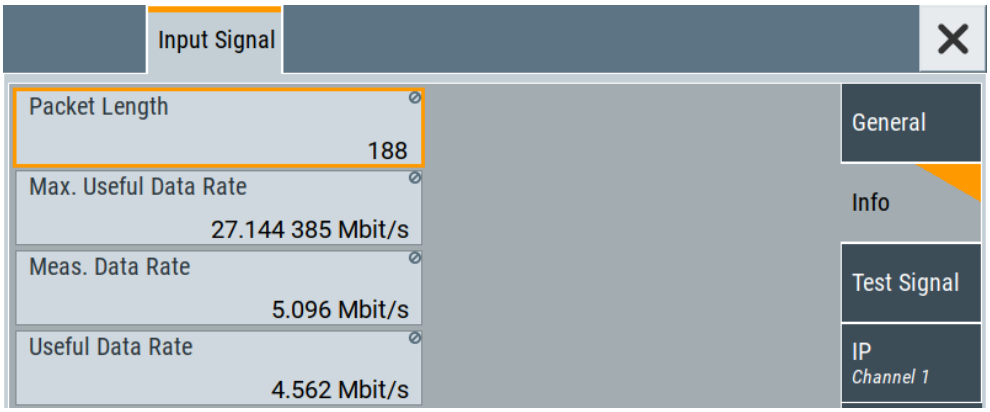
This chapter provides an overview of the different input signals that the R&S SMCV100B uses as modulation data.

- How to monitor external IP input data 77
- How to monitor an external TS input signal 77
- How to monitor an internal TS player signal 78

4.2.1 How to monitor external IP input data

The R&S SMCV100B receives external IP input data as described in Chapter 4.1.1, "How to apply an external IP input signal", on page 71.

► Select "Input Signal" > "Info"



The "Info" side tab displays the physical properties of the input IP stream data.

The standard packet length is 188 byte. The maximum useful data rate is specified by the broadcast standard.

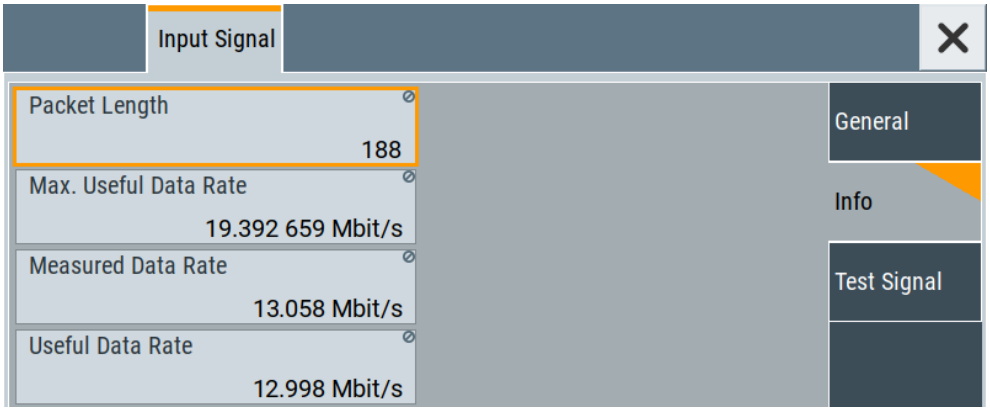
The measured data rate is lower and depends on the TS source settings. The useful data rate is lower than the measured data rate due to null packets present in the transport stream.

If "Stuffing" > "On", the useful data rate can be lower than the maximum useful data rate.

4.2.2 How to monitor an external TS input signal

The R&S SMCV100B receives external TS input data as described in Chapter 4.1.2, "How to apply an external TS input signal", on page 74.

► Select "Input Signal" > "Info".

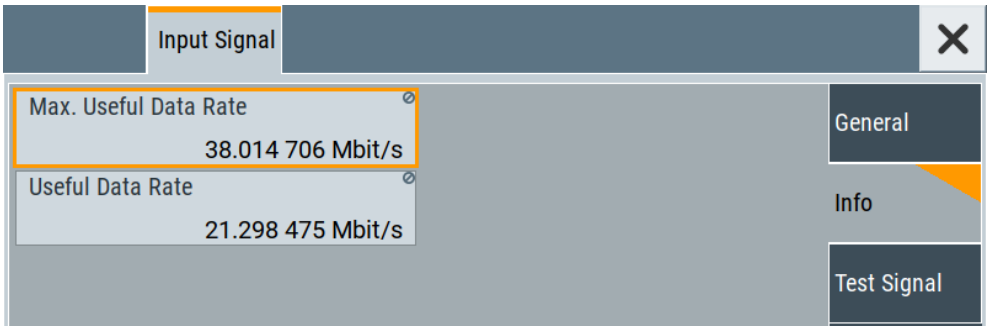


The "Info" side tab displays the physical properties of the input TS stream data.

4.2.3 How to monitor an internal TS player signal

The R&S SMCV100B receives internal TS input data as described in Chapter 4.1.3, "How to generate an internal TS signal", on page 75.

► Select "Input Signal" > "Info".



The "Info" side tab displays the physical properties of the TS player stream data.

4.3 Troubleshooting external input signal warnings

This chapter provides warning messages and handling of the R&S SMCV100B when enabling modulation of external input signals. Some of these warning messages can appear in all standards or can be standard-specific. The table below provides an overview on the broadcast standards with TS/ETI input signal sources and related warning messages and their remedies.

Standard	TS/ETI source	Warning message	Remedy
All standards	TS IN, IP TS x, IP ETI x, TS player	Data rate out of range	Adjust the data rate in the configuration of the corresponding standard or provide a transport/ETI stream with the correct data rate.
All standards	TS IN, IP TS x, IP ETI x, TS player	Data rate too low	Adjust the data rate in the configuration of the corresponding standard or provide a transport/ETI stream with the correct data rate.
All standards	TS IN, IP TS x, IP ETI x, TS player	Data rate too high	Adjust the data rate in the configuration of the corresponding standard or provide a transport/ETI stream with the correct data rate.
All TS standards	TS IN, IP TS x, TS player	Useful data rate too high	Adjust the data rate of the provided transport stream.
All TS standards	TS IN, IP TS x, TS player	Missing transport stream	Check if a transport stream is provided and wait until the transport stream is established.
All TS standards	TS IN, IP TS x, TS player	Wrong packet length	Provide a transport stream with valid packet length that complies with the standard.
All TS standards	TS IN, IP TS x, TS player	Invalid transport stream input format	Set a correct TS input format that complies with the standard.
ATSC 3.0	IP, TS player	Missing IP stream	Check IP settings at the input interface of the coder and provide a correct IP stream.
ATSC 3.0	IP, TS player	STL Demux unlocked	Check the provided STL transport stream for errors and STL settings on the "Special" tab of the coder.
ATSC 3.0, DVB-T2	TS IN, IP TS x, TS player	Missing timestamps for SFN operation	Set correct SFN timestamps in the provided transport stream.
ATSC 3.0, DVB-T2, T-DMB/DAB	"USER 2" connector	Missing 1PPS signal for SFN operation	Connect a 1PPS signal to the "USER 2" connector on the rear panel of the R&S SMCV100B.
DVB-T2	TS IN, IP TS x, TS player	Stuffing not allowed in SFN operation	Disable stuffing at the input interface settings of the specific coder.
DVB-T2	TS IN, IP TS x, TS player	T2-MI Demux unlocked	Check the provided T2-MI transport stream for errors.
T-DMB/DAB	TS IN, IP ETI x, TS player	Missing ETI stream	Check if an ETI stream is provided and wait until the ETI stream is established.
T-DMB/DAB	TS IN, IP ETI x, TS player	Wrong ETI layer	Provide an ETI stream with the correct ETI layer.
T-DMB/DAB	TS IN, IP ETI x, TS player	Missing or invalid TIST for SFN operation	Set a correct time stamp (TIST) packet in the provided ETI stream.
T-DMB/DAB, ISDB-T	TS IN, IP TS x, IP ETI x, TS player	Missing or invalid TIST/IP for automatic control operation	T-DMB/DAB: Set a correct time stamp (TIST) packet in the provided ETI stream. ISDB-T: Set a correct information packet (IP) in the provided BTS transport stream.

5 Remote-control commands

The following commands are required to generate signals with the DVB-T2 option in a remote environment. We assume that the R&S SMCV100B has already been set up for remote operation in a network as described in the R&S SMCV100B 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 SMCV100B user manual.

Common suffixes

The following common suffixes are used in the remote commands:

Suffix	Value range	Description
`SOURce<hw>`	1	Available baseband signals
`PLP<ch>`	1 to 20	Available number PLPs

Programming examples

This description provides simple programming examples. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

At the beginning of the most remote control program, an instrument preset/reset is recommended to set the instrument to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

The following commands specific to the DVB-T2 are described here:

- General commands....81
- Input commands....83
- Mode and stream commands....98
- BICM commands....104
- OFDM commands....108
- System commands....112
- SFN delay commands....122
- Frame info commands....127
- TSGen subsystem....132
- BCIP subsystem....140

5.1 General commands

Example: Saving current configuration

```
SOURce1:BB:T2DVb:SETTing:STORe "/var/user/my_dvbt2"
// Saves the file "my_dvbt2.dvbt2" in the directory as above.
*RST

SOURce1:BB:T2DVb:SETTing:CATalog?
// Response: "my_dvbt2"
SOURce1:BB:T2DVb:SETTing:LOAD "/var/user/my_dvbt2"
SOURce1:BB:T2DVb:STATe 1
SOURce1:BB:T2DVb:SETTing:DELete "/var/user/my_dvbt2"
```

Commands

[:SOURce<hw>]:BB:T2DVb:PRESet 81
[:SOURce<hw>]:BB:T2DVb:STATe 81
[:SOURce<hw>]:BB:T2DVb:SETTing:CATalog? 82
[:SOURce<hw>]:BB:T2DVb:SETTing:DELete 82
[:SOURce<hw>]:BB:T2DVb:SETTing:LOAD 82
[:SOURce<hw>]:BB:T2DVb:SETTing:STORe 82

[:SOURce<hw>]:BB:T2DVb: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:T2DVb:STATe`.

Example: See Example"Saving current configuration" on page 81.

Usage: Event

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

[:SOURce<hw>]:BB:T2DVb:STATe <State>

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

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Saving current configuration" on page 81.

Manual operation: See "State" on page 13

[:SOURce<hw>]:BB:T2DVb:SETTing:CATalog?

Queries the files with settings in the default directory. Listed are files with the file extension `*.dvbt2`.

Return values:

<FileNames> <filename1>,<filename2>,...

Returns a string of filenames separated by commas.

Example: See Example"Saving current configuration" on page 81.

Usage: Query only

Manual operation: See "Save/Recall" on page 13

[:SOURce<hw>]:BB:T2DVb:SETTing:DELete <Delete>

Deletes the selected file from the default or the specified directory. Deleted are files with extension `*.dvbt2`.

Parameters:

<Filename> "<filename>"

Filename or complete file path; file extension can be omitted

Example: See Example"Saving current configuration" on page 81.

Usage: Setting only

Manual operation: See "Save/Recall" on page 13

[:SOURce<hw>]:BB:T2DVb:SETTing:LOAD <Recall>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.dvbt2`.

Parameters:

<Filename> "<filename>"

Filename or complete file path; file extension can be omitted

Example: See Example"Saving current configuration" on page 81.

Manual operation: See "Save/Recall" on page 13

[:SOURce<hw>]:BB:T2DVb:SETTing:STORe <Save>

Saves the current settings into the selected file; the file extension (`*.dvbt2`) is assigned automatically.

Parameters:

<Filename> "<filename>"

Filename or complete file path

Example: See Example"Saving current configuration" on page 81.

Manual operation: See "Save/Recall" on page 13

5.2 Input commands

The section contains the commands for configuring the input signal. It also contains commands for querying IP input information.

For configuring IP channel settings and local IP data network parameters, see:

- Chapter 5.2.5, "IP subsystem", on page 94
- Chapter 5.10, "BCIP subsystem", on page 140

Commands

- General commands....83
- PLP info commands....87
- T2-MI packet timing commands....90
- Test signal commands....92
- IP subsystem....94

5.2.1 General commands

Example: Querying general T2-MI interface parameters

```
SOURce1:BB:T2DVb:INPut:T2MI:INTerface?
// Response: "0"

SOURce1:BB:T2DVb:INPut:T2MI:INTerface ON
SOURce1:BB:T2DVb:INPut:T2MI:ANALyzer?
// Response: "No error"

SOURce1:BB:T2DVb:INPut:T2MI:RESetlog
SOURce1:BB:T2DVb:INPut:T2MI:PID #H1000
SOURce1:BB:T2DVb:INPut:T2MI:SID #H0
```

Example: Configuring general input signal properties

```
SOURce1:BB:T2DVb:SOURce EXT

//*****************************************************************************
// Incoming MPEG transport stream for single PLP transmission.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface 0

//*****************************************************************************
// Incoming T2-MI stream.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface 1
// Input transport stream for single-PLP or multi-PLP transmission.
```

```
//*****************************************************************************
// Prepare for IP based transport stream
//*****************************************************************************
SOURce1:BB:T2DVb:INPut?
// Response: "TS"
SOURce1:BB:T2DVb:INPut:FORMat?
// Response: "ASI"
SOURce1:BB:T2DVb:INPut IP
SOURce1:BB:T2DVb:INPut:TSCHannel 2

//*****************************************************************************
// Query incoming stream properties
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:NPLP?
// Response: "1"
SOURce1:BB:T2DVb:INPut:T2MI:ANALyzer?
// Response: "No error"
```

For configuring IP channel settings and local IP data network parameters, see:

- Chapter 5.2.5, "IP subsystem", on page 94
- Chapter 5.10, "BCIP subsystem", on page 140

Commands

[:SOURce<hw>]:BB:T2DVb:SOURce....84
[:SOURce<hw>]:BB:T2DVb:INPut....84
[:SOURce<hw>]:BB:T2DVb:INPut:FORMat....85
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:ANALyzer?....85
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:INTerface....85
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:PID....85
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:RESetlog....86
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:SID....86
[:SOURce<hw>]:BB:T2DVb:INPut:TSCHannel....86

[:SOURce<hw>]:BB:T2DVb:SOURce <Dvbt2Source>

Sets the modulation source for the input signal.

Parameters:

<Dvbt2Source> EXTernal | TSPLayer | TESTsignal

*RST: EXTernal

Manual operation: See "Source" on page 16

[:SOURce<hw>]:BB:T2DVb:INPut <Dvbt2Input>

Sets the external input interface.

Parameters:

<Dvbt2Input> TS | IP

*RST: TS

Manual operation: See "Input" on page 17

[:SOURce<hw>]:BB:T2DVb:INPut:FORMat <Dvbt2InpFormat>

Sets the input format of the input signal.

Parameters:

<Dvbt2InpFormat> ASI | SMPTE

*RST: ASI

Example: See Example"Configuring general input signal properties" on page 83.

Manual operation: See "Input Format" on page 17

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:ANALyzer?

Queries the status of the T2-MI analyzer by an error message.

Return values:

<Analyzer> string

No error
Implies correct behavior of the analyzer.

*RST: No error

Example: See Example"Querying general T2-MI interface parameters" on page 83.

Usage: Query only

Manual operation: See "Status Info" on page 15

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:INTerface <Interface>

Activates the T2-MI modulator interface.

Parameters:

<Interface> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Querying general T2-MI interface parameters" on page 83.

Example: See Example"Querying T2-MI packet timing parameters" on page 90.

Manual operation: See "T2-MI Interface" on page 14

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:PID <Pid>

Sets the PID.

The PID belongs to MPEG transport stream packets, that contain T2-MI data.

Parameters:

<Pid> integer

Range: #H0 to #H1FFF
*RST: #H1000

Example: See Example"Querying general T2-MI interface parameters" on page 83.

Manual operation: See "T2-MI PID (Hex)" on page 14

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:RESetlog

Resets the log file.

Example: See Example"Querying general T2-MI interface parameters" on page 83.

Usage: Event

Manual operation: See "Reset Log File" on page 14

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:SID <Sid>

Sets the T2-MI transport SID.

Use the SID, when transmitting a composite signal, in accordance with annex I of the specification ETSI EN 302 755.

Parameters:

<Sid> integer

Range: #H0 to #H7
*RST: #H0

Example: See Example"Querying general T2-MI interface parameters" on page 83.

Manual operation: See "T2-MI SID (Hex)" on page 14

[:SOURce<hw>]:BB:T2DVb:INPut:TSCHannel <Dvbt2TsChannel>

Selects the IP-based transport stream (TS) channel. You can select 1 out of 4 IP TS channels as input at the "IP Data" interface.

To configure a particular channel, see Chapter 3.2.5, "IP channel x settings", on page 26.

Parameters:

<Dvbt2TsChannel> 1 | 2 | 3 | 4

*RST: 1

Example: See Example"Configuring general input signal properties" on page 83.

Manual operation: See "IP TS Channel" on page 18

5.2.2 PLP info commands

Example: Querying PLP input properties

```
SOURce1:BB:T2DVb:SOURce EXT

//*****************************************************************************
// Query properties of external input signals at TS IN interface.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut TS
SOURce1:BB:T2DVb:INPut:T2MI:INTerface?
// Response: "0"

SOURce1:BB:T2DVb:INPut:NPLP?
// Response: "1"

// Single-PLP transmission. PLP<ch> = PLP1 in SCPI denotes PLP 0 in GUI.
SOURce1:BB:T2DVb:PLP1:INPut:FORMat?
// Response: "TS"
SOURce1:BB:T2DVb:PLP1:PACKetlength?
// Response: "P188"
SOURce1:BB:T2DVb:PLP1:INPut:STUFfing?
// Response: "1"
SOURce1:BB:T2DVb:PLP1:USEFul:RATE:MAX?
// Response in Bit/s: "36140759"
SOURce1:BB:T2DVb:PLP1:INPut:DATarate?
// Response in Bit/s: "5018504"
SOURce1:BB:T2DVb:PLP1:USEFul:RATE?
// Response in Bit/s: "4550760"

//*****************************************************************************
// Query properties of external input signals at IP Data interface.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut IP
SOURce1:BB:T2DVb:INPut:TSCHannel 1
SOURce1:BB:T2DVb:INPut:T2MI:INTerface?
// Response: "1"

SOURce1:BB:T2DVb:INPut:NPLP?
// Response: "19"
// Multi-PLP transmission.

SOURce1:BB:T2DVb:PLP19:INPut:FORMat?
// Response: "GFPS"
// PLP 18 (GUI) input format is a generic fixed-length packetized stream.

SOURce1:BB:T2DVb:PLP19:USEFul:RATE?
// Response in Bit/s: "100344"

//*****************************************************************************
// Query properties of internal TS player input signals.
```

```
//*****************************************************************************
SOURce1:BB:T2DVb:SOURce TSPL
SOURce1:BB:T2DVb:PLP1:INPut:FORMat?
// Response: "TS"

SOURce1:BB:T2DVb:PLP1:USEFul:RATE:MAX?
// Response in Bit/s: "38583461"

SOURce1:BB:T2DVb:PLP1:USEFul:RATE?
// Response in Bit/s: "4566952"
```

Commands

[:SOURce<hw>]:BB:T2DVb:INPut:NPLP? 88
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:FORMat 88
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:STUFfing 89
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:PACKetlength? 89
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:USEFul[:RATE]? 89
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:USEFul[:RATE]:MAX? 90
[:SOURce<hw>]:BB:T2DVb:PLP<ch>[:INPut]:DATarate? 90

[:SOURce<hw>]:BB:T2DVb:INPut:NPLP?

Queries the number of physical layer pipes (PLP).

Return values:

<Nplp> integer

Range: 1 to 20
*RST: 1

Example: See Example"Querying PLP input properties" on page 87.

Usage: Query only

Manual operation: See "Number of PLPs" on page 17

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:FORMat <Format>

Queries the input format of each PLP `<num>` for all input sources.

Parameters:

<Format> GFPS | GCS | GSE | TS

GFPS
Generic fixed-length packetized stream

GCS
Generic continuous stream

GSE
Generic stream encapsulation

TS
Transport stream

*RST: TS

Example: See Example"Querying PLP input properties" on page 87.

Manual operation: See "PLP Input Format" on page 19

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:STUFfing <Stuffing>

Activates stuffing.

Parameters:

<Stuffing> OFF | ON

ON
Inserts null packets and corrects the PCR values.

OFF
The data rate of the transport stream source must match the data rate required for the current modulation parameters.

*RST: ON

Example: See Example"Querying PLP input properties" on page 87.

Manual operation: See "Stuffing" on page 18

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:PACKetlength?

Queries the packet length of the external transport stream in bytes.

Return values:

<Packetlength> P188 | INValid

P188
188 byte packets specified for serial input and parallel input.

INValid
Packet length does not match the specified length.

Example: See Example"Querying PLP input properties" on page 87.

Usage: Query only

Manual operation: See "Packet Length" on page 19

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:USEFul[:RATE]?

Queries the data rate of useful data r_{useful} of the external transport stream. The data rate is measured at the input of the installed input interface.

Return values:

<Rate> integer

Range: 0 to 999999999
*RST: 0

Example: See Example"Querying PLP input properties" on page 87.

Usage: Query only

Manual operation: See "Useful Data Rate / Mbit/s" on page 20

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:USEFul[:RATE]:MAX?

Queries the maximum data rate, that is derived from the current modulation parameter settings.

The value is the optimal value at the TS input interface, that is necessary for the modulator.

Return values:

<Max> integer

Range: 0 to 999999999

Example: See Example"Querying PLP input properties" on page 87.

Usage: Query only

Manual operation: See "Max. Useful Data Rate / Mbit/s" on page 20

[:SOURce<hw>]:BB:T2DVb:PLP<ch>[:INPut]:DATarate?

Queries the measured value of the data rate of one of the following:

- External transport stream including null packets input at "User 1" connector
- External transport stream including null packets input at "IP Data/LAN" connector (TSoverIP)

The value equals the sum of useful data rate r_{meas} and the rate of null packets r_0:

$r_{meas} = r_{meas} + r_0$

Return values:

<Datarate> integer

Range: 0 to 999999999

Example: See Example"Querying PLP input properties" on page 87.

Usage: Query only

Manual operation: See "Measured Data Rate / Mbit/s" on page 20

5.2.3 T2-MI packet timing commands

Example: Querying T2-MI packet timing parameters

```
SOURce1:BB:T2DVb:INPut:T2MI:INTerface ON
SOURce1:BB:T2DVb:INPut:T2MI:MEASuremode ABSOLUTE

// All following responses to timing commands are in seconds.
SOURce1:BB:T2DVb:INPut:T2MI:MIN:T1?
// Response: "0.297277"
SOURce1:BB:T2DVb:INPut:T2MI:MIN:T2?
// Response: "0.155838"
SOURce1:BB:T2DVb:INPut:T2MI:MIN:T3?
```

```
// Response: "0"
SOURce1:BB:T2DVb:INPut:T2MI:MAX:T1?
// Response: "0.254925"
SOURce1:BB:T2DVb:INPut:T2MI:MAX:T2?
// Response: "0"
SOURce1:BB:T2DVb:INPut:T2MI:MAX:T3?
// Response: "0.303451"
SOURce1:BB:T2DVb:INPut:T2MI:MAX:T4?
// Response: "0"
```

Commands

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MEASuremode....91
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T3?....91
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T2?....91
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T1?....91
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T4?....92
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T3?....92
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T2?....92
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T1?....92

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MEASuremode <Measuremode>

Specifies the measurement mode to configure the evaluation of T2-MI timing parameters.

Parameters:

<Measuremode> ABSOLUTE | DELTA

*RST: ABSOLUTE

Example: See Example"Querying T2-MI packet timing parameters" on page 90.

Manual operation: See "Measurement Mode" on page 22

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T3?
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T2?
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MIN:T1?

Queries the current value of minimum time parameters $T_{min1}/T_{min2}/T_{min3}$.

Return values:

<MinT1> float

Range: -99.999999 to 99.999999
Increment: 0.000001
*RST: 0
Default unit: s

Example: See Example"Querying T2-MI packet timing parameters" on page 90.

Usage: Query only

Manual operation: See "T2-MI T_{min1}" on page 22

[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T4?
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T3?
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T2?
[:SOURce<hw>]:BB:T2DVb:INPut:T2MI:MAX:T1?

Queries the current value of the maximum time parameters T_{max1}/T_{max2}/T_{max3}/T_{max4}.

Return values:

<MaxT1> float

Range: -99.999999 to 99.999999
Increment: 0.000001
*RST: 0
Default unit: s

Example: See Example"Querying T2-MI packet timing parameters" on page 90.

Usage: Query only

Manual operation: See "T2-MI T_{max1}" on page 23

5.2.4 Test signal commands

Example: Configuring test signal properties

```
SOURce1:BB:T2DVb:INPut:T2MI:INTerface OFF

SOURce1:BB:T2DVb:SOURce TEST
SOURce1:BB:T2DVb:PLP1:INPut:TESTsignal?
// Response: "TTSP"
SOURce1:BB:T2DVb:PLP1:INPut:FORMat?
// Response: "TS"

//*****************************************************************************
// Configure test signal properties.
//*****************************************************************************
SOURce1:BB:T2DVb:TSPacket H184
SOURce1:BB:T2DVb:PIDTestpack NULL
SOURce1:BB:T2DVb:PID?
// Response in decimal representation: "8191"
// Response in hexadecimal representation: "1FFF"
SOURce1:BB:T2DVb:PIDTestpack VAR
SOURce1:BB:T2DVb:PID 4607
// Corresponds to 11FF in hexadecimal representation.
SOURce1:BB:T2DVb:PAYLoad PRBS
SOURce1:BB:T2DVb:PRBS P23_1
```

Commands

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:TESTsignal 93
[:SOURce<hw>]:BB:T2DVb:PAYLoad 93
[:SOURce<hw>]:BB:T2DVb:PID 93
[:SOURce<hw>]:BB:T2DVb:PIDTestpack 93
[:SOURce<hw>]:BB:T2DVb:PRBS[:SEQuence] 94
[:SOURce<hw>]:BB:T2DVb:TSPacket 94

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:INPut:TESTsignal <TestSignal>

Defines the test signal data.

Parameters:

<TestSignal> TTSP

*RST: TTSP

Example: See Example"Configuring test signal properties" on page 92.

Manual operation: See "Test Signal" on page 18

[:SOURce<hw>]:BB:T2DVb:PAYLoad <Payload>

Defines the payload area content of the TS packet.

Parameters:

<Payload> PRBS | H00 | HFF

*RST: PRBS

Example: See Example"Configuring test signal properties" on page 92.

Manual operation: See "Payload Test/Stuff" on page 25

[:SOURce<hw>]:BB:T2DVb:PID <Pid>

Sets the PID.

Parameters:

<Pid> integer

Range: 0 to 8191

*RST: 8191

Example: See Example"Configuring test signal properties" on page 92.

Manual operation: See "PID (Hex)" on page 25

[:SOURce<hw>]:BB:T2DVb:PIDTestpack <PidTSPacket>

If a header is present in the test packet ("Test TS Packet > Head/184 Payload"), you can specify a fixed or variable packet identifier (PID).

Parameters:
<PidTSPacket> NULL | VARiable
*RST: NULL

Example: See Example"Configuring test signal properties" on page 92.

Manual operation: See "PID Test Packet" on page 25

[:SOURce<hw>]:BB:T2DVb:PRBS[:SEQuence] <Prbs>

Sets the length of the PRBS sequence.

You can select a PRBS 15 or a PRBS 23 sequence as specified by ITU-T O.151.

Parameters:
<Prbs> P23_1 | P15_1
*RST: P23_1

Example: See Example"Configuring test signal properties" on page 92.

Manual operation: See "PRBS" on page 25

[:SOURce<hw>]:BB:T2DVb:TSPacket <TSPacket>

Specifies the structure of the test transport stream packet that is fed to the modulator.

Parameters:
<TSPacket> H184 | S187
*RST: H184

Example: See Example"Configuring test signal properties" on page 92.

Manual operation: See "Test TS Packet" on page 25

5.2.5 IP subsystem

The `SOURce:BB:INPut:IP` subsystem contains the commands for configuring input IP data from a local IP data network.

To configure local IP data network parameters, see Chapter 5.10, "BCIP subsystem", on page 140.

Common suffixes

The following common suffixes are used in the `SOURce:BB:INPut:IP` remote commands:

Suffix	Value range	Description
`IP<ch>`	1 to 4	IP channel number

Example: Configure IP channel 2 properties

```
// Use the data from IP channel 2 as input for modulation data.
SOURce1:BB:INPut:IP2:STATe ON
// Specify alias as "Alias 2".
SOURce1:BB:INPut:IP2:ALIas "Alias 2"

//*****************************************************************************
// Define Unicast properties.
//*****************************************************************************
SOURce1:BB:INPut:IP2:TYPe UNI
// Local IP data interface is configured for Unicast reception
SOURce1:BB:INPut:IP2:PORT 6002

//*****************************************************************************
// Define multicast properties.
//*****************************************************************************
SOURce1:BB:INPut:IP2:TYPe MULT
// Local IP data interface is configured for Multicast reception
SOURce1:BB:INPut:IP2:MULTicast:ADDRess?
// Response: "226.0.0.0"
SOURce1:BB:INPut:IP2:IGMP:SOURce:ADDRess?
// Response: "0.0.0.0"
SOURce1:BB:INPut:IP2:IGMP:SOURce:ADDRess "192.168.10.1"
SOURce1:BB:INPut:IP2:IGMP:SOURce:PING
SOURce1:BB:INPut:IP2:IGMP:SOURce:RESult?
// Response: "Ping: Successful"
```

Commands

[:SOURce<hw>]:BB:INPut:IP<ch>[:STATe]....95
[:SOURce<hw>]:BB:INPut:IP<ch>:ALIas....96
[:SOURce<hw>]:BB:INPut:IP<ch>:PORT....96
[:SOURce<hw>]:BB:INPut:IP<ch>:TYPE....96
[:SOURce<hw>]:BB:INPut:IP<ch>:MULticast:ADDRess....97
[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:ADDRess....97
[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:PING....97
[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:RESult?....97

[:SOURce<hw>]:BB:INPut:IP<ch>[:STATe] <Alias>

Activates/deactivates the "IP Channel x" as IP input.

Specify the current IP TS Channel with the command `SOURce1:BB:DigStd:INPut:TSCHannel`. `DigStd` stands for the IP TS Channel in the corresponding broadcast standard.

Parameters:

<Alias> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configure IP channel 2 properties" on page 95.

Manual operation: See "Input IP" on page 27

[:SOURce<hw>]:BB:INPut:IP<ch>:ALIas <Alias>

Specifies an alias, i.e. name for the IP connection.

Parameters:
<Alias> string

Example: See Example"Configure IP channel 2 properties" on page 95.

Manual operation: See "Alias" on page 27

[:SOURce<hw>]:BB:INPut:IP<ch>:PORT <Port>

Sets the port of the input IP data at the "IP Data" connector.

Parameters:
<Port> integer

Range: 0 to 65535
*RST: 6002

Example: See Example"Configure IP channel 2 properties" on page 95.

Manual operation: See "Port" on page 28

[:SOURce<hw>]:BB:INPut:IP<ch>:TYPE <Type>

Sets the IP input type.

Parameters:
<Type> UNIcast | MULTicast

UNIcast
Analyzes all unicast IP packets that arrive at the specified port.
See `[:SOURce<hw>]:BB:INPut:IP<ch>:PORT` on page 96.

MULTicast
When an IP address is in the multicast address range, an attempt is made to join a multicast group using IGMP. Set multicast address and port.
See:
`[:SOURce<hw>]:BB:INPut:IP<ch>:MULticast:ADDRess` on page 97
`[:SOURce<hw>]:BB:INPut:IP<ch>:PORT` on page 96

*RST: UNIcast

Example: See Example"Configure IP channel 2 properties" on page 95.

Manual operation: See "Type" on page 28

[:SOURce<hw>]:BB:INPut:IP<ch>:MULticast:ADDRess

Sets the destination IP address (IPv4) of the IP connection.

Parameters:

<Address> string

Range: 224.0.0.0 to 239.255.255.255

Example: See Example"Configure IP channel 2 properties" on page 95.

Manual operation: See "Multicast Address" on page 28

[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:ADDRess

Specifies the IGMP source address of the network.

Parameters:

<Address> string

Example: See Example"Configure IP channel 2 properties" on page 95.

Manual operation: See "IGMPv3 Source Address" on page 28

[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:PING

Triggers pinging of the IGMP source address in the local IP data network. Query the result via `[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:RESult?` on page 97.

Example: See Example"Configure IP channel 2 properties" on page 95.

Usage: Event

Manual operation: See "Ping Source Address" on page 28

[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:RESult?

Queries the result of pinging the IGMP source address.

See `[:SOURce<hw>]:BB:INPut:IP<ch>:IGMP[:SOURce]:PING` on page 97.

Return values:

<PingResult> string

Returns ping messages.

Example: See Example"Configure IP channel 2 properties" on page 95.

Usage: Query only

Manual operation: See "Ping Result" on page 28

5.3 Mode and stream commands

The section contains the commands for configuring mode and stream parameters of individual PLPs.

Example: Configuring mode and stream parameters

```
//*****************************************************************************
// Enable setting of PLP 0 parameters by deactivating the T2-MI interface.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface OFF

//*****************************************************************************
// Set PLP 0 mode and stream parameters.
//*****************************************************************************
SOURce1:BB:T2DVb:PLP1:ID 0
SOURce1:BB:T2DVb:PLP1:GROup 0
SOURce1:BB:T2DVb:PLP1:TYPE?
// Response: "DT1"
// Fixed type for single-PLP transmission.
SOURce1:BB:T2DVb:PLP1:BB_Mode HEM
// Enables high-efficiency baseband mode.

//*****************************************************************************
// Query PLP 0 mode and stream parameters.
//*****************************************************************************
SOURce1:BB:T2DVb:PLP1:ISSY?
// Response: "0"
// The synchronizer uses a short input stream clock reference.
SOURce1:BB:T2DVb:PLP1:NPD?
// Response: "0"
// Null packet deletion is off.
// Query in-band signaling state.
SOURce1:BB:T2DVb:PLP1:IBS?
// Response: "0"
SOURce1:BB:T2DVb:L:T2Version V121
// Setting L1 T2 version V1.2.1 allows querying in-band sign. types A/B states.
SOURce1:BB:T2DVb:PLP1:IBS:A?
// Response: "0"
SOURce1:BB:T2DVb:PLP1:IBS:B?
// Response: "0"

//*****************************************************************************
// Query parameters related to multi-PLP transmission.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:NPLP?
// Response: "4"
// Indicates multi-PLP trasmission with four PLPs.
// Query the number of other PLPs signaled within in-band signaling.
SOURce1:BB:T2DVb:PLP1:OIBPlp?
// Response: "0"
```

```
SOURce1:BB:T2DVb:PLP1:CMTYpe?
// Response: "ACM"
SOURce1:BB:T2DVb:PLP1:STAFlag?
// Response: "1"
// Static scheduling for PLP 0 from T2 frame to T2 frame.
SOURce1:BB:T2DVb:PLP1:PADFlag?
// Response: "0"
// BBFrame padding disabled for PLP 0.
```

Commands

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BB_Mode 99
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CMTYpe? 99
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:GROup 100
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS? 100
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS:A? 101
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS:B? 101
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ID 101
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ISSY? 102
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:NPD? 102
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:OIBPlp? 102
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:PADFlag? 103
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:STAFlag? 103
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TYPE 103

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BB_Mode <BBMode>

Defines the baseband mode.

Parameters:

<BBMode> HEM | NM

*RST: HEM

Example: See Example"Configuring mode and stream parameters" on page 98.

Manual operation: See "BB Mode" on page 30

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CMTYpe?

Queries the CM type for multi-PLP. Multi-PLP requires number of PLPs > 1, see `[:SOURce<hw>]:BB:T2DVb:INPut:NPLP?` on page 88.

Return values:

<CMType> CCM | ACM

CCM
Constant coding and modulation. The setting implies identical settings for all PLPs of the commands:
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FECFrame` on page 106
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:RATE` on page 107
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CONStel` on page 105
`[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CROTation` on page 105

ACM
Variable coding and modulation. Not all PLPs use the same coding and modulation.

*RST: CCM

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "CM Type" on page 33

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:GROup <Group>

Sets the PLP group ID for multi-PLP, i.e. the number of PLPs is greater than 1.

See `[:SOURce<hw>]:BB:T2DVb:INPut:NPLP?` on page 88.

Parameters:
<Group> integer

Range: 0 to 255
*RST: 1

Example: See Example"Configuring mode and stream parameters" on page 98.

Manual operation: See "PLP Group ID (Hex)" on page 30

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS?

Queries the in-band signaling state.

Return values:
<IBS> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "In-Band Signaling" on page 33

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS:A?

Queries the in-band signaling type A state.

Query requires L1 T2 specification version higher than V1.1.1, see `[:SOURce<hw>]:BB:T2DVb:L:T2Version` on page 120.

Return values:

<IBSA> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "In-Band Signaling A" on page 33

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:IBS:B?

Queries the in-band signaling type B state.

Query requires L1 T2 specification version higher than V1.1.1, see `[:SOURce<hw>]:BB:T2DVb:L:T2Version` on page 120.

Return values:

<IBSB> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "In-Band Signaling B" on page 33

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ID <PlpId>

Sets the PLP ID. The PLP ID has to be unique.

Parameters:

<PlpId> integer

Range: 0 to 255

*RST: 0

Example: See Example"Configuring mode and stream parameters" on page 98.

Manual operation: See "PLP ID (Hex)" on page 30

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:ISSY?

Queries the ISSY state.

Return values:

<Issy> OFF | SHORt | LONG

OFF
ISSY is not active. ISSY indicator field is 0.

SHORt
ISSY is active. ISSY indicator field is 1. The synchronizer uses a short ISCR.

LONG
ISSY is active. ISSY indicator field is 1. The synchronizer uses a long ISCR.

*RST: OFF

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "ISSY" on page 32

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:NPD?

Queries the null packet deletion state.

Return values:

<NPD> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "Null Packet Deletion" on page 33

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:OIBPIp?

Queries the number of other PLPs signaled within the in-band signaling of the PLP for multi-PLP. Multi-PLP requires number of PLPs > 1, see `[:SOURce<hw>]:BB:T2DVb:INPut:NPLP?` on page 88.

Return values:

<OIBPIps> integer

Range: 0 to 255
*RST: 0

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "Other In-Band PLPs" on page 33

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:PADFlag?

Queries if BBFrame padding other than for in-band signaling is used for the current PLP.

Return values:
<PaddingFlag> 1 | ON | 0 | OFF
*RST: 1

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "Static Padding Flag" on page 34

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:STAFlag?

Queries if the scheduling for the current PLP varies from T2 frame to T2 frame or remains static.

Return values:
<StaticFlag> 1 | ON | 0 | OFF
*RST: 1

Example: See Example"Configuring mode and stream parameters" on page 98.

Usage: Query only

Manual operation: See "Static Flag" on page 34

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TYPE <Type>

Sets the PLP type.

The type depends on the number of PLPs in the setup.

Parameters:
<Type> DT1 | DT2 | COMMon

COMMon
Common PLP of the PLP Group. Requires a multi-PLP setup, see `[:SOURce<hw>]:BB:T2DVb:INPut:NPLP?` on page 88.

DT1
Data type 1. Fixed for a single-PLP setup. Configurable for a multi-PLP setup.

DT2
Data type 2. Requires a multi-PLP setup.

*RST: DT1

Example: See Example"Configuring mode and stream parameters" on page 98.

Manual operation: See "PLP Type" on page 30

5.4 BICM commands

The section contains the commands for configuring BICM.

Example: Configure BICM parameters

```
//******************************************************************************
// Enable setting of PLP 0 parameters by deactivating the T2-MI interface.
//******************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface OFF

//******************************************************************************
// Set PLP 0 coding and modulation parameters.
//******************************************************************************
SOURce1:BB:T2DVb:PLP1:FECFrame NORM
// Sets the FEC frame N_LDPC = 64800.
SOURce1:BB:T2DVb:PLP1:RATE R3_5
// Sets the code rate 3/5.
SOURce1:BB:T2DVb:PLP1:CONStel T256
// Sets 256 QAM constellation.
SOURce1:BB:T2DVb:PLP1:CROTation?
// Response: "0"
// Constellation rotation is disabled.

//******************************************************************************
// Set PLP 0 interleaving parameters.
//******************************************************************************
SOURce1:BB:T2DVb:PLP1:TIL:TYPE 0
// Set time interleaver type 0.
SOURce1:BB:T2DVb:PLP1:TIL:FINT?
// Response: "1"
// Time interleaver frame interval is fixed to 1 for single-PLP transmission.
SOURce1:BB:T2DVb:PLP1:TIL:LENGth 3
// Set the time interleaver length to 3.
SOURce1:BB:T2DVb:PLP1:FRAMeindex?
// Response: "0"
// Index of the first frame of the superframe is 0.
SOURce1:BB:T2DVb:PLP1:BLOCks?
// Response: "202"
// 202 FEC blocks per interleaving frame.
SOURce1:BB:T2DVb:PLP1:MAXBlocks?
// Response: "202"
// 202 FEC blocks is maximum per interleaving frame.
```

Commands

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BLOCks?.....105
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CONStel.....105
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CROTation.....105
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FECFrame.....106
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FRAMeindex.....106
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:MAXBlocks?.....106
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:RATE.....107
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:FINT.....107
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:LENGth.....107
[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:TYPE.....107

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:BLOCks?

Queries the number of FEC blocks per interleaving frame.

Return values:

<FECBlocks> integer

Range: 0 to 1023
*RST: 0

Example: See Example"Configure BICM parameters" on page 104.

Usage: Query only

Manual operation: See "FEC Blocks per IF" on page 37

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CONStel <Constellation>

Defines the constellation.

Parameters:

<Constellation> T4 | T16 | T64 | T256

T4
QPSK

T16|T64|T256
16/64/256QAM

*RST: T256

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "Constellation" on page 36

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:CROTation <CRotation>

Sets the constellation rotation state.

Parameters:

<CRotation> 1 | ON | 0 | OFF

ON
Transmits the constellation rotated, i.e. the Q path is delayed vs. the I path. For each constellation, there is a different (but fixed) angle of rotation.

OFF
Transmits non-rotated constellation.

*RST: 1

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "Const. Rotation" on page 36

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FECFrame <NPFecFrame>

Sets the FEC frame.

Parameters:
<NPFecFrame> NORMal | SHORt

NORMal
N_{LDPC} = 64800

SHORt
N_{LDPC} = 16200

*RST: NORMal

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "FEC Frame" on page 35

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:FRAMeindex <FFIndex>

Queries the index of the first frame of the super frame, in that the current PLP occurs.

Parameters:
<FFIndex> integer

Range: 0 to 255
*RST: 0

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "First Frame Index" on page 36

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:MAXBlocks?

Queries the maximum number of FEC blocks per interleaving frame.

Return values:
<FECBlocksMax> integer

Range: 0 to 1023
*RST: 0

Example: See Example"Configure BICM parameters" on page 104.

Usage: Query only

Manual operation: See "Max. Number of Blocks" on page 38

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:RATE <Coderate>

Sets the code rate.

Parameters:

<Coderate> R1_2 | R3_5 | R2_3 | R3_4 | R4_5 | R5_6 | R1_3 | R2_5

*RST: R3_5

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "Code Rate" on page 35

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:FINT <FrameInterval>

Defines the time interleaver frame interval (I_{Jump}).

For limitations, see specification ETSI EN 302 755.

Parameters:

<FrameInterval> integer

Range: 1 to 255

*RST: 1

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "Frame Interval (I_{Jump})" on page 36

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:LENGth <TILLength>

Defines the time interleaver length within the time interleaving frame.

For limitations, see specification ETSI EN 302 755.

Parameters:

<TILLength> integer

Range: 0 to 255

*RST: 3

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "Time Interleaver Length" on page 36

[:SOURce<hw>]:BB:T2DVb:PLP<ch>:TIL:TYPE <TILType>

Defines the time interleaver type.

Parameters:

<TILType> integer

0
Maps each interleaving frame directly to a T2 frame.

1
Maps each interleaving frame to more than one T2 frame.

Range: 0 to 1
*RST: 0

Example: See Example"Configure BICM parameters" on page 104.

Manual operation: See "Time Interleaver Type" on page 36

5.5 OFDM commands

The section contains the commands for configuring OFDM symbol parameters.

Example: Configuring OFDM parameters

```
//*****************************************************************************
// Configure bandwidth parameters.
//*****************************************************************************
SOURce1:BB:T2DVb:CHANnel:BANDwidth BW_1_7
// Sets 1.7 MHz channel bandwidth
// Query the used bandwidth in MHz.
SOURce1:BB:T2DVb:USED:BANDwidth?
// Response in Hz: "1535156.3"
// The used bandwidth value indicates, that extended carrier mode is active.
SOURce1:BB:T2DVb:FFT:MODE?
// Response: "M32E"
// 32K FFT size using extended carrier mode.
SOURce1:BB:T2DVb:BANDwidth:VARiation 10
// Sets a bandwidth variation of 10 ppm.

//*****************************************************************************
// Set/query OFDM parameters with deactivated the T2-MI interface.
//*****************************************************************************
SOURce1:BB:T2DVb:GUARd:INTerval G19256
// Sets guard interval to 19/256.
SOURce1:BB:T2DVb:PILot PP4
// Sets the pilot pattern to PP4.
SOURce1:BB:T2DVb:NT2Frames 10
// Sets 10 T2 frames per super frame.
SOURce1:BB:T2DVb:LDATa 9
// Sets 9 data symbols per T2 frame.
SOURce1:BB:T2DVb:LF?
// Response: "10"
// 10 OFDM symbols per T2 frames.
SOURce1:BB:T2DVb:NSUB?
// Response: "1"
// Subslices per T2 frame is fixed to 1 for single-PLP transmission.
```

Commands

[:SOURce<hw>]:BB:T2DVb:BANDwidth:VARiation 109
[:SOURce<hw>]:BB:T2DVb:CHANnel[:BANDwidth] 109
[:SOURce<hw>]:BB:T2DVb:FFT:MODE 109
[:SOURce<hw>]:BB:T2DVb:GUARd:INTerval 110
[:SOURce<hw>]:BB:T2DVb:LDATa 110
[:SOURce<hw>]:BB:T2DVb:LF? 110
[:SOURce<hw>]:BB:T2DVb:NSUB 110
[:SOURce<hw>]:BB:T2DVb:NT2Frames 111
[:SOURce<hw>]:BB:T2DVb:PILot 111
[:SOURce<hw>]:BB:T2DVb:USED[:BANDwidth]? 111

[:SOURce<hw>]:BB:T2DVb:BANDwidth:VARiation <BandwidthVar>

Changes the used bandwidth in the range of ±1000 ppm.

Parameters:

<BandwidthVar> integer

Range: -1000 to 1000
*RST: 0
Default unit: ppm

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "Bandwidth Variation" on page 40

[:SOURce<hw>]:BB:T2DVb:CHANnel[:BANDwidth] <ChannelBW>

Selects the channel bandwidth.

Parameters:

<ChannelBW> BW_2 | BW_5 | BW_6 | BW_7 | BW_8

*RST: BW_8

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "Channel Bandwidth" on page 38

[:SOURce<hw>]:BB:T2DVb:FFT:MODE <FFTSize>

Defines the FFT size.

Parameters:

<FFTSize> M1K | M2K | M4K | M8K | M8E | M16K | M16E | M32K | M32E

M1K|M2K|M4K|M8K|M16K|M32K
1K/2K/4K/8K/16K/32K FFT size using normal carrier mode

M8E|M16E|M32E
8K/16K/32K FFT size using extended carrier mode

*RST: M32E

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "FFT Size" on page 40

[:SOURce<hw>]:BB:T2DVb:GUARd:INTerval <GuardInterval>

Sets the guard interval length.

Parameters:
<GuardInterval> G1_4 | G1_8 | G1_16 | G1_32 | G1128 | G19128 | G19256
*RST: G1128

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "Guard Interval" on page 40

[:SOURce<hw>]:BB:T2DVb:LDATa <DataSymbols>

Sets the number of data symbols per T2 frame.

Parameters:
<DataSymbols> integer
Range: 0 to 4095
*RST: 59

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "Data Symbols per T2 Frame (L_DATA)" on page 41

[:SOURce<hw>]:BB:T2DVb:LF?

Queries the computed number of OFDM symbols per T2 frame.

Return values:
<OfdmSymbols> integer
Range: 0 to 4095
*RST: 4

Example: See Example"Configuring OFDM parameters" on page 108.

Usage: Query only

Manual operation: See "OFDM Symbols per T2 Frame (L_F)" on page 41

[:SOURce<hw>]:BB:T2DVb:NSUB <Subslices>

Sets the number of subslices per T2 frame.

The number of subslices is "1" for "T2-MI Interface > Off".

Parameters:
<Subslices> integer
Range: 0 to 32767
*RST: 1

Example:
```
:SOURce1:BB:T2DVb:INPut:T2MI:INTerface 0
:SOURce1:BB:T2DVb:NSUB?
\\ Response: "1"
```

Example: See also Example"Configuring OFDM parameters" on page 108.

Manual operation: See "Subslices per T2 Frame (N_SUB)" on page 41

[:SOURce<hw>]:BB:T2DVb:NT2Frames <NT2Frames>

Sets the number of T2 frames per super frame.

Parameters:

<NT2Frames> integer

Range: 2 to 255
*RST: 2

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "T2 Frames per Super Frame (N_T2)" on page 41

[:SOURce<hw>]:BB:T2DVb:PILot <PilotPattern>

Sets the pilot pattern.

Parameters:

<PilotPattern> PP1 | PP2 | PP3 | PP4 | PP5 | PP6 | PP7 | PP8

*RST: PP7

Example: See Example"Configuring OFDM parameters" on page 108.

Manual operation: See "Pilot Pattern" on page 40

[:SOURce<hw>]:BB:T2DVb:USED[:BANDwidth]?

Queries the used channel bandwidth.

The used bandwidth depends on the channel bandwidth, the FFT size and the carrier mode as described in Table 3-2.

Return values:

<UsedBW> integer

Range: 0.0 to 9999999.9

Example: See Example"Configuring OFDM parameters" on page 108.

Usage: Query only

Manual operation: See "Used Bandwidth" on page 39

5.6 System commands

The section contains the commands for configuring the DVB-T2 system.

- Network commands....112
- L1 commands....117
- ID commands....121

5.6.1 Network commands

Example: Configuring network parameters

```
//*****************************************************************************
// Configure common T2 network settings
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface OFF

SOURce1:BB:T2DVb:PAPR TR
// Enables tone reservation (TR).

SOURce1:BB:T2DVb:TXSYs MISO
// Sets for multi input single output (MISO) transmission system.
SOURce1:BB:T2DVb:MISO:MODE?
// Response: "MAN"
// Manual MISO mode is enabled.
SOURce1:BB:T2DVb:MISO:GROup G2
// Modulator transmits with MISO group 2.

SOURce1:BB:T2DVb:FEF?
// Response: "0"
// Future extension frames are disabled.
SOURce1:BB:T2DVb:TFS?
// Response: "0"
// Time frequency slicing is disabled.

//*****************************************************************************
// Query future extension frame (FEF) parameters.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface ON
// T2-MI stream with FEF settings is needed for the following commands

SOURce1:BB:T2DVb:FEF?
// Response: "1"
// Future extension frames are enabled.
SOURce1:BB:T2DVb:FEF:TYPE?
// Response: "0"
// FEF part has type 0.
SOURce1:BB:T2DVb:FEF:LENGth?
// Response: "555000"
// FEF length is 555000 elementary periods T.
```

```
SOURce1:BB:T2DVb:FEF:INTerval?
// Response: "1"
// One T2 frame between two FEF parts.
SOURce1:BB:T2DVb:FEF:PAYLoad?
// Response: "NULL"
// I/Q values of the FEF payload are zero.

//******************************************************************************
// Configure single-frequency network properties.
//******************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface ON
SOURce1:BB:T2DVb:NETWorkmode SFN

SOURce1:BB:T2DVb:PROFile MULTi
// Modulator operates in multiple profile operation mode.
```

For single-frequency network delays and mode commands, see Chapter 5.7, "SFN delay commands", on page 122.

Commands

[:SOURce<hw>]:BB:T2DVb:FEF 113
[:SOURce<hw>]:BB:T2DVb:FEF:INTerval 113
[:SOURce<hw>]:BB:T2DVb:FEF:LENGth 114
[:SOURce<hw>]:BB:T2DVb:FEF:PAYLoad 114
[:SOURce<hw>]:BB:T2DVb:FEF:TYPE 115
[:SOURce<hw>]:BB:T2DVb:MISO:MODE? 115
[:SOURce<hw>]:BB:T2DVb:MISO[:GROup] 115
[:SOURce<hw>]:BB:T2DVb:NETWorkmode 115
[:SOURce<hw>]:BB:T2DVb:PAPR 115
[:SOURce<hw>]:BB:T2DVb:PROFile 116
[:SOURce<hw>]:BB:T2DVb:TFS 116
[:SOURce<hw>]:BB:T2DVb:TXSYs 116

[:SOURce<hw>]:BB:T2DVb:FEF <FEF>

Enables/disables FEF.

Parameters:

<FEF> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "Future Extension Frames" on page 45

[:SOURce<hw>]:BB:T2DVb:FEF:INTerval <FEFInterval>

Queries the number of T2 frames between two FEF parts. The T2 frame shall always be the first frame in a T2 super frame which contains both FEF parts and T2 frames.

Parameters:

<FEFInterval> integer

Range: 0 to 255
*RST: 0

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "FEF Interval" on page 45

[:SOURce<hw>]:BB:T2DVb:FEF:LENGth <FEFLength>

Queries the length of the associated FEF part as the number of elementary periods T, from the start of the P1 symbol of the FEF part to the start of the P1 symbol of the next T2 frame.

The FEF length is "0" for "T2-MI Interface > Off".

Parameters:

<FEFLength> integer

Range: 0 to 16777215
*RST: 0

Example:

```
:SOURce1:BB:T2DVb:INPut:T2MI:INTerface 0
:SOURce1:BB:T2DVb:INPut:FEF:LENGth?
\\ Response: "0"
```

Example: See also Example"Configuring network parameters" on page 112.

Manual operation: See "FEF Length" on page 45

[:SOURce<hw>]:BB:T2DVb:FEF:PAYLoad <FEFPayload>

Sets the FEF payload.

Parameters:

<FEFPayload> NULL | NOISe

NULL
I/Q values of the FEF payload are zeroes.

NOISe
I/Q values of the FEF payload are modulated in the frequency domain using a PRBS and transformed into the time domain by IFFT.
The technique allows generating payload with a power level equal to the T2 frame.

*RST: NULL

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "FEF Payload" on page 45

[:SOURce<hw>]:BB:T2DVb:FEF:TYPE <FEFType>

Queries the type of the associated FEF part.

Parameters:

<FEFType> integer

Range: 0 to 15
*RST: 0

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "FEF Type (Hex)" on page 45

[:SOURce<hw>]:BB:T2DVb:MISO:MODE?

Sets the MISO group mode, that allows to set the MISO group of the modulator manually.

Return values:

<GroupMode> MANual

*RST: MANual

Example: See Example"Configuring network parameters" on page 112.

Usage: Query only

Manual operation: See "MISO Group Mode" on page 44

[:SOURce<hw>]:BB:T2DVb:MISO[:GROup] <MisoGroup>

Sets the MISO group.

Parameters:

<MisoGroup> G1 | G2

*RST: G1

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "MISO Group" on page 44

[:SOURce<hw>]:BB:T2DVb:NETWorkmode <Networkmode>

Sets the network mode.

Parameters:

<Networkmode> MFN | SFN

*RST: MFN

Manual operation: See "Network Mode" on page 43

[:SOURce<hw>]:BB:T2DVb:PAPR <Papr>

Sets the technique to reduce the peak to average power ratio.

Parameters:
<Papr> OFF | TR
*RST: OFF

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "Peak To Average Power Ratio" on page 44

[:SOURce<hw>]:BB:T2DVb:PROFile <Profilemode>

Sets the profile mode.

Mutes P1FEF, if the modulator operates in a multi profile environment and is used to generate a RF combined T2Base/T2Lite composite signal.

Parameters:
<Profilemode> SINGLE | MULTI
*RST: SINGLE

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "Profile Mode" on page 43

[:SOURce<hw>]:BB:T2DVb:TFS <TFS>

Queries the TFS state.

The current firmware does not support TFS.

Parameters:
<TFS> OFF

OFF
Fixed response of the query.

*RST: OFF

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "Time Frequency Slicing" on page 45

[:SOURce<hw>]:BB:T2DVb:TXSYs <TransmissionSys>

Sets the transmission system.

Parameters:
<TransmissionSys> T2LM | T2LS | NONT2 | MISO | SISO

T2LM
T2 Lite MISO

T2LS
T2 Lite SISO

NONT2
Non-T2

MISO
MISO

SISO
SISO

*RST: SISO

Example: See Example"Configuring network parameters" on page 112.

Manual operation: See "Transmission System" on page 44

5.6.2 L1 commands

Example: Configuring L1 parameters

```
//*****************************************************************************
// Setting L1 parameters requires disabling T2-MI interface.
//*****************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface OFF

SOURce1:BB:T2DVb:L:T2Version V111
// Sets T2 version to V1.1.1.
SOURce1:BB:T2DVb:L:CONStel T64
// Sets L1 post modulation to 64QAM constellation.
SOURce1:BB:T2DVb:L:REPetition ON
SOURce1:BB:T2DVb:L:EXTension?
// Response: "0"
// L1 post extension is off.
SOURce1:BB:T2DVb:L:SCRambled?
// Response: "0"
// L1 post scrambling is off. Set version V1.3.1 to activate it.
SOURce1:BB:T2DVb:L:T2Version V131
SOURce1:BB:T2DVb:L:SCRambled ON
SOURce1:BB:T2DVb:L:T2Baselite?
// Response: "0"
// T2 base lite transmission not acitve.
SOURce1:BB:T2DVb:NAUX?
// Response: "0"
// Number of auxiliary frames is fixed to zero.
SOURce1:BB:T2DVb:L:RFSignalling?
// Response: "0"
// RF signaling is disabled.
SOURce1:BB:T2DVb:L:RFSignaling:FREQuency?
// Response: "0"
```

Commands

[:SOURce<hw>]:BB:T2DVb:L:CONStel....118
[:SOURce<hw>]:BB:T2DVb:L:EXTension....118
[:SOURce<hw>]:BB:T2DVb:L:REPetition....118

[:SOURce<hw>]:BB:T2DVb:L:RFSignalling:FREQuency?.....119
[:SOURce<hw>]:BB:T2DVb:L:RFSignalling.....119
[:SOURce<hw>]:BB:T2DVb:L:SCRambled.....119
[:SOURce<hw>]:BB:T2DVb:L:T2Baselite.....120
[:SOURce<hw>]:BB:T2DVb:L:T2Version.....120
[:SOURce<hw>]:BB:T2DVb:NAUX.....120

[:SOURce<hw>]:BB:T2DVb:L:CONStel <L1PostMod>

Sets the modulation of the L1 post signal.

Parameters:

<L1PostMod> T2 | T4 | T16 | T64

T2
BPSK

T4
QPSK

T16
16QAM

T64
64QAM

*RST: T64

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "L1 Post Modulation" on page 47

[:SOURce<hw>]:BB:T2DVb:L:EXTension <L1PostExt>

Queries the L1 post extension state.

The current firmware does not support L1 post extension.

Parameters:

<L1PostExt> OFF

OFF
Fixed response of the query.

*RST: OFF

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "L1 Post Extension" on page 47

[:SOURce<hw>]:BB:T2DVb:L:REPetition <L1Repetition>

Enables/disables L1 repetition.

Parameters:

<L1Repetition> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "L1 Repetition" on page 47

[:SOURce<hw>]:BB:T2DVb:L:RFSignalling:FREQuency?

Queries the signaled frequency in the L1 signaling.

Return values:

<L1Freq> integer

Range: 0 to 4294967295
*RST: 0
Default unit: Hz

Example: See Example"Configuring L1 parameters" on page 117.

Usage: Query only

Manual operation: See "Frequency" on page 48

[:SOURce<hw>]:BB:T2DVb:L:RFSignalling <RFSignalling>

Queries the RF signaling state in L1.

The setting depends on the setting of the "T2-MI Interface":

- "T2-MI Interface > Off": 0x0000 0000 is sent.
- "T2-MI Interface > On": The value from the T2-MI stream is sent.

Parameters:

<RFSignalling> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "L1 RF Signaling" on page 48

[:SOURce<hw>]:BB:T2DVb:L:SCRambled <L1PostScr>

Enables/disables L1 post scrambling according to T2 version 1.3.1 of specification ETSI EN 302 755.

You can query the used version via `[:SOURce<hw>]:BB:T2DVb:L:T2Version` on page 120.

Parameters:

<L1PostScr> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "L1 Post Scrambled" on page 47

[:SOURce<hw>]:BB:T2DVb:L:T2Baselite <T2Baselite>

Enables/disables T2 base lite signaling according to T2 version 1.3.1 of specification ETSI EN 302 755.

You can query the used version via `[:SOURce<hw>]:BB:T2DVb:L:T2Version` on page 120.

Parameters:

<T2Baselite> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "T2 Base Lite" on page 47

[:SOURce<hw>]:BB:T2DVb:L:T2Version <T2Version>

Sets the version of T2 specification ETSI EN 302 755, that is used for transmission.

Parameters:

<T2Version> V111 | V121 | V131

*RST: V121

Example: See Example"Configuring mode and stream parameters" on page 98.

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "L1 T2 Version" on page 46

[:SOURce<hw>]:BB:T2DVb:NAUX <NumAuxStr>

Queries the number of auxiliary streams.

The current firmware does not support auxiliary streams.

Parameters:

<NumAuxStr> integer

0

Fixed response of the query.

*RST: 0

Example: See Example"Configuring L1 parameters" on page 117.

Manual operation: See "Num. Aux. Streams" on page 47

5.6.3 ID commands

Example: Configuring ID parameters

```
SOURce1:BB:T2DVb:ID:CELL #H0123
// Sets the hexadecimal cell ID 0123.
SOURce1:BB:T2DVb:ID:NETWork #H4567
// Sets the hexadecimal network ID 4567.
SOURce1:BB:T2DVb:ID:T2SYstem #H89AB
// Sets the hexadecimal T2 sytsem ID 89AB.
SOURce1:BB:T2DVb:ID:TXID:AVAil?
// Response: "0"
// No transmitter identification signals within the current geographic cell.
```

Commands

[:SOURce<hw>]:BB:T2DVb:ID:CELL....121
[:SOURce<hw>]:BB:T2DVb:ID:NETWork....121
[:SOURce<hw>]:BB:T2DVb:ID:T2SYstem.... 122
[:SOURce<hw>]:BB:T2DVb:ID:TXID:AVAil.... 122

[:SOURce<hw>]:BB:T2DVb:ID:CELL <CellId>

Sets the cell identification (ID).

Parameters:

<CellId> integer

16-bit value in hexadecimal representation.

Range: #H0 to #HFFFF
*RST: #H0

Example: See Example"Configuring ID parameters" on page 121.

Manual operation: See "Cell ID (Hex)" on page 49

[:SOURce<hw>]:BB:T2DVb:ID:NETWork <NetworkId>

Sets the network identification.

Parameters:

<NetworkId> integer

16-bit value in hexadecimal representation.

Range: #H0 to #HFFFF
*RST: #H0

Example: See Example"Configuring ID parameters" on page 121.

Manual operation: See "Network ID (Hex)" on page 49

[:SOURce<hw>]:BB:T2DVb:ID:T2SYstem <T2SystemId>

Sets the T2 system identification.

Parameters:

<T2SystemId> integer

16-bit value in hexadecimal representation.

Range: #H0 to #HFFFF
*RST: #H0

Example: See Example"Configuring ID parameters" on page 121.

Manual operation: See "T2 System ID (Hex)" on page 49

[:SOURce<hw>]:BB:T2DVb:ID:TXID:AVAil <Avail>

Queries if transmitter identification signals are available within the current geographic cell.

Parameters:

<Avail> integer

8-bit value in hexadecimal representation.

Range: #H0 to #HFF
*RST: #H0

Example: See Example"Configuring ID parameters" on page 121.

Manual operation: See "TX ID Availability (Hex)" on page 49

5.7 SFN delay commands

The section contains the commands for configuring single-frequency network delays.

Example: Configuring single-frequency network delay parameters

```
//******************************************************************************
// Activate SFN network mode.
//******************************************************************************
SOURce1:BB:T2DVb:INPut:T2MI:INTerface ON
SOURce1:BB:T2DVb:NETWorkmode SFN

//******************************************************************************
// Configure timestamp parameters.
//******************************************************************************
SOURce1:BB:T2DVb:DELay:TSP:MODE?
// Response: "ABS"
// Timestamp mode is relative.
SOURce1:BB:T2DVb:DELay:TSP:UPDate
// Updates the UTC time and date reference.
SOURce1:BB:T2DVb:DELay:TSP:DATE?
```

```
// Response: "2020-02-26"
SOURce1:BB:T2DVb:DELay:TSP:TIME?
// Response: "10:01.15"
//SOURce1:BB:T2DVb:DELay:TSP:OFFSet -2
// Sets an offset of -2 seconds.
SOURce1:BB:T2DVb:DELay:TSP:SEConds?
// Response in seconds: "636026505"
// 636026505 seconds elapsed since 2000.

//*****************************************************************************
// Configure delay parameters.
//*****************************************************************************
SOURce1:BB:T2DVb:DELay:PROCess?
// Response: "0.3522332"
// Processing delay is 0.3522332 seconds.
SOURce1:BB:T2DVb:DELay:STATic 0.000003
// The start of transmission is shifted to 3 µs later.
SOURce1:BB:T2DVb:DELay:DYNamic?
// Response: "1.5111824"
// Dynamic delay is 1.5111824 seconds.
// Query the total delay in µs, that is the sum of processing and dynamic delay.
SOURce1:BB:T2DVb:DELay:TOTal?
// Response: "1.8638689"
// Total delay is 1.8638689 seconds.

// Set a maximum permissible delay of, e.g., 10 µs.
SOURce1:BB:T2DVb:DELay:DEViation 0.00001
// Mutes the P1 symbol of the first T2 frame in a super frame.
SOURce1:BB:T2DVb:DELay:MUTep1 1
```

Commands

[:SOURce<hw>]:BB:T2DVb:DELay:DEViation....123
[:SOURce<hw>]:BB:T2DVb:DELay:DYNamic?....124
[:SOURce<hw>]:BB:T2DVb:DELay:MUTep1....124
[:SOURce<hw>]:BB:T2DVb:DELay:PROCess?....124
[:SOURce<hw>]:BB:T2DVb:DELay:STATic....125
[:SOURce<hw>]:BB:T2DVb:DELay:TOTal?....125
[:SOURce<hw>]:BB:T2DVb:DELay:TSP:DATE?....125
[:SOURce<hw>]:BB:T2DVb:DELay:TSP:MODE?....126
[:SOURce<hw>]:BB:T2DVb:DELay:TSP:OFFSet....126
[:SOURce<hw>]:BB:T2DVb:DELay:TSP:SEConds?....126
[:SOURce<hw>]:BB:T2DVb:DELay:TSP:TIME?....127
[:SOURce<hw>]:BB:T2DVb:DELay:TSP:UPDate....127

[:SOURce<hw>]:BB:T2DVb:DELay:DEViation <MaxDevTime>

Sets the maximum permissible delay.

Parameters:

<MaxDevTime> float

Range: 1E-6 to 500E-6
Increment: 0.0000001
*RST: 10E-6

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Manual operation: See "Max. Deviation Time" on page 51

[:SOURce<hw>]:BB:T2DVb:DELay:DYNamic?

Queries the transmission delay currently generated by the SFN delay (FIFO).

Return values:

<DynDelay> float

Range: 0 to 8.0
Increment: 0.0000001
*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "Dynamic Delay" on page 50

[:SOURce<hw>]:BB:T2DVb:DELay:MUTep1 <MuteP1>

Activates muting the P1 symbol of the first T2 frame in a super frame. To mute the P1 symbol, the symbol is set to zero.

Parameters:

<MuteP1> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Manual operation: See "Mute 1st Super Frame P1" on page 51

[:SOURce<hw>]:BB:T2DVb:DELay:PROCess?

Queries the delay from the modulator input up to the SFN delay (FIFO).

Return values:

<ProcDelay> float

Range: 0 to 4.0
Increment: 0.0000001
*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "Processing Delay" on page 50

[:SOURce<hw>]:BB:T2DVb:DELay:STATic <StaticDelay>

Sets the delay to shift the time of transmission positively or negatively.

Parameters:

<StaticDelay> float

Range: -4.0 to 4.0
Increment: 0.0000001
*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Manual operation: See "Static Delay" on page 50

[:SOURce<hw>]:BB:T2DVb:DELay:TOTal?

Queries the sum of processing delay and dynamic delay.

Return values:

<TotalDelay> float

Range: -4.0 to 16.0
Increment: 0.0000001
*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "Total Delay" on page 51

[:SOURce<hw>]:BB:T2DVb:DELay:TSP:DATE?

Queries the UTC date from the last UTC reference update.

Return values:

<TSPDate> string

Format `<yyyy>-<mm>-<dd>`

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "UTC Date" on page 52

[:SOURce<hw>]:BB:T2DVb:DELay:TSP:MODE?

Queries the type of the currently received T2-MI timestamps.

Return values:

<TimestampMode> RELative | ABSolute

RELative
Received T2-MI stream has T2-MI packets with relative timestamps.

ABSolute
Received T2-MI stream has T2-MI packets with absolute timestamps. If received, the following subparameters are displayed.

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "Timestamp Mode" on page 51

[:SOURce<hw>]:BB:T2DVb:DELay:TSP:OFFSet <TSPOffset>

Modifies the UTC/GPS leap seconds offset.

Parameters:

<TSPOffset> integer

Range: -255 to 255
*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Manual operation: See "Offset" on page 52

[:SOURce<hw>]:BB:T2DVb:DELay:TSP:SEConds?

Queries the elapsed time in seconds since 2000. The value is based on the value of the last UTC reference update.

Return values:

<TSPSeconds> integer

Range: 0 to 1099511627775
*RST: 0

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "Seconds Since 2000" on page 53

[:SOURce<hw>]:BB:T2DVb:DELay:TSP:TIME?

Queries the UTC time from the last UTC reference update.

Return values:

<TSPTime> string

Format `<hour>:<minute>:<second>`

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Query only

Manual operation: See "UTC Time" on page 52

[:SOURce<hw>]:BB:T2DVb:DELay:TSP:UPDate

Triggers an update of the UTC time and date reference.

Example: See Example"Configuring single-frequency network delay parameters" on page 122.

Usage: Event

Manual operation: See "Update Timestamp" on page 52

5.8 Frame info commands

The section contains the commands for querying frame information.

- Frame and symbol duration commands....128
- L1 signaling commands....130
- Data cell commands....132

5.8.1 Frame and symbol duration commands

Example: Querying frame and symbol duration information

```
SOURce1:BB:T2DVb:INFO:TSF?
// Response in s: "0.433888"
// Super frame duration is 33.888 ms.
SOURce1:BB:T2DVb:INFO:TF?
// Response in s: "0.216944"
// T2 frame duration is 216.944 ms.
SOURce1:BB:T2DVb:INFO:TFEF?
// Response in s: "0"
// Future extension frame duration is 0 s.
SOURce1:BB:T2DVb:INFO:TP1?
// Response in s: "0.000224"
// P1 symboly duration is 0.224 ms.
SOURce1:BB:T2DVb:INFO:TP2?
SOURce1:BB:T2DVb:INFO:TS?
// Response for both commands in s: "0.003612"
// P2 symbol and OFDM data symbol duration is 3.612 ms.
```

Commands

[:SOURce<hw>]:BB:T2DVb:INFO:TF? 128
[:SOURce<hw>]:BB:T2DVb:INFO:TFEF? 128
[:SOURce<hw>]:BB:T2DVb:INFO:TSF? 129
[:SOURce<hw>]:BB:T2DVb:INFO:TP1? 129
[:SOURce<hw>]:BB:T2DVb:INFO:TP2|TS? 129

[:SOURce<hw>]:BB:T2DVb:INFO:TF?

Queries the T2 frame duration.

Return values:

<T2FrameDur> float

Range: 0 to 0.999999
Increment: 0.000001
*RST: 0

Example: See Example"Querying frame and symbol duration information" on page 128.

Usage: Query only

Manual operation: See "T2 Frame Duration (T_F)" on page 54

[:SOURce<hw>]:BB:T2DVb:INFO:TFEF?

Queries the future extension frame duration.

Return values:

<FEFDur> integer

Range: 0 to 9.999999
Increment: 0.000001
*RST: 0

Example: See Example"Querying frame and symbol duration information" on page 128.

Usage: Query only

Manual operation: See "Future Extension Frame Duration (T_FEF)" on page 54

[:SOURce<hw>]:BB:T2DVb:INFO:TSF?

Queries the super frame duration.

Return values:

<SuperFrameDur> float

Range: 0 to 999.999999
Increment: 0.000001
*RST: 0

Example: See Example"Querying frame and symbol duration information" on page 128.

Usage: Query only

Manual operation: See "Super Frame Duration (T_SF)" on page 54

[:SOURce<hw>]:BB:T2DVb:INFO:TP1?

Queries the P1 symbol duration.

Return values:

<P1SymbolDur> float

Range: 0 to 0.001000
Increment: 0.000001
*RST: 0

Example: See Example"Querying frame and symbol duration information" on page 128.

Usage: Query only

Manual operation: See "P1 Symbol Duration (T_P1)" on page 54

[:SOURce<hw>]:BB:T2DVb:INFO:TP2|TS?

Queries the P2 and OFDM data symbol duration.

Return values:

<OfdmSymbolDur> float

Range: 0 to 0.010000
Increment: 0.000001
*RST: 0

Example: See Example"Querying frame and symbol duration information" on page 128.

Usage: Query only

Manual operation: See "OFDM Symbol Duration (T_P2, T_S)" on page 54

5.8.2 L1 signaling commands

Example: Querying L1 signaling parameters

```
SOURce1:BB:T2DVb:INFO:PREBits?
// Response: "200"
// L1-pre singnaling length is 200 bit.
SOURce1:BB:T2DVb:INFO:PRECells?
// Response: "1800"
// L1-pre singnaling length is 1800 cells.
SOURce1:BB:T2DVb:INFO:POSBits?
// Response: "350"
// L1-post singnaling length is 350 bit.
SOURce1:BB:T2DVb:INFO:POSCells?
// Response: "750"
// L1-post singnaling length is 750 cells.
```

Commands

[:SOURce<hw>]:BB:T2DVb:INFO:POSBits? 130
[:SOURce<hw>]:BB:T2DVb:INFO:POSCells? 131
[:SOURce<hw>]:BB:T2DVb:INFO:PREBits? 131
[:SOURce<hw>]:BB:T2DVb:INFO:PRECells? 131

[:SOURce<hw>]:BB:T2DVb:INFO:POSBits?

Queries the L1-post signaling length in bits.

Return values:

<L1PostSigBits> integer

Range: 0 to 262175
*RST: 0

Example: See Example"Querying L1 signaling parameters" on page 130.

Usage: Query only

Manual operation: See "L1 Post Signaling Bits" on page 55

[:SOURce<hw>]:BB:T2DVb:INFO:POSCells?

Queries the L1-post signaling length in cells.

Return values:
<L1PostSigCells> integer

Range: 0 to 262143
*RST: 0

Example: See Example"Querying L1 signaling parameters" on page 130.

Usage: Query only

Manual operation: See "L1 Post Signaling Cells" on page 55

[:SOURce<hw>]:BB:T2DVb:INFO:PREBits?

Queries the L1-pre signaling length in bits.

Return values:
<L1PreSigBits> integer

Range: 0 to 200
*RST: 0

Example: See Example"Querying L1 signaling parameters" on page 130.

Usage: Query only

Manual operation: See "L1 Pre Signaling Bits" on page 55

[:SOURce<hw>]:BB:T2DVb:INFO:PRECells?

Queries the L1-pre signaling length in cells.

Return values:
<L1PreSigCells> integer

Range: 0 to 1840
*RST: 0

Example: See Example"Querying L1 signaling parameters" on page 130.

Usage: Query only

Manual operation: See "L1 Pre Signaling Cells" on page 55

5.8.3 Data cell commands

Example: Querying the number of data cells

```
SOURce1:BB:T2DVb:INFO:DP?
// Response: "1637178"
// Maximum number of PLP data cells per T2 frame is 1637178.
SOURce1:BB:T2DVb:INFO:DPUSed?
// Response: "1636200"
// Current T2 frame has 1636200 data cells.
```

Commands

[:SOURce<hw>]:BB:T2DVb:INFO:DP?.....132
[:SOURce<hw>]:BB:T2DVb:INFO:DPUSed?.....132

[:SOURce<hw>]:BB:T2DVb:INFO:DP?

Queries the maximum possible number of PLP data cells in the T2 frame.

Return values:

<Dplp> integer

Range: 0 to 1E7
*RST: 0

Example: See Example"Querying the number of data cells" on page 132.

Usage: Query only

Manual operation: See "Per T2 Frame (D_PLP)" on page 56

[:SOURce<hw>]:BB:T2DVb:INFO:DPUSed?

Queries the current number of PLP data cells in the T2 frame.

Return values:

<Dplpused> integer

Range: 0 to 1E7
*RST: 0

Example: See Example"Querying the number of data cells" on page 132.

Usage: Query only

Manual operation: See "Current T2 Frame (D_PLP_USED)" on page 56

5.9 TSGen subsystem

The `TSGen` subsystem contains the commands for configuring the TS player.

Example: Playing a TS player file

```
//*****************************************************************************
// Select a file, e.g. a user-defined setting.
//*****************************************************************************
TSGen:CONFigure:PLAYfile "/var/user/my_test_player_test.trp"
// Selects the file "my_test_player_test" with extension *.trp.

//*****************************************************************************
// Within the file, define a section, that you want to play.
// You can set start/stop position for a maximum section length of 10 hours.
//*****************************************************************************
TSGen:CONFigure:SEEK:STARt 60000 // milliseconds
// Section start is after one minute from the original file start.
// The first minute is ignored.
TSGen:CONFigure:SEEK:STOP 120000 // milliseconds
// Section stop is after one minute from the original file start.
// The total section length is one minute.

//*****************************************************************************
// Navigate to a certain position within the file/section of the file.
//*****************************************************************************
TSGen:CONFigure:SEEK:POSition 100000 // milliseconds
// The current player position of file/section of the file is at 1 minute 40 seconds.

//*****************************************************************************
// Reset play-related settings
//*****************************************************************************
TSGen:CONFigure:SEEK:RESet

//*****************************************************************************
// Pause, stop, play the file.
//*****************************************************************************
TSGen:CONFigure:COMMand PAUS
// Pauses playing the file.
TSGen:CONFigure:COMMand STOP
// Stops playing the file.
TSGen:CONFigure:COMMand PLAY
// Activates playing the file.
```

Example: Configuring and monitoring TS player output

```
//*****************************************************************************
// Configure general and stuffing parameters of the TS player output.
//*****************************************************************************
TSGen:CONFigure:STUFfing ON
TSGen:CONFigure:STOPdata TTSP
TSGen:CONFigure:TSPacket H184
TSGen:CONFigure:PIDTestpacket VAR
TSGen:CONFigure:PID 8100
// Corresponds to a PID = 1FA4 in hexadecimal representation.
TSGen:CONFigure:PAYLoad PRBS
TSGen:CONFigure:PRBS:SEQuence P23_1
```

```
//*****************************************************************************
// Monitor TS player output data.
//*****************************************************************************
// You can only change the data rate, if you stop the TS player.
TSGen:CONFigure:COMMand STOP
TSGen:CONFigure:TSRate 350E6
// Corresponds to a net data rate of 350 MBit/s.
TSGen:CONFigure:COMMand PLAY

TSGen:CONFigure:PLENgth?
// Response: "P188"
// Packet length is 188 bytes.
TSGen:READ:ORIGtsrate?
// Response in bit/s: "5018502"
```

Example: Configuring seamless loop parameters

```
TSGen:CONFigure:SEAMless:CC ON
TSGen:CONFigure:SEAMless:PCR OFF
TSGen:CONFigure:SEAMless:TT ON
```

Commands

:TSGen:CONFigure:COMMand 134
:TSGen:CONFigure:PAYLoad 135
:TSGen:CONFigure:PID 135
:TSGen:CONFigure:PIDTestpack 135
:TSGen:CONFigure:PLAYfile 136
:TSGen:CONFigure:PLENgth 136
:TSGen:CONFigure:PRBS[:SEQuence] 136
:TSGen:CONFigure:SEAMless:CC 136
:TSGen:CONFigure:SEAMless:PCR 137
:TSGen:CONFigure:SEAMless:TT 137
:TSGen:CONFigure:SEEK:POSition 137
:TSGen:CONFigure:SEEK:RESet 137
:TSGen:CONFigure:SEEK:STARt 138
:TSGen:CONFigure:SEEK:STOP 138
:TSGen:CONFigure:STOPdata 138
:TSGen:CONFigure:STUFfing 138
:TSGen:CONFigure:TSPacket 139
:TSGen:CONFigure:TSRate 139
:TSGen:READ:FMEMory 139
:TSGen:READ:ORIGtsrate 140
:TSGen:READ:PLAYfile:LENGth? 140

:TSGen:CONFigure:COMMand <PlayerStatus>

Triggers playing, pausing and stopping of the TS player file selected with `:TSGen:CONFigure:PLAYfile`.

Parameters:
<PlayerStatus> STOP | PAUSe | PLAY | RESet
*RST: STOP

Example: See Example"Playing a TS player file" on page 133.

Manual operation: See "Play" on page 62
See "Pause" on page 62
See "Stop" on page 62

:TSGen:CONFigure:PAYLoad <PayLoad>

Determines the payload of the test packet. Also influences the payload of the generated stuffing packets while the TS player is running.

Parameters:
<PayLoad> HFF | H00 | PRBS
*RST: PRBS

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Payload Test/Stuff" on page 66

:TSGen:CONFigure:PID <PID>

The available values depend on the settings of `:TSGen:CONFigure:PIDTestpack`.

If `:TSGen:CONFigure:PIDTestpack` is set to `NULL`,
then `:TSGen:CONFigure:PID` is `1FFF(hex)`.

Otherwise the values are variable.

Parameters:
<PID> integer
Range: 0 to 8191
*RST: 8191

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "PID (Hex)" on page 66

:TSGen:CONFigure:PIDTestpack <PIDTestpack>

Sets the PID, if `:TSGen:CONFigure:TSPacket` is `H184|H200|H204`.

Parameters:
<PIDTestpack> VARiable | NULL
*RST: NULL

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "PID Test Packet" on page 66

:TSGen:CONFigure:PLAYfile <PlayFile>

Specifies the file path and filename of the TS player file.

Parameters:
<PlayFile> string

Example: See Example"Playing a TS player file" on page 133.

Manual operation: See "Select File" on page 61

:TSGen:CONFigure:PLENgth <PLength>

Queries the packet length of the loaded file.

Parameters:
<PLength> P188 | P204 | P208 | INV
*RST: INV

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Packet Length" on page 64

:TSGen:CONFigure:PRBS[:SEQuence] <PRBS>

Sets the length of the PRBS sequence.

Parameters:
<PRBS> P15_1 | P23_1
*RST: P23_1

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "PRBS" on page 66

:TSGen:CONFigure:SEAMless:CC <CC>

Activates the correction of the continuity counters in the replayed TS data stream. The correction allows you to decode the stream without interruption when the play file is looping.

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

Example: See Example"Configuring seamless loop parameters" on page 134.

Manual operation: See "Continuity Counter" on page 67

:TSGen:CONFigure:SEAMless:PCR <PCR>

Activates the correction of time stamps in the replayed TS data stream. The correction allows you to decode the stream without interruption when the play file is looping.

Parameters:

<PCR> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring seamless loop parameters" on page 134.

Manual operation: See "PCR, DTS/PTS" on page 67

:TSGen:CONFigure:SEAMless:TT <TT>

Activates the correction of the time and date table in the replayed TS data stream. The correction allows you to decode the stream without interruption when the play file is looping.

Parameters:

<TT> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"Configuring seamless loop parameters" on page 134.

Manual operation: See "TDT/TOT" on page 67

:TSGen:CONFigure:SEEK:POSition <Position>

Sets the position, that is the current playing time position.

You can select a value in a 10-hour range.

Parameters:

<Position> float

Range: 0 to 36000000
Increment: 0.1
*RST: 0

Example: See Example"Playing a TS player file" on page 133.

Manual operation: See "Running/Position Player [hh:mm:ss:fff]" on page 60
See "Position Player [hh:mm:ss.fff]" on page 62

:TSGen:CONFigure:SEEK:RESet

Resets the following parameters to their default state:

- `:TSGen:CONFigure:SEEK:STARt` on page 138
- `:TSGen:CONFigure:SEEK:STOP` on page 138

Example: See Example"Playing a TS player file" on page 133.

Usage: Event

Manual operation: See "Reset Window" on page 62

:TSGen:CONFigure:SEEK:STARt <Start>

Sets an individual start time.

You can select a value in a 10-hour range.

Parameters:

<Start> float

Range: 0 to 36000000
Increment: 0.1
*RST: 0

Example: See Example"Playing a TS player file" on page 133.

Manual operation: See "Start [hh:mm:ss.fff]" on page 62

:TSGen:CONFigure:SEEK:STOP <Stop>

Sets an individual stop time.

You can select a value in a 10-hour range.

Parameters:

<Stop> float

Range: 0 to 36000000
Increment: 0.1
*RST: 23040.2

Example: See Example"Playing a TS player file" on page 133.

Manual operation: See "Stop [hh:mm:ss.fff]" on page 62

:TSGen:CONFigure:STOPdata <StopData>

Ensures that a standardized TS data stream is always output at the TS output at the rear of the R&S SMCV100B.

Parameters:

<StopData> TTSP | NONE

*RST: NONE

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Stop Data" on page 64

:TSGen:CONFigure:STUFfing <Stuffing>

Activates nullpacket stuffing.

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

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Nullpacket Stuffing" on page 64

:TSGen:CONFigure:TSPacket <TSPaket>

Sets the structure of the generated test packets in pause or stop status.

Parameters:
<TSPaket> H184 | H200 | H204 | S187 | S203 | S207

S187|S203|S207
A sync byte (0x47) followed by 187/203/207 payload bytes.

H184|H200|H204
A sync byte (0x47) followed by three header bytes and 184/200/204 payload bytes.

*RST: H184

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Test TS Packet" on page 65

:TSGen:CONFigure:TSRate <TSRate>

Sets the output data rate of the player.

Parameters:
<TSRate> integer

Range: 1 to 35E7
*RST: 5018502

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Data Rate" on page 63

:TSGen:READ:FMEMory <FMemory>

Queries the file size of the TS player file.

Parameters:
<FMemory> integer

Range: 0 to 10
*RST: 0

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Select File" on page 61

:TSGen:READ:ORIGtsrate <ORIGtsrate>

Displays the calculated original TS data rate.

Parameters:

<ORIGtsrate> integer

Range: 1 to 350000000
*RST: 5018502

Example: See Example"Configuring and monitoring TS player output" on page 133.

Manual operation: See "Orig. Data Rate" on page 63

:TSGen:READ:PLAYfile:LENGth?

Queries calculated original loop time.

Return values:

<Length> integer

Range: 0 to 100
*RST: 0

Example: See Example"Configuring and monitoring TS player output" on page 133.

Usage: Query only

Manual operation: See "Select File" on page 61

5.10 BCIP subsystem

The `SYSTem:COMMunicate:BCIP` subsystem contains the commands for configuring local IP data network parameters.

Common suffixes

The following common suffixes are used in the remote commands:

Suffix	Value range	Description
`BCIP<hw>`	1	Available local IP LAN interfaces

Example: Retrieving information on local network-related settings

```
//*****************************************************************************
// Monitor IP interface 1 local network status.
//*****************************************************************************
SYSTem:COMMunicate:BCIP1:NETWork:STATus?
// Response: "0"
// The instrument is diconnected from the local IP network.
SYSTem:COMMunicate:BCIP1:NETWork:RESTart
SYSTem:COMMunicate:BCIP1:NETWork:STATus?
// Response: "1"

//*****************************************************************************
// Query local IP data network properties.
//*****************************************************************************
SYSTem:COMMunicate:BCIP1:NETWork:COMMon:HOSTname?
// Response: "SMCV100B-123456-IP-Data"
SYSTem:COMMunicate:BCIP1:NETWork:IPADdress:MODE STAT
SYSTem:COMMunicate:BCIP1:NETWork:IPADdress "10.113.0.104"
SYSTem:COMMunicate:BCIP1:NETWork:IPADdress:SUBNet:MASK "255.255.252.0"
SYSTem:COMMunicate:BCIP1:NETWork:MACaddress?
// Response: "00 90 B8 21 89 F8"
SYSTem:COMMunicate:BCIP1:NETWork:PROTocol?
// Response: "UDP"
```

Commands

:SYSTem:COMMunicate:BCIP<hw>:NETWork:COMMon:HOSTname 141
:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress 142
:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress:MODE 142
:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress:SUBNet:MASK 142
:SYSTem:COMMunicate:BCIP<hw>:NETWork:MACaddress 142
:SYSTem:COMMunicate:BCIP<hw>:NETWork:PROTocol 142
:SYSTem:COMMunicate:BCIP<hw>:NETWork:RESTart 143
:SYSTem:COMMunicate:BCIP<hw>:NETWork:STATus 143

:SYSTem:COMMunicate:BCIP<hw>:NETWork:COMMon:HOSTname <Hostname>

Sets an individual hostname for the vector signal generator.

Note: We recommend that you do not change the hostname to avoid problems with the network connection. If you change the hostname, be sure to use a unique name.

Parameters:

<Hostname> string

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "Hostname" on page 69

:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress

Sets the IP address.

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "IP Address" on page 69

:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress:MODE <IPMode>

Selects manual or automatic setting of the IP address.

Parameters:

<IPMode> AUTO | STATic

*RST: AUTO

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "Address Mode" on page 69

:SYSTem:COMMunicate:BCIP<hw>:NETWork:IPADdress:SUBNet:MASK

Sets the subnet mask.

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "Subnet Mask" on page 70

:SYSTem:COMMunicate:BCIP<hw>:NETWork:MACaddress <MACAddress>

Queries the MAC address of the network adapter.

Parameters:

<MACAddress> string

Range: 00:00:00:00:00:00 to ff:ff:ff:ff:ff:ff

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "MAC Address" on page 70

:SYSTem:COMMunicate:BCIP<hw>:NETWork:PROTocol <Protocol>

Specifies the network protocol.

Parameters:

<Protocol> UDP

*RST: UDP

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "Protocol" on page 70

:SYSTem:COMMunicate:BCIP<hw>:NETWork:RESTart

Triggers a restart of the network.

Example: See Example"Retrieving information on local network-related settings" on page 141.

Usage: Event

Manual operation: See "Restart Network" on page 69

:SYSTem:COMMunicate:BCIP<hw>:NETWork:STATus <NetworkStatus>

Queries the network connection state.

Parameters:

<NetworkStatus> 1 | ON | 0 | OFF

*RST: n.a. (no preset. default: 0)

Example: See Example"Retrieving information on local network-related settings" on page 141.

Manual operation: See "Network Status" on page 68

Annex

A DVB-T2 test cases

Test case type	Test case	Remark
DTG	DVBT2_DTG_xyz	117 test cases, xyz = 000 to 109, 162 to 168
	DVBT2_DTG_xyz_MISO_Groupa	104 test cases, xyz = 110 to 161 a = 1 to 2
NorDig UTP 2.4	DVBT2_NORDIG_3_xy_z	-
NorDig UTS 2.2.2	DVBT2_NORDIG_3_xy_z	-
DVB V&V	DVBT2_VV_xyz_OFCOMa	7 test cases, xyz = 001, 003, 012 to 016 a = 1 to 7
	DVBT2_VV_xyz	13 test cases, xyz = 004 to 011, 017, 019, 034 to 036
	DVBT2_VV_xyz_MISO_Groupa	2 test cases, xyz = 018 a = 1 to 7

Glossary: Abbreviations

A

ACE: Active Constellation Extension

ACM: Adaptive Coding and Modulation

ASI: Asynchronous Serial Interface

B

BICM: Bit-Interleaved Coding and Modulation

BPSK: Binary Phase Shift Keying

C

CM: Coding and Modulation

D

DHCP: Dynamic Host Configuration Protocol

DVB-H: Digital Video Broadcast - Handheld

DVB-T: Digital Video Broadcast - Terrestrial

F

FEC: Forward Error Correction

FEF: Future Extension Frame(s)

FFT: Fast Fourier Transform

FIFO: First In First Out

G

GPS: Global Positioning System

I

IFFT: Inverse Fast Fourier Transform

IGMP: Internet Group Management Protocol

IGMPv3: Internet Group Management Protocol version 3

ISCR: Input Stream Clock Reference

ISSY: Input Stream Synchronizer

M

MAC: Media Access Control

MFN: Multi-frequency Network

MISO: Multiple Input Single Output

MPE FEC: Multiprotocol encapsulation forward error correction

MPEG: Moving Picture Experts Group
https://mpeg.chiariglione.org/

N

NTP: Network Time Protocol

O

OFDM: Orthogonal Frequency-Division Multiplexing

P

PCR: Programme Clock Reference

PID: Packet Identifier

PLP: Physical Layer Pipe

PRBS: Pseudo-Random Bit Sequence

Q

QAM: Quadrature Amplitude Modulation

QPSK: Quaternary Phase Shift Keying

R

RTP: Real-Time Transport Protocol

S

SFN: Single-frequency Network

SID: Stream Identifier

SISO: Single Input Single Output

SMPTE: Society of Motion Picture and Television Engineers

https://www.smpte.org/

T

T2-MI: T2 Modulator interface

TCP: Transmission Control Protocol

TFS: Time Frequency Slicing

TPS: Transmission Parameter Signalling

TR: Tone Reservation

TS: Transport Stream

U

UDP: User Datagram Protocol

UTC: Universal Time Coordinated

V

VSB: Vestigial Sideband Modulation

Glossary: Specifications

E

ETSI EN 302 307: Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2)
https://www.etsi.org/deliver/etsi_en/302300_302399/302307/

ETSI EN 302 755: Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)
https://www.etsi.org/deliver/etsi_en/302700_302799/302755/

ETSI TS 102 773: Digital Video Broadcasting (DVB); Modulator Interface (T2-MI) for a second generation digital terrestrial television broadcasting system (DVB-T2)
https://www.etsi.org/deliver/etsi_ts/102700_102799/102773/

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ITU-T O.151: ITU-T Recommendation O.151
https://www.itu.int/rec/T-REC-O.151-199210-I/en

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