ROHDE&SCHWARZ

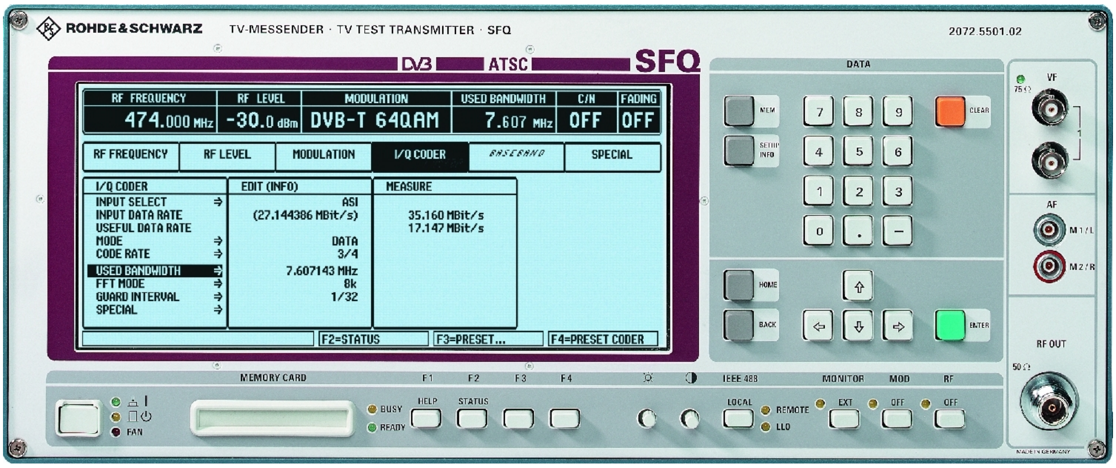
Broadcasting Division

Operating Manual

TV TEST TRANSMITTER

SFQ

2072.5501...



Printed in the Federal
Republic of Germany

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 970017

This is to certify that:

Equipment type	Stock No.	Designation
SFQ	2072.5501.02/.10/.20/.30	TV Test Transmitter
SFQ-B2	2072.6108.02	Broadband-FM-Modulator
SFQ-B3	2072.7379.02	2 FM-Subcarrier
SFQ-B4	2072.7479.02	2 ADR-Subcarrier
SFQ-B5	2072.7579.02/.03/.04	Noise Generator
SFQ-B6	2072.7679.02/.03	Input Interface
SFQ-B10	2072.6166.02	DVB-T Coder
SFQ-B11	2072.6189.02/.03/.04	Fading Simulation
SFQ-B12	2072.6220.02	ATSC/8VSB Coder
SFQ-B13	2072.6243.02	ITU-T/J.83B Coder
SFQ-B14	2072.6266.02	I/Q Output
SFQ-B15	2072.5976.02	DVB-T/DVB-S Coder
SFQ-B21	2081.9812.02	DVB-C Coder
SFQ-B23	2072.5830.02	DVB-S/DSNG Coder

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1993 + A2 : 1995
EN55011 : 1998 + A1 : 1999
EN61326-1 : 1997 + A1 : 1998

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in controlled electromagnetic environments to EN61326/A1 have been used as a basis.

Affixing the EC conformity mark as from 1997

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2002-08-22

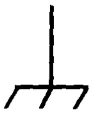
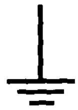
Central Quality Management FS-QZ / Becker

Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

							
Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground	Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, pollution severity 2 overvoltage category 2, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. For measurements in circuits with voltages $V_{rms} > 30$ V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

Safety Instructions

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

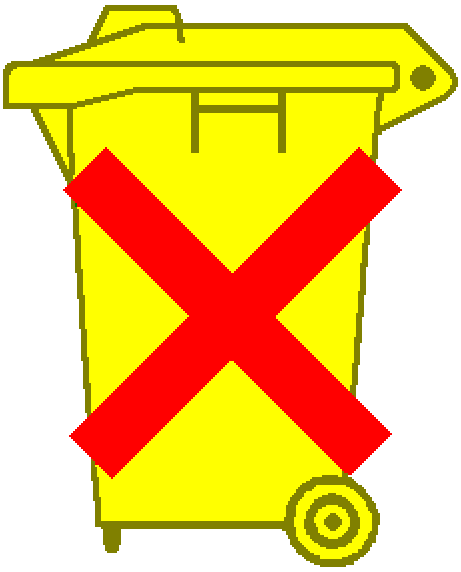
    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

ROHDE&SCHWARZ

Kundeninformation zur Batterieverordnung (BattV)
Dieses Gerät enthält eine schadstoffhaltige Batterie.
Diese darf nicht mit dem Hausmüll entsorgt werden.

Nach Ende der Lebensdauer darf die Entsorgung nur über eine Rohde&Schwarz-Kundendienststelle oder eine geeignete Sammelstelle erfolgen.



Safety Regulations for Batteries (according to BattV)
This equipment houses a battery containing harmful substances that must not be disposed of as normal household waste.
After its useful life, the battery may only be disposed of at a Rohde & Schwarz service center or at a suitable depot.

Consignes de sécurité pour batteries (selon BattV)
Cet appareil est équipé d'une pile comprenant des substances nocives. Ne jamais la jeter dans une poubelle pour ordures ménagéres.
Une pile usagée doit uniquement être éliminée par un centre de service client de Rohde & Schwarz ou peut être collectée pour être traitée spécialement comme déchets dangereux.

Verwendung von Patenten

Dieses Gerät enthält Technologie, die von Marconi Instruments LTD. unter den US Patenten 4609881 und 4870384 sowie unter den entsprechenden Patenten in Deutschland und anderswo zugelassen wurde.

Patent Information

This product contains technology licensed by Marconi Instruments LTD. under US patents 4609881 and 4870384 and under corresponding patents in Germany and elsewhere.

Exploitation de brevets

Ce produit contient de la technologie dont l'exploitation est autorisée par MARCONI INSTRUMENTS LTD. conformément aux brevets d'invention des Etats-Unis 4609881 et 4870384 ainsi que selon les brevets correspondants déposés en Allemagne et ailleurs.

Preparation for Use

Manual Control

Remote Control

Maintenance

1 Preparation for Use

The controls and indicators of the instrument are combined in separately arranged and colour-coded functional groups. A brief description of these functional groups is given in the following together with references to the chapter containing a detailed description.

Chapter 1 Preparation for Use is subdivided as follows:

- Legend for Front and Rear View Chapter 1.1
- Putting into Operation Chapter 1.2
- Connection Chapter 1.3
- Power Up Chapter 1.4
- Configuration Chapter 1.5
- Options Chapter 1.6

1.1 Legend for Front and Rear View

1.1.1 Front View

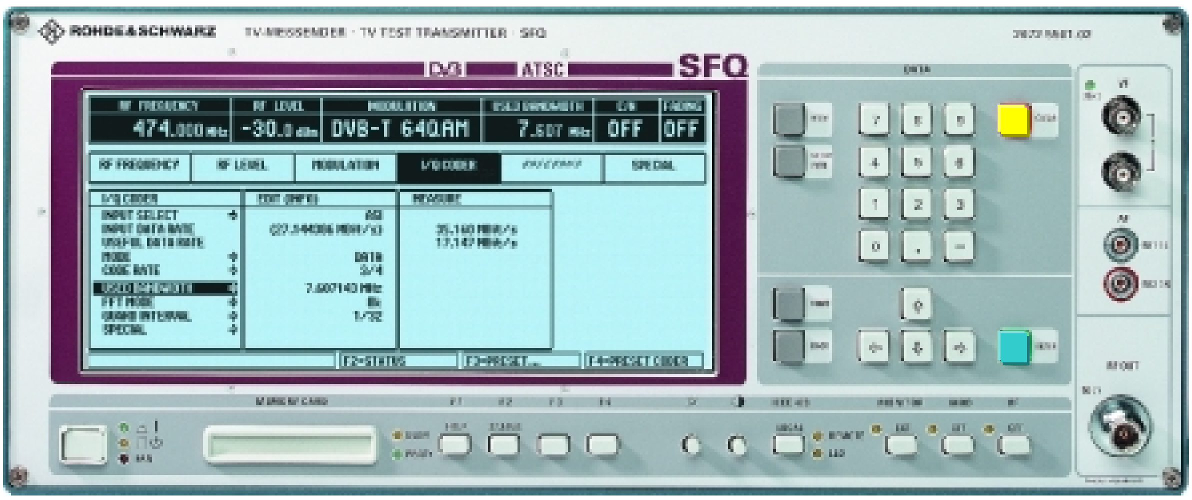
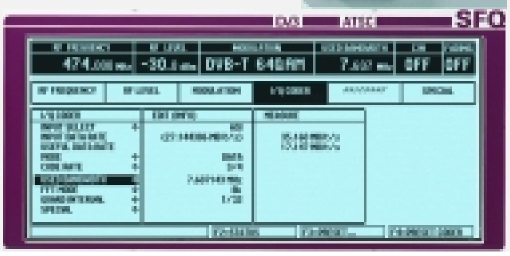


Fig. 1-1 Front view



POWER Switching on the SFQ

ON LED green; lights if SFQ is switched on
STANDBY LED yellow; lights if SFQ is in standby mode
FAN LED red; lights if fan is not running

DISPLAY

SFQ has an LCD display with CGA mode for menu display with a resolution of 640 x 200 pixels.

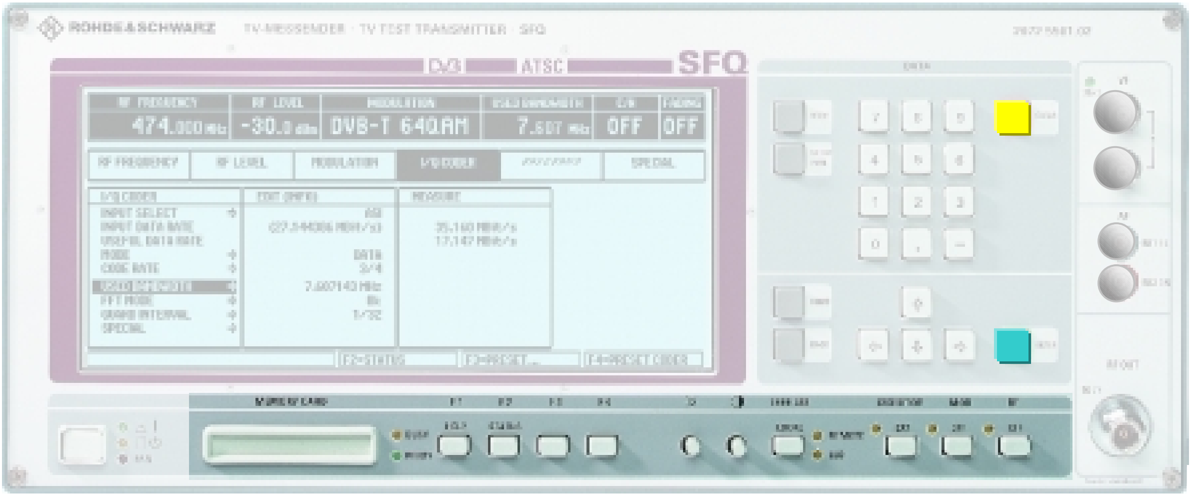
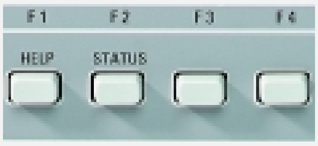


Fig. 1-2 Front View

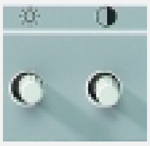
MEMORY CARD

Memory to PCMCIA standard with 68-pin connector. Instrument settings can be stored on the MEMORY CARD and recalled.



F1 to F4

F1 shows the help menus
F2 shows in a menu all set values
F3/F4 are function keys assigned varying functions.



Adjusting Screen Contrast and Brightness

IEEE 488

With IEEE-bus operation, the LOCAL key switches to local (front-panel) control unless this is inhibited by local lockout. Local lockout status is indicated by the LLO LED.

IEEE-bus operation is indicated by the REMOTE LED.

MONITOR Switchover key for LCD display/external monitor

MOD Modulation ON/OFF key

RF RF ON/OFF key

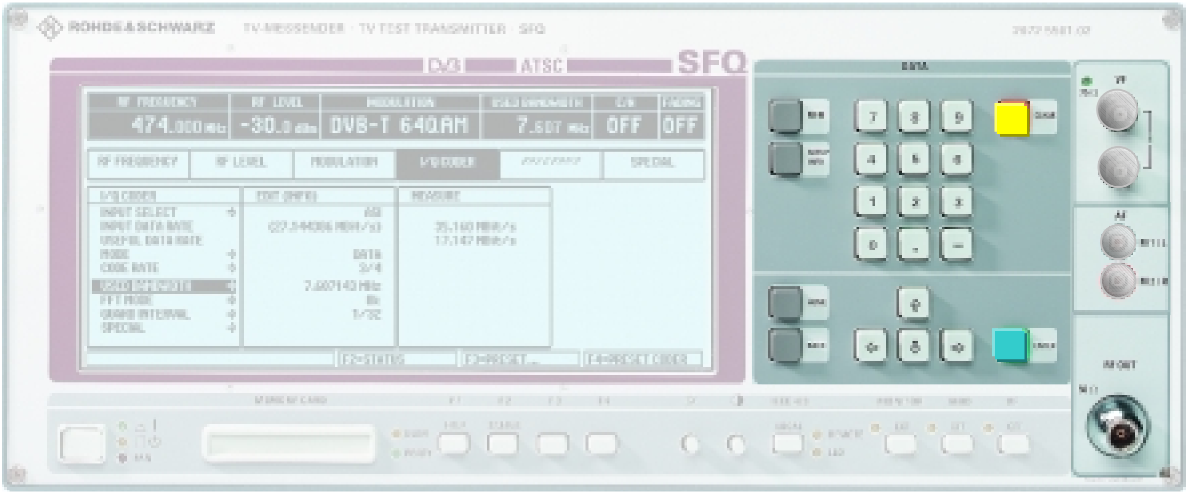
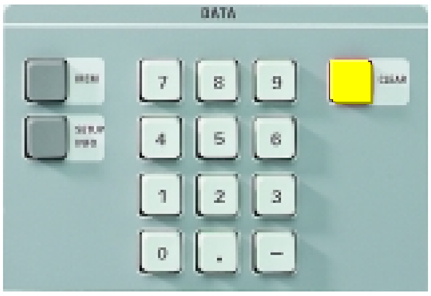


Fig. 1-3 Front View



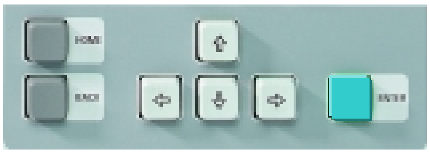
DATA Keyboard for numeric data entry. Entry is terminated with the ENTER key.

MEM Operation of MEMORY CARD, memory management

SETUP In the associated menu displayed on the screen

INFO basic settings can be made, e.g. the definition of interfaces.

CLEAR Reset of numeric entries.



CURSOR KEYS
The CURSOR keys are provided for menu-guided operation and for stepwise variation of data variables.

An entry is terminated with the ENTER key.

RF OUT

RF N female connector, 50 Ω

Only SFQ with option SFQ-B2:

VF

Output and input (loopthrough filter) for the video signal (only available if option SFQ-B2 is fitted)

With internal 75 Ω termination the green LED lights.

AF

M1/L Input M1 or left channel

M2/R Input M2 or right channel

1.1.2 Rear View

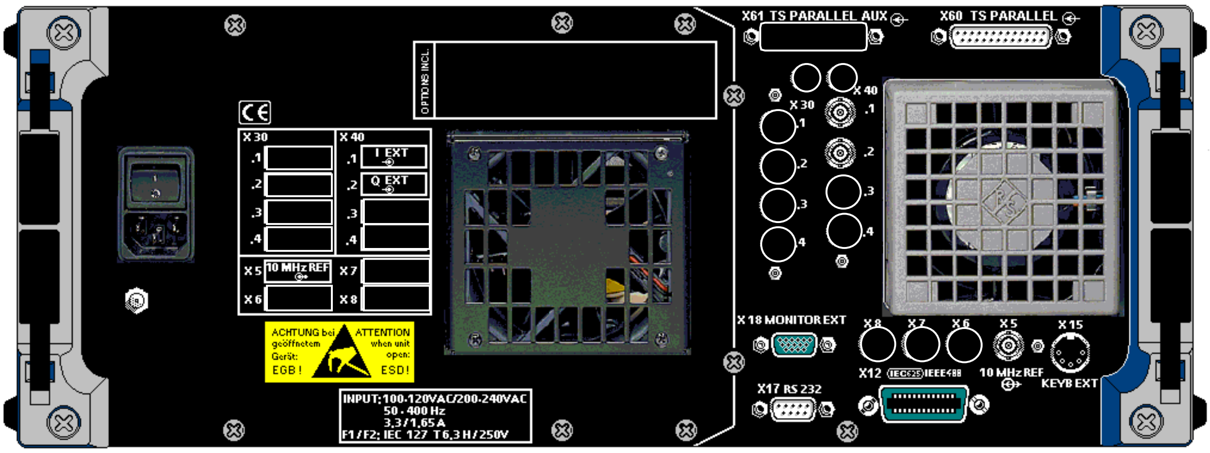


Fig. 1-4 Rear View

AC SUPPLY CONNECTION

Power switch

AC supply connector X1

100/120 V : IEC127-T3.15L / 250 V

220/230 V : IEC127-T1.6L / 250 V

Setting to the correct AC supply voltage is made automatically.

FAN 1

Sucks in cooling air

Note: *The fan should not be covered up in order to avoid overheating of the unit !*

FAN 2

expels air.

Note: *The fan should not be covered up in order to avoid overheating of the unit!*

1.1.2.1 Standard Pin Assignments

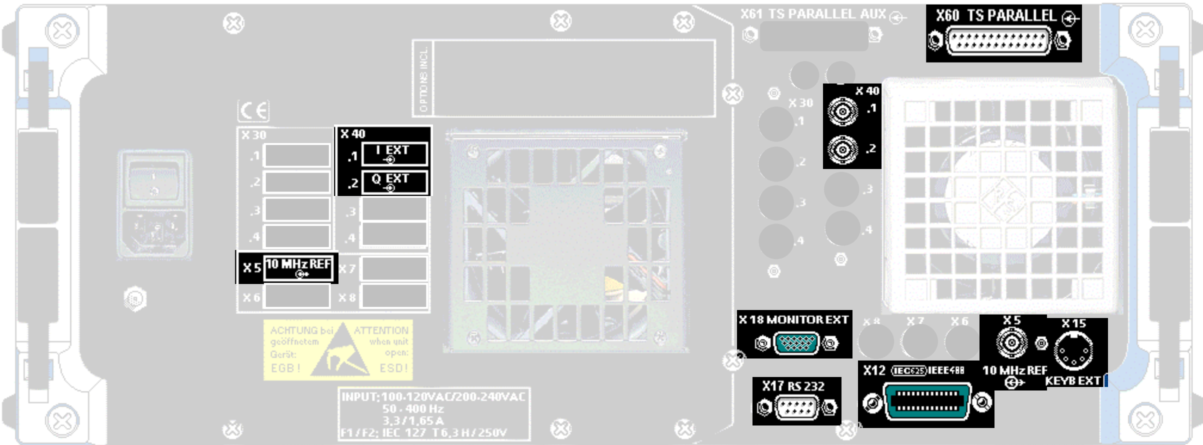
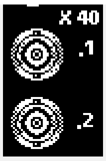


Fig. 1-5 Standard Pin Assignments

X 40

.1 **I EXT**, input for external I signals

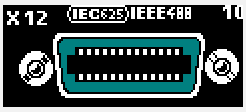
.2 **Q EXT**, input for external Q signals

MONITOR EXT X 18

Monitor connector, female

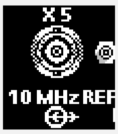
RS 232 X 17

RS-232 connector, female

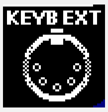


IEC625/IEEE488 X 12

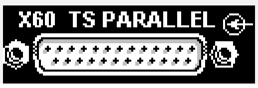
IEC/IEEE-bus connector, see chapter 3

X5 **10 MHz REF**, input / output



KEYB EXT An external keyboard allows for manual control of all instrument functions. In addition, any alphanumeric entries can be made in appropriate menus.



X 60 Input **TS PARALLEL**

1.1.2.2 Additional Pin Assignments with SFQ-Z5

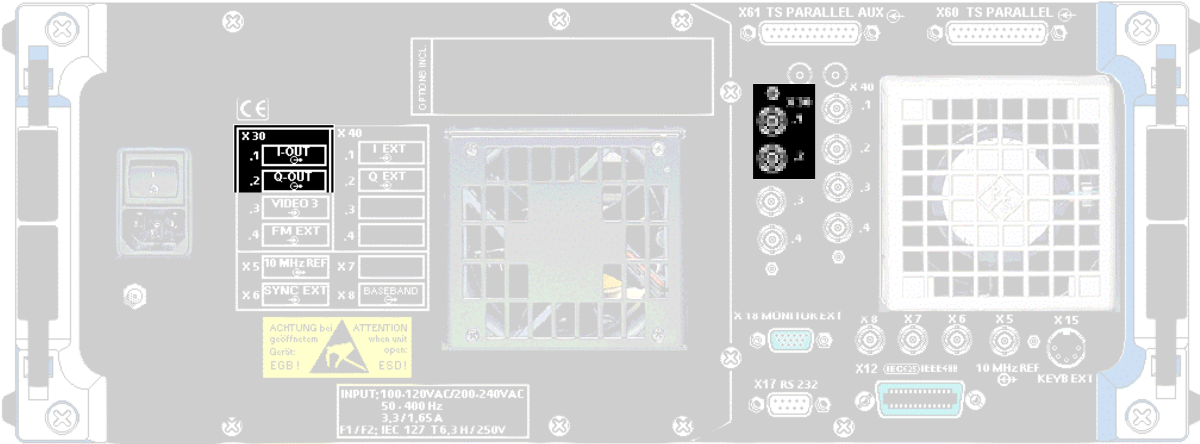
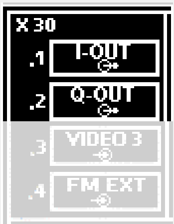
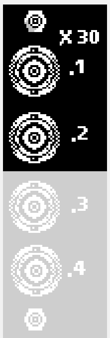


Fig. 1-6 SFQ-Z5

SFQ-Z5 Diversity Cable Set 2081.9158.02





X 30

.1	**I-OUT**, Output
.2	**Q-OUT**, Outut

1.1.2.3 Additional Pin Assignments with SFQ-B6 INPUT INTERFACE 2072.7679.02/03

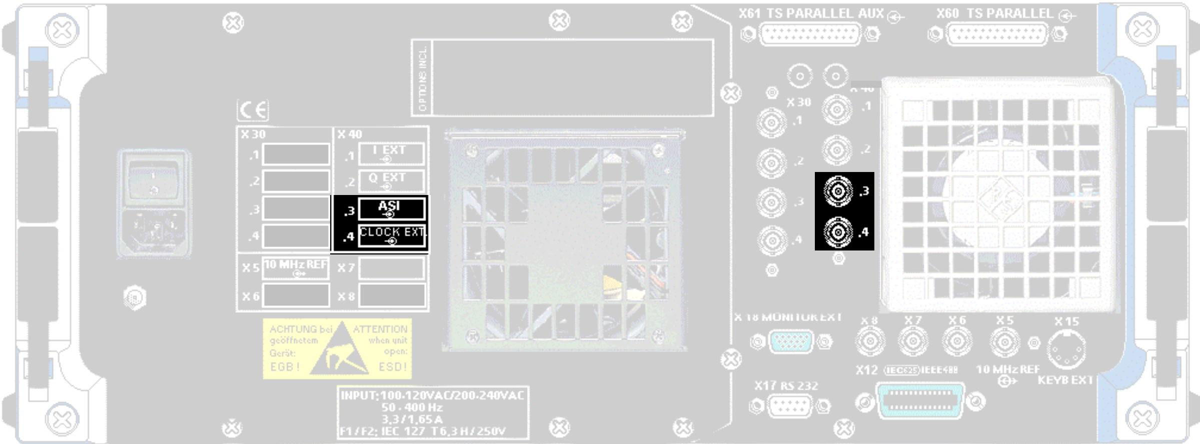
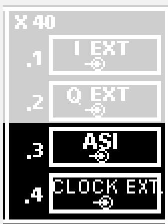
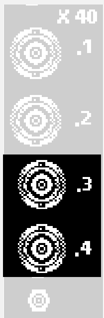


Fig. 1-7 SFQ-B6

SFQ-B6 INPUT INTERFACE 2072.7679.02/03





X 40

.3 With the INPUT INTERFACE option SFQ-B6 fitted, this connector is used as a **transport stream input** for **ASI**. If option SFQ-B6 model 03 is fitted, this connector may also be used as an SMPTE310 input.

.4 If the INPUT INTERFACE option SFQ-B6 is fitted, this connector is used as an input for the **ASI EXT. CLOCK** and **SPI EXT. CLOCK**

1.1.2.4 Additional Pin Assignments with Option SFQ-B10

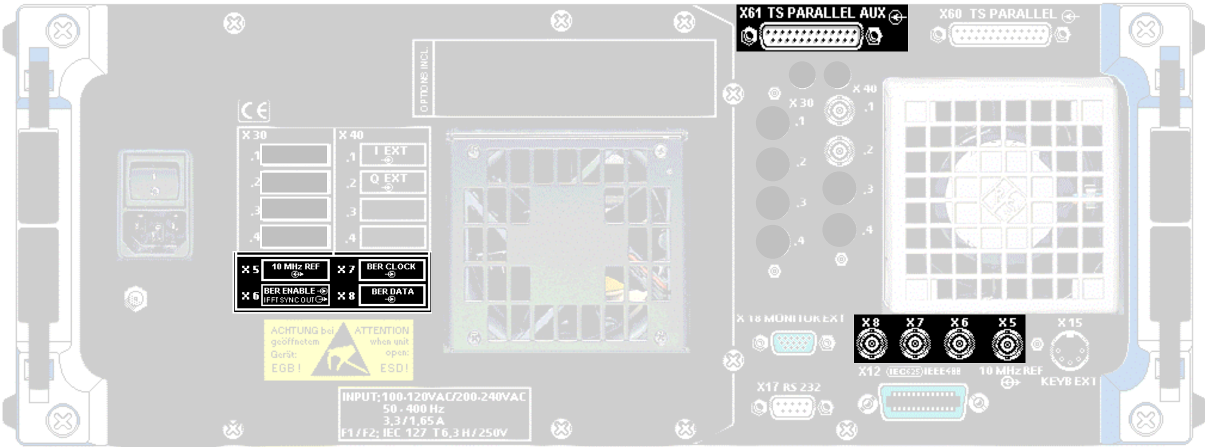
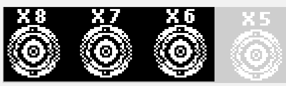
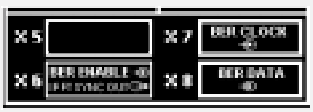


Fig. 1-8 Additional Pin Assignments with Option SFQ-B10

	**X 61**	Input **TS PARALLEL AUX** for hierarchical coding to DVB-T (option SFQ-B16)
	**X 5** to **X8**	
	Note:	*Labelling for X6 to X8 depends on the option,* *the labelling for option SFQ-B17 is shown here.*
	**X6**	**BER ENABLE / IFFT SYNC OUT**, input/output (option B17)
	X7	**BER CLOCK**, input (option SFQ-B17)
	X8	**BER DATA** , input (option SFQ-B17)

1.1.2.5 Additional Pin Assignments with SFQ-B14 IQ OUTPUT/INPUT 2072.6266.02

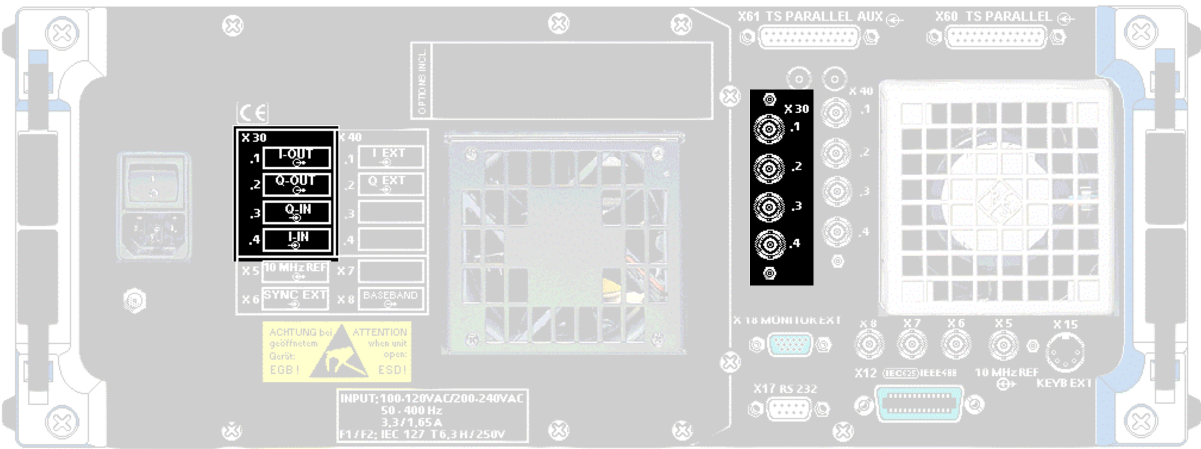
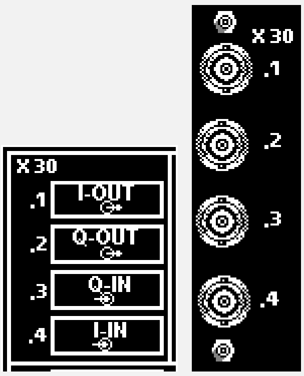


Fig. 1-9 SFQ-B14



X 30	With option SFQ-B14 installed
.1	**I-OUT**
.2	**Q-OUT**
.3	**Q-IN**
.4	**I-IN**

1.1.2.6 Additional Pin Assignments with SFQ-B27 Impulsive Noise 2110.0407.02

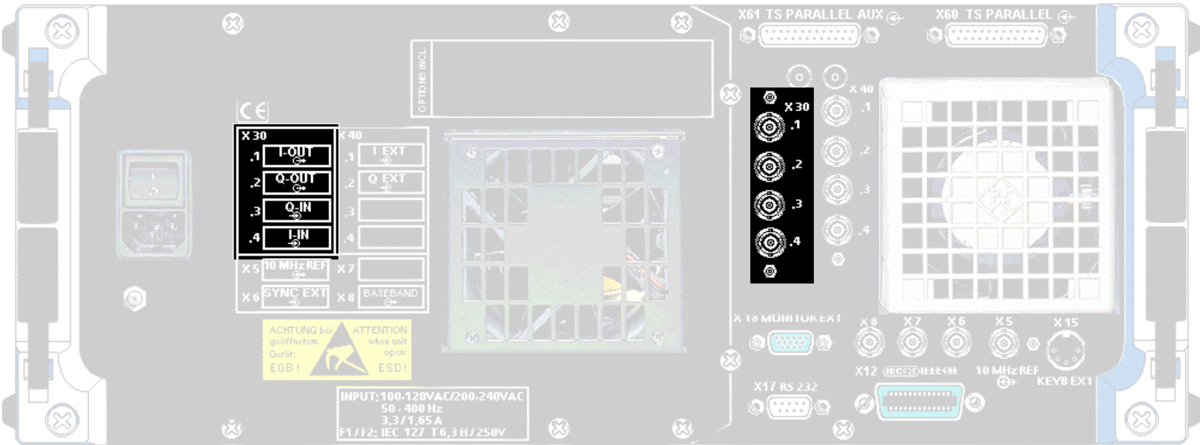
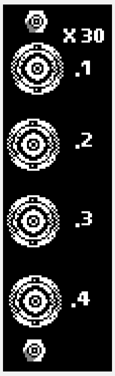


Fig. 1-10 SFQ-B27



X 30	With option SFQ-B27 installed
.1	
.2	
.3	**Noise Gate**
.4	

1.1.2.7 Additional Pin Assignments with SFQ-B2, -B3 and -B4

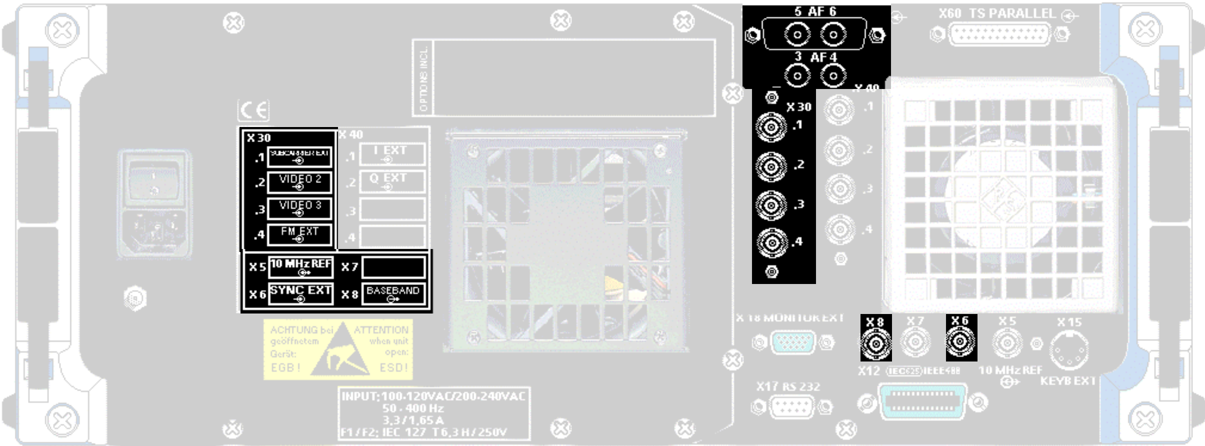
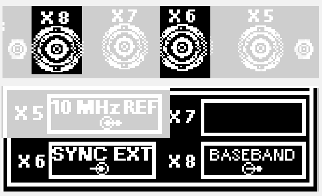


Fig. 1-11 SFQ-B2; -SFQ-B3; SFQ-B4

SFQ-B2 FM MODULATOR 2072.6108.02
SFQ-B3 FM SUBCARRIER 2072.7379.02
SFQ-B4 ADR SUBCARRIER 2072.7479.02

X 30	With option SFQ-B2 installed
.1	**SUBCARRIER EXT**, input
.2	**VIDEO 2**, input
3.	**VIDEO 3**, input
.4	**FM EXT**, input



X 5 to **X8**

X6	**SYNC EXT**, input
X7	
X8	**BASEBAND**, output

AF 5/6 **AF connectors**

Note: AF connectors 3, 4, 5 and 6 are fitted but not connected when option SFQ-B2 is installed. They are only required for options SFQ-B3 and SFQ-B4.

1.2 Putting into Operation

see also section 1.1, Legend for Front and Rear View

Prior to putting the instrument into operation make sure that

- the setting for the available AC supply voltage is correct (see section 1.3.1),
- signal levels applied to the inputs do not exceed permissible limits,
- the instrument is operated within the permissible temperature range (permissible ambient temperature range +5°C to +45°C),
- the fan at the rear of the instrument is not obstructed (to prevent overheating of the unit),
- the outputs of the instrument are not overloaded or wrongly connected.

Warning:

Input voltages above permissible limits (see data sheet) may cause the instrument to be damaged.

1.2.1 Positioning the Instrument

The instrument is equipped with feet that can be folded out at the instrument front to facilitate operation. To do so lift up the instrument at the front and swing down the feet.

The instrument is constructed so that its operating temperature remains sufficiently low even in continuous operation. When the unit is used as a benchtop make sure that the air vents are not obstructed to prevent the instrument being overheated - especially during continuous operation. Sufficient ventilation must also be ensured when the unit is rackmounted. .

1.2.2 EMC Safety Precautions

Warning:

To prevent electromagnetic interference the instrument should be operated closed and with all screening covers fitted. Take the appropriate measures when calibrating the open instrument. Make sure that only suitable, screened IEC/IEEE-bus cables are used.

1.3 Connecting the Instrument

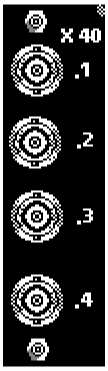
1.3.1 AC Supply Connection

The instrument may be operated at 90 V to 132 V and 180 V to 265 V AC at frequencies from 47 Hz to 440 Hz. The AC supply connector is at the rear of the unit. The instrument automatically sets itself to the applied voltage by selecting one of the two permissible voltage ranges. Adjusting the instrument to a particular AC supply voltage is therefore not required.

When the instrument is switched off, an "O" is visible above the power switch which may be on for any period of time. The instrument need only be switched off when it is to be completely disconnected from the AC supply.

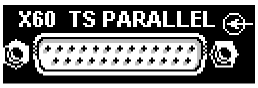
1.3.2 MPEG2 Signal Feed for Vector Modulation

1.3.2.1 ASI Connector



Connector for feeding in an external MPEG2 transport stream.
If option SFQ-B6 INPUT INTERFACE is installed, the connector X40.3 serves as a transport stream input for **ASI**.
If model 03 of option SFQ-B6 INPUT INTERFACE is fitted, connector X40.3 may also be used as an **SMPTE310 input** for certain modulation modes.

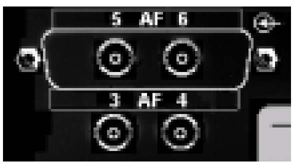
1.3.2.2 TS PARALLEL Connector



Connector for feeding in an external MPEG Transport Stream through **TS PARALLEL**.

If option SFQ-B6 INPUT INTERFACE is installed, this connector serves as a transport stream input for **SPI** and **TS PARALLEL**.

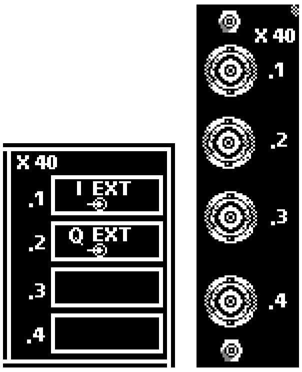
2nd connector for feeding in a second external transport stream for hierarchical coding in DVB-T mode.
(TS PARALLEL AUX or SPI AUX).



Depending on the model, there may be AF connectors in place of TS PARALLEL AUX connector.

1.3.3 External I/O Signal Feed for Vector Modulation

Feed-in through connectors X40.1 and X40.2.



X 40

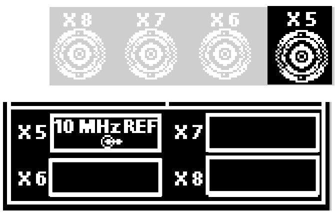
.1 **I EXT**, input for external signals

.2 **Q EXT**, input for external signals

.3 If the option SFQ-B6 INPUT INTERFACE is installed, this connector serves as a transport stream input for **ASI**.

.4 If the option SFQ-B6 INPUT INTERFACE is installed, this connector serves as an external clock input for **ASI EXT. CLOCK** and **SPI EXT. CLOCK**.

1.3.4 10 MHz REF Input/Output

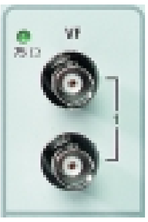


X5: 10 MHz REF input or output.

X6 to X8 are system connectors and are wired and labelled according to the options fitted.

1.3.5 Feed-in of Analog Video/Sound Signals for FM Modulation

1.3.5.1 VF Connector



Connector VF (BNC) is a video input with a loopthrough filter. Either of the connectors can be used as an input or output. With an internal termination into 75 Ω the yellow LED lights. In this case the output of the loopthrough filter must not be terminated into 75 Ω.

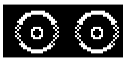
The input level is 1 V pp. All modulator settings are calibrated to this input level.

1.3.5.2 AF Connector, Front Panel

The displayed frequency deviation applies to an AF input level of +9 dBm with preemphasis switched off.

The input impedance is >5 kΩ.

1.3.5.3 AF Connectors, Rear Panel (for Additional Sound Subcarriers)



AF connectors (only with option SFQ-B3 fitted),
or CLK and DATA connectors (only with option SFQ-B4 fitted)
labelled **ADR** CLK / **ADR** DATA.

1.3.6 RF Connector

The RF output provides signals between 0.3 MHz and 3.3 GHz.

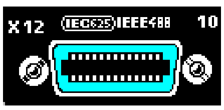
In the SETUP/PRESET menu, the units dBm, dBμV or mV can be selected for RF LEVEL entry.

1.3.7 External Monitor

Multisync VGA monitors with 32-kHz horizontal frequency are suitable for connection.

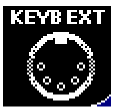
The display is of CGA resolution.

1.3.8 RS-232 Interface



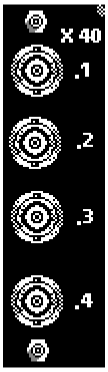
For data transmission and remote control from a detached PC the two RS-232 connectors are to be linked by a cable.

1.3.9 KEYBOARD Connector



A standard PC keyboard may be connected to the 5-contact keyboard connector.

1.3.10 Synchronization of SFQ Data Rate without Input Interface with External Clock



Note:

This chapter is only relevant for units without INPUT INTERFACE.

External synchronization is not required for units with input interface or can easily be performed via connector **X40.4**
*(*ASI EXT CLOCK, SPI EXT CLOCK*).*

The data rate of MPEG2 transport stream packets can be given in different ways in SFQ:

1. The internal PRBS or NULL TS PACKETS are modulated and determine the clock and symbol rate. The internal free-running VCO is used for clock generation. Free-running does however not imply high clock accuracy.
2. An external MPEG2 data stream synchronizes the whole SFQ clock housekeeping via the MPEG2 data input TS PARALLEL. Data clock and symbol clock are as accurate as the applied signal.
3. With its crystal-controlled clock, the INPUT INTERFACE determines the data rate and the symbol rate of PRBS and NULL TS PACKETS.

It is often that neither an MPEG2 data stream nor the INPUT INTERFACE is available. SFQ still has to guarantee the specified data and symbol rates for the internal PRBS and NULL TS PACKETS.

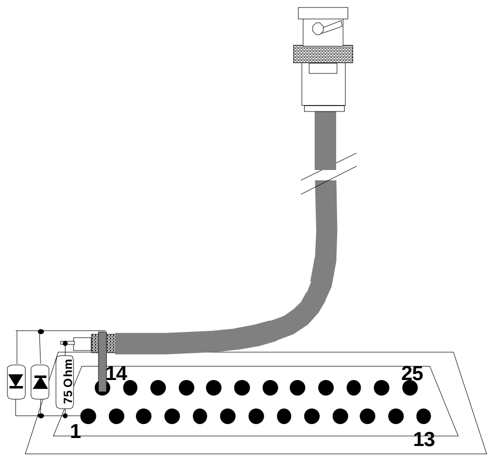
The solution is the synchronization of SFQ by means of an external sinewave generator providing the required accuracy. Such generators are always available in labs and service centers. R&S generators of this type are in all members of the R&S family SMX, in AFG and AFGU, ADS etc.

Preconditions

The firmware version of SFQ should be 1.04 or higher.

Preparation for Use

An adapter cable is to be connected to the TS PARALLEL input on the rear of SFQ according to the following figure:



View of solder contacts

Fig. 1.3-1 Adapter Cable

The sync signal is applied to the adapter via the coaxial cable with BNC connector. The outer conductor is soldered to pin 14 of the 25-pin connector and the inner conductor to pin 1 via a 75 Ω protective resistor. Two anti-parallel diodes (1N4448 or similar Si diodes) are provided between pin 1 and pin 14 and prevent too high input voltages.

A sinewave signal of the signal generator can now be applied to the clock input (pin 1 clock input, pin 14 is grounded) of the TS PARALLEL interface. The 8-bit wide MPEG2 TS data are missing.

Calculation of TS Data Rate Frequency

The frequency to be set for the desired TS data rate at the signal generator is to be calculated. A byte of MPEG2 TS data is read by the TS PARALLEL interface with one clock of frequency f_C. The clock rate is given in bit/sec. The frequency to be selected is therefore calculated as follows:

$f_{Generator} = f_C / 8$.

For a simulation of the cable clock rate of 38.152941 Mbit/sec the following has to be set:

$f_{Generator} = 4.7691176$ MHz

(Exact values were used. The normal accuracy is 38.15 Mbit/sec.)

Permissible Amplitude of Applied Sinewave

Now a sinewave of permissible amplitude needs to be applied via the adapter. Since the anti-parallel diodes limit the signal to approx. ±0.7 V the amplitude should be within the limits 1.4 V $< V_{pp} <$ 3 V. A DC voltage offset must not be available.

Further SFQ Settings

After SFQ has synchronized to the applied clock, the message FRMERR (Frame Error) is displayed in the status bar field "I/Q Coder". This message signifies that a clock is being applied to the TS PARALLEL interface but that the MPEG2 TS data are invalid or not packetized and not provided with the SYNC WORD. With synchronism established following the measurement of the clock rate in the I/Q Coder menu and acceptance of the clock rate with F3 ACCEPT, NULL TS PACKETS can be selected as a modulation source. SFQ then generates and modulates TS packets in QAM or QPSK with a valid sync word 47 hex using the data rate determined by the sinewave generator.

Circuit diagram

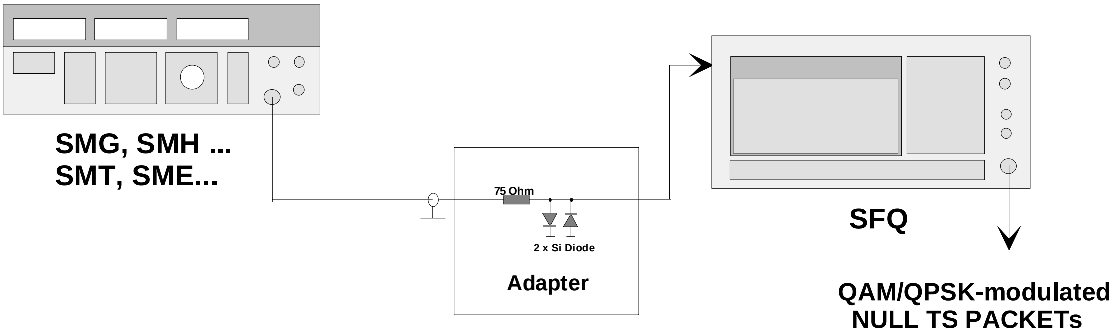


Fig. 1.3-2 Circuit diagram

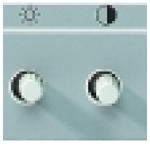
1.4 Switching On

The instrument is switched on by pressing the power switch at the rear and the POWER key at the front panel.

For a temporary switch-off, the STANDBY mode is selected by pressing the POWER key.

The red FAN LED lights if the fan is not active or defective.

1.4.1 Adjusting Screen Contrast and Brightness



1 ***2***

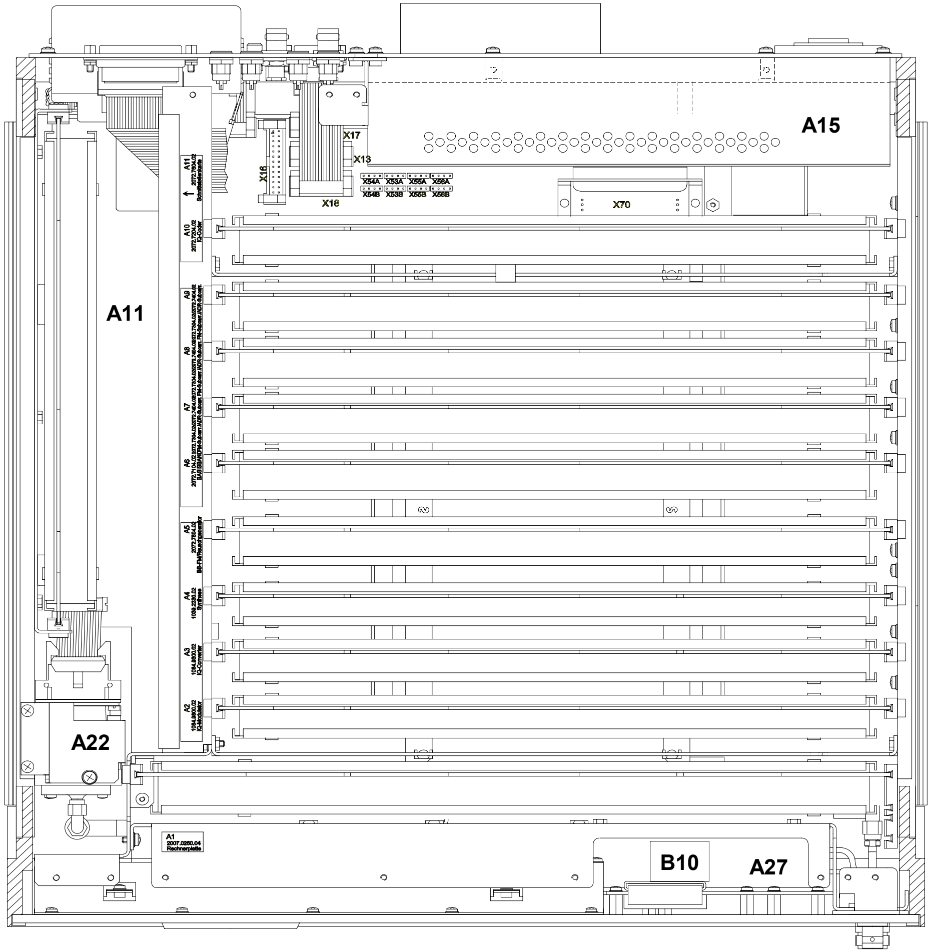
The screen contrast is adjusted by means of the right control knob (***2***), the brightness with the left control (***1***) below the display.

1.4.2 Non-Volatile Memory

If the lithium battery on the controller board of the instrument is flat, settings can no longer be stored in the non-volatile memory. To replace the battery refer to section 4.5.

1.5 Instrument Configurations

1.5.1 Model .02



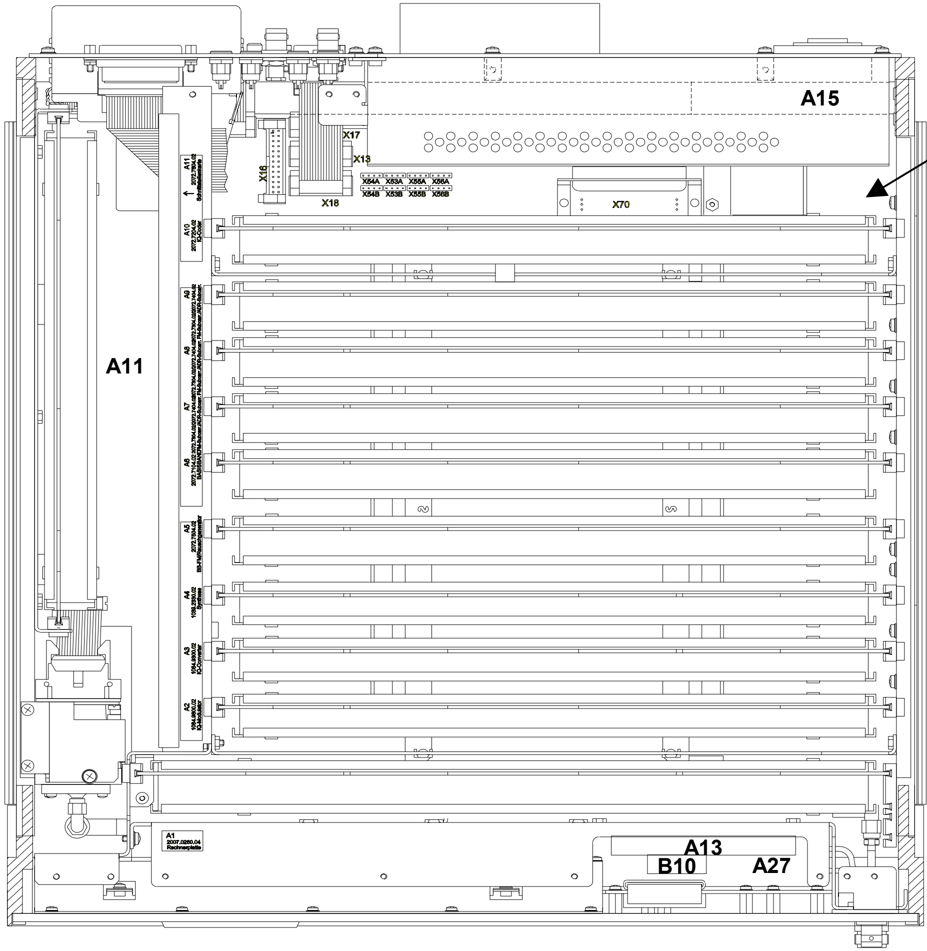
Slot:	Module:	Order No. of PCB:
A15	AC SUPPLY	1039.1510.00
A26	MOTHERBOARD	2072.7004.04
A10		
A9		
A8		
A7		
A6		
A5		
A4	SYNTHESIZER	1039.2330.02
A3	I/Q CONVERTER	1084.9300.04
A2	I/Q MODULATOR..............................	1084.9800...
A1	CONTROLLER.............	2008.0260.04
A11		
A13		
A22	ATTENUATOR	1008.7375.02
B10	DC/AC CONVERTER....	0840.5698.00
A27	KEYBOARD	2008.0125.02

CODER options
(a coder is always fitted)

SFQ-B10	DVB-T CODER	**2072.6166.02**
SFQ-B12	ATSC/8VSB CODER	**2072.6220.02**
SFQ-B13	ITU/J83B CODER	**2072.6243.02**
SFQ-B15	DVB-C/S CODER	**2072.5976.02**
SFQ-B21	DVB-C CODER	**2081.9812.02**
SFQ-B23	DVB-S CODER	**2072.5830.02**

Fig. 1.5-1 Layout of modules

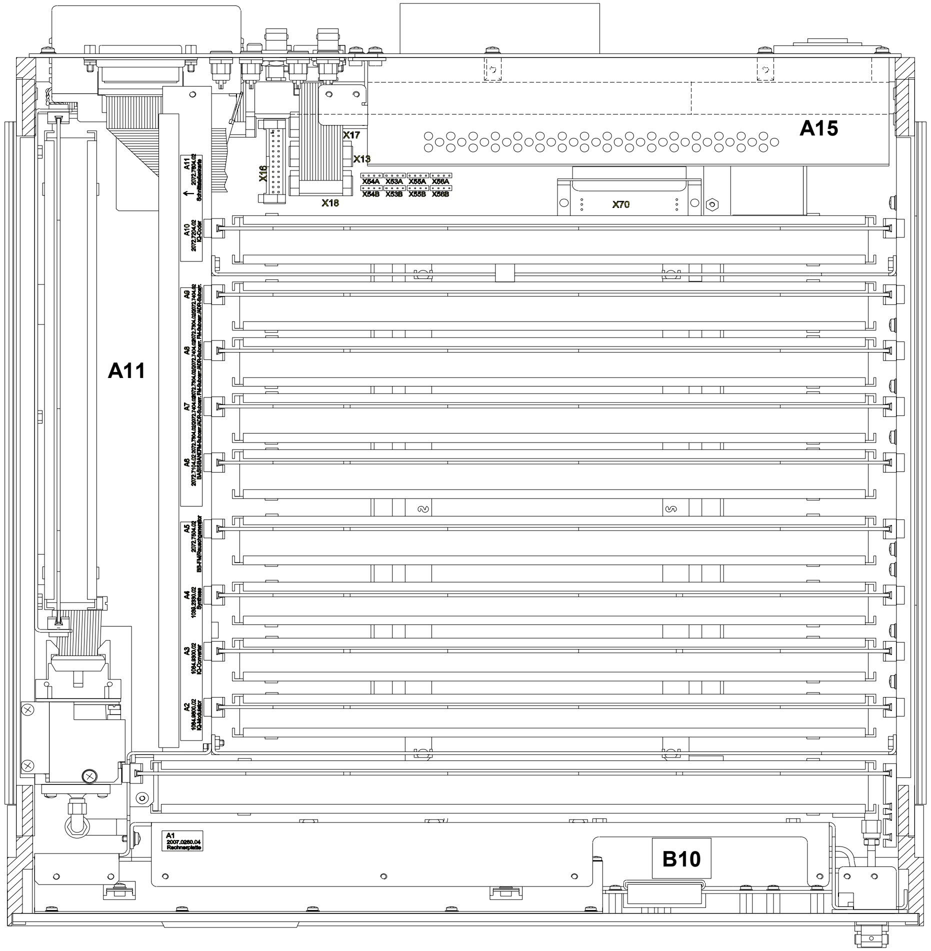
1.5.1.1 SFQ equipped with SFQ-B2, SFQ-B3, SFQ-B4 and SFQ-B6



Slot:	Module:	Order No. Of PCB:
A15	AC SUPPLY	1039.1510.00
A26	MOTHERBOARD	2072.7004.04
A10	CODER option	
A9	SFQ-B3 FM sound subbcarriers SFQ-B4 ADR sound subbcarriers	2072.7379.02 or 2072.7479.02
A8	SFQ-B3 FM sound subcarriers SFQ-B4ADR sound subcarriers	2072.7379.02 or 2072.7479.02
A7	SFQ-B2 FM sound subcarriers	2072.6108.02
A6	SFQ-B2 baseband	2072.6108.02
A5	SFQ-B2 BB-FM modulator noise.	2072.6108.02
A4	SYNTHESIZER	1039.2330.02
A3	I/Q CONVERTER	1084.9300.04
A2	I/Q MODULATOR	1084.9800...
A1	CONTROLLER	2008.0260.04
A11	SFQ-B6 INPUT INTERFACE	2072.7679.03
A13	VIDEO SELECTOR	2008.0425.02
A22	ATTENUATOR	1008.7375.02
B10	DC/AC CONVERTER	0840.5698.00
A27	KEYBOARD	2008.0125.02

Fig. 1.5-2 Layout of modules

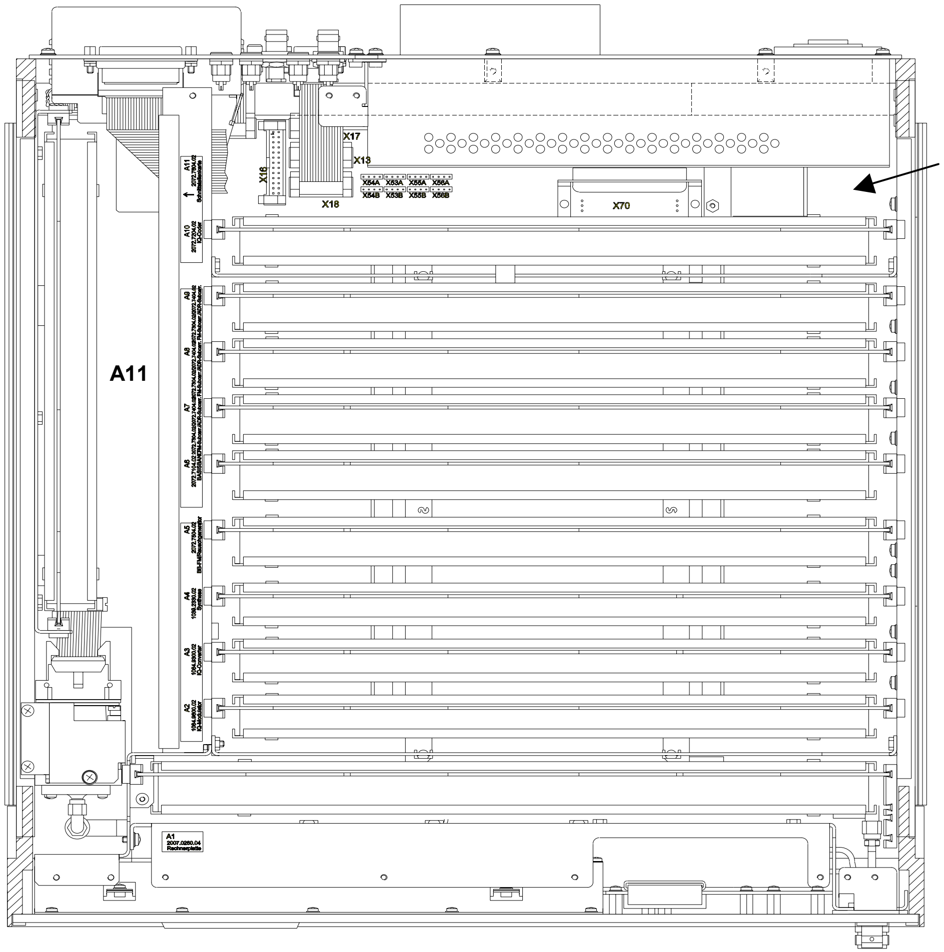
1.5.1.2 SFQ equipped with SFQ-B5, SFQ-B6, SFQ-B11 model .02, SFQ-B11 model .04 and coder option



Slot:	Module:	Order No. of PCB:
A15	AC SUPPLY	1039.1510.00
A26	MOTHERBOARD	2072.7004.04
A10	CODER option	
A9		
A8		
A7	SFQ-B11 FADING SIM. 7 to 12	2072.6189.04
A6	SFQ-B11 FADING SIM. 1 to 6	2072.6189.02
A5	SFQ-B5 NOISE GENERATOR	2072.7579.03
A4	SYNTHESIZER	1039.2330.02
A3	I/Q CONVERTER	1084.9300.04
A2	I/Q MODULATOR..................................	1084.9800...
A1	CONTROLLER......................................	2008.0260.04
A11	SFQ-B6 INPUT INTERFACE..................	2072.7679.03
A22	ATTENUATOR	1008.7375.02
B10	DC/AC CONVERTER	0840.5698.00
A27	KEYBOARD	2008.0125.02

Fig. 1.5-3 Layout of modules

1.5.1.3 SFQ equipped with SFQ-B5, SFQ-B6, SFQ-B10, SFQ-B11 model .02, SFQ-B11 model .04, SFQ-B12, SFQ-B13, SFQ-B15, SFQ-B21 and SFQ-B23



Slot:	Module:	Order No. of PCB:
A15	AC SUPPLY	1039.1510.00
A26	MOTHERBOARD	2072.7004.04
A10	SFQ-B10 DVB-T CODER	2072.6166.02
A9	SFQ-B12 ATSC/8VSB CODER	2072.6220.02 or
	SFQ-B13 ITU-T/J.83B CODER	2072.6243.02
A8	**SFQ-B15** DVB-C/S CODER	**2072.5976.02** or
	SFQ-B21 DVB-C CODER	**2081.9812.02**
	SFQ-B23 DVB-S CODER	**2072.5830.02**
A7	SFQ-B11 FADING SIM. 7 to 12	2072.6189.04
A6	SFQ-B11 FADING SIM. 1 to 6	2072.6189.02
A5	SFQ-B5 NOISE GEN.	2072.7579.03
A4	SYNTHESE	1039.2330.02
A3	I/Q CONVERTER	1084.9300.04
A2	I/Q MODULATOR	1084.9800...
A1	CONTROLLER	2008.0260.04
A11	SFQ-B6 INPUT INTERFACE	2072.7679.03
A22	ATTENUATOR	1008.7375.02
B10	DC/AC CONVERTER	0840.5698.00
A27	KEYBOARD	2008.0125.02

Fig. 1.5-4 Layout of modules

1.6 Options

Type	Designation	Order No.	Display in SETUP/HW/ EQUIPMENT	
SFQ-B5	NOISE GENERATOR	2072.7579.02 2072.7579.03 2072.7579.04	NOISE GEN. NOISE GEN. II NOISE GEN. III	2072.7504.02 2081.9258.02
SFQ-Z5	Diversity Cable Set	2081.9158.02	CABLE **)	
SFQ-B6	INPUT INTERFACE	2072.7679.02 2072.7679.03	INPUT INTERFACE INPUT INTERFACE II	2072.7604.02 2081.9329.02
SFQ-B10	DVB-T CODER	2972.6166.02	DVB-T CODER	2072.6895.02
SFQ-B11	FADING SIMULATOR PATHS 1 to 6	2072.6189.02	FADING SIMULATOR or	1085.4060.02 1114.9702.02
SFQ-B11	FADING SIMULATOR PATHS 7 to 12	2072.6189.04	FADING SIMULATOR or	1085.4060.02 1114.9702.02
SFQ-B12	ATSC / 8VSB/J.83B	2072.6220.02	Enabling 8VSB/J.83B US CODER	2072.6937.02
SFQ-B13	ITU-T J.83/B CODER	2072.6243.02	Enabling J.83/B US CODER	2072.6932.02
SFQ-B14	IQ OUTPUT/INPUT	2072.6266.02	CABLE	
SFQ-B15	DVB-C/DVB-S CODER	2072.5976.02	IQ CODER	2072.7204.02
SFQ-B16	DVB-T/HIER. CODING	2072.5976.02	SOFTWARE ***)**	
SFQ-B17	BER MEASUREMENT	2072.7056.02	SOFTWARE ***)**	
SFQ-B21	CODER DVB-C	2081.9812.02	Enabling DVB-C C/S+ CODER	2081.9829.02
SFQ-B23	CODER DVB-S	2072.5830.02	Enabling DVB-S C/S + CODER	2081.9829.02
SFQ-B18	POWER SUPPLY UPGRADE	2072.7191.02	-5 V BOARD POWER SUPPLY	2081.9635.02 1039.1510.00
SFQ-B20	MEMORY EXPANSION	2072.6450.02	MEMORY CARD BIOS PROM	2072.6395.02 2072.6414.00
SFQ-B2	FM MODULATOR	2072.6108.02	BASEBAND FM SUBCARRIER VIDEO SELECTOR BB FM/NOISE GEN.	2072.7104.02 2072.7304.02 2008.0425.02 2072.7504.03
SFQ-B3	FM SUBCARRIER	2072.7379.02	FM SUBCARRIER	2072.7304.02
SFQ-B4	ADR SUBCARRIER	2072.7479.02	ADR SUBCARRIER	2072.7404.02

***)** Retrofitting of hardware see SFQ-B10
****)** Retrofitting of hardware see SFQ-B5
I

Installation of Options

For reasons of safety and quality (ISO9001), only adequately equipped Rohde & Schwarz service centers are allowed to install options that require the instrument to be opened or the calibration seal to be broken (examples: electrostatically safe workplace, necessary service tools, calibration facilities, etc). A new calibration seal must be affixed after the option has been installed.
The Update CD describes the Options installation.

2 Manual Control

2.1 Basic Operation

2.1.1 Front Panel

Operation of SFQ is started by selecting an opening menu with the cursor keys on the front panel and pressing ENTER for confirmation.

By means of these keys operating menus are called up where the required instrument settings can be made. Submenus are available in addition for more complex settings.

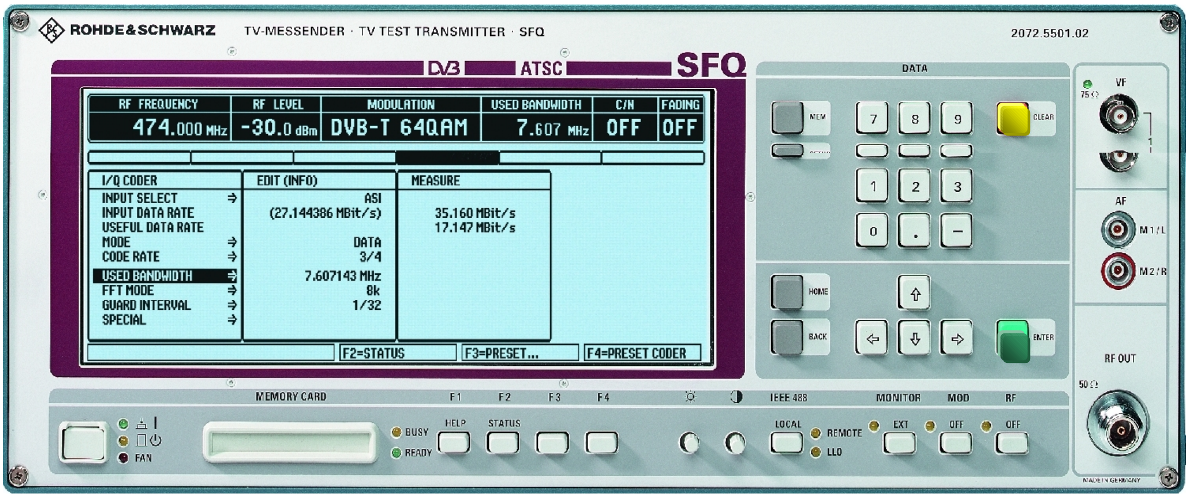
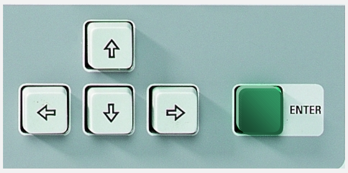
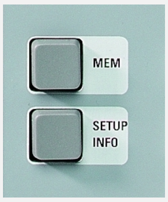


Fig. 2-1 Front panel



Menu items can be selected and parameters varied by means of cursor keys  and .

Numeric entries are confirmed with the ENTER key.



The currently displayed menu can be quit by pressing the MEM key or the

SETUP/INFO key which opens up the corresponding menus.

2.1.2 External Keyboard

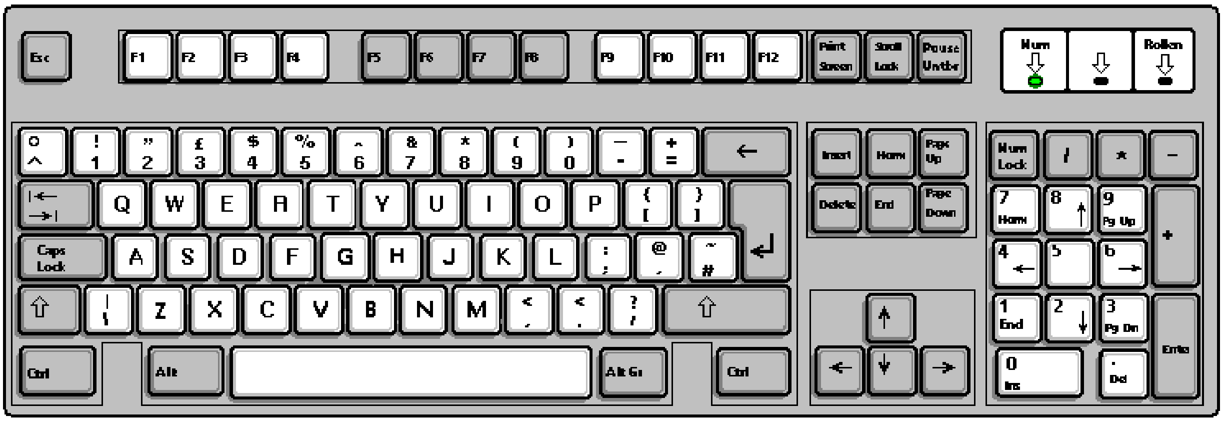
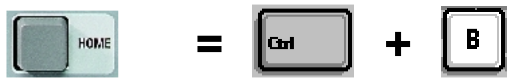
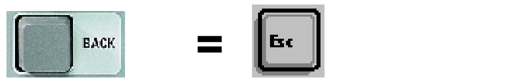
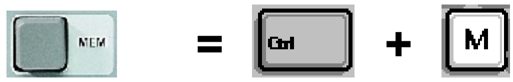
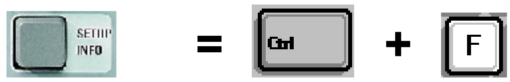
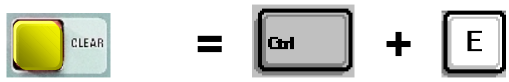
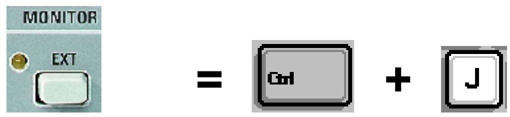
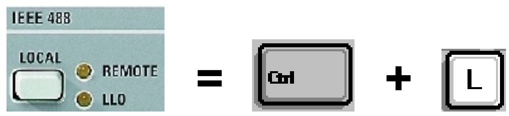


Fig. 2-2 Keyboard

The instrument can also be operated from an external keyboard. Operating menus are called up in the same way as on the front panel by means of the cursor keys and the ENTER key. ESC and HOME cause a return to the previous menu or to the initial menu. Numerals are entered via the numeric keypad or varied by means of the cursor keys.

The functions of the SFQ front-panel keys correspond to those of an external keyboard with the following exceptions:

HOME	
BACK	
MEM	
SETUP INFO	
CLEAR	
RF	
MOD	
MONITOR	
IEEE488	

2.1.3 Switch-On Procedure

Upon switch-on a program is triggered for testing and initialization of the instrument. The program tests the hardware configuration and initializes the individual modules. Set parameters of the remote-control interface are displayed in bottom half of the screen. In the case of a fault, an error message is displayed with information on the defective unit.

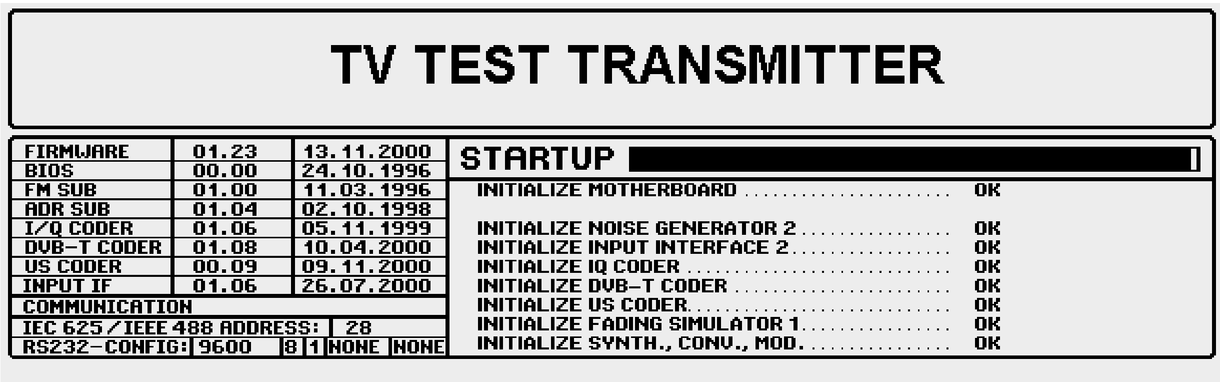


Fig. 2-3 Startup menu

With the startup mask displayed, default values can be called up by means of key F2 = RESET.

The menu for selecting individual parameters is opened. At the top of this menu a status field with the main parameters is displayed. The selection fields for instrument settings are displayed below: FREQUENCY, RF LEVEL, MODULATION, I/Q CODER, BASEBAND and SPECIAL. These fields comprise areas for the display of important operating states. Selection of one of the setting fields opens up a submenu holding further parameters to be entered either in an EDIT window or selected from an additional list.

RF FREQUENCY	RF LEVEL	MODULATION	I/Q CODER	BASEBAND	SPECIAL

Fig. 2-4 Menu selection fields

2.1.4 General Information

2.1.4.1 Menu Operation

Operating menus are in the form of pull-down menus. Subsequently opened menus do not cover up already opened menus so that the complete path is visible until its termination.

Selection within a menu or submenu is made by means of the cursor keys. The selected field is either marked by a dark background or an arrow. The selection is confirmed by means of the ENTER key which can assume four functions:

- Opening a submenu
- Selecting predefined parameters (toggle function)
- Switching to EDIT mode if an entry is necessary
- Returning to previous menu with the selected parameters or values entered in the EDIT mode being retained.

In the EDIT mode, entries are made with the aid of the numeric keypad. Values can also be changed with the aid of the cursor keys, the tens digit being selected with the left/right cursor and the values being changed with the up/down cursor (repeat function). In the case of cursor entry the new values are checked for reliability (maximum/minimum) and usually set immediately in the instrument. In the case of numeric keypad entry the values are checked and accepted only after pressing the ENTER key. The following special keys are provided:

CLEAR: For correcting entries made in EDIT mode

BACK: Return to previous menu without retaining any changes/settings

HOME: Return to topmost menu level without acceptance of any changes/settings

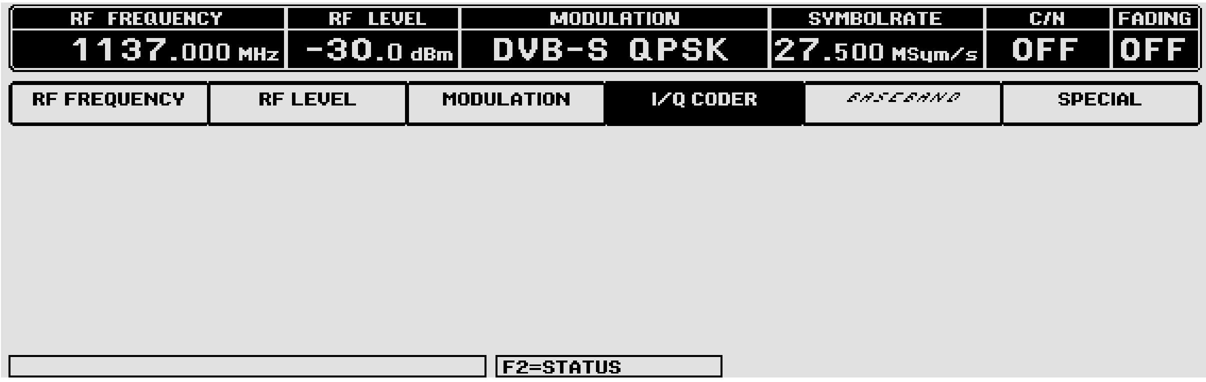
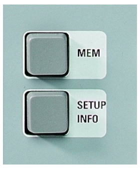


Fig. 2-5 Menu selection

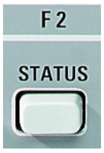
Pressing the **BACK** key causes a return to the previous menu level.

Pressing the **HOME** key causes a return to the initial menu irrespective of how many submenus are open.



Further selection menus can be called up directly by pressing the **MEM** key,

SETUP/INFO and



STATUS (**F2**) provided the operator is not in an EDIT window.

Pressing **HOME** causes a return to the normal operating menu.

2.1.4.2 Calibration

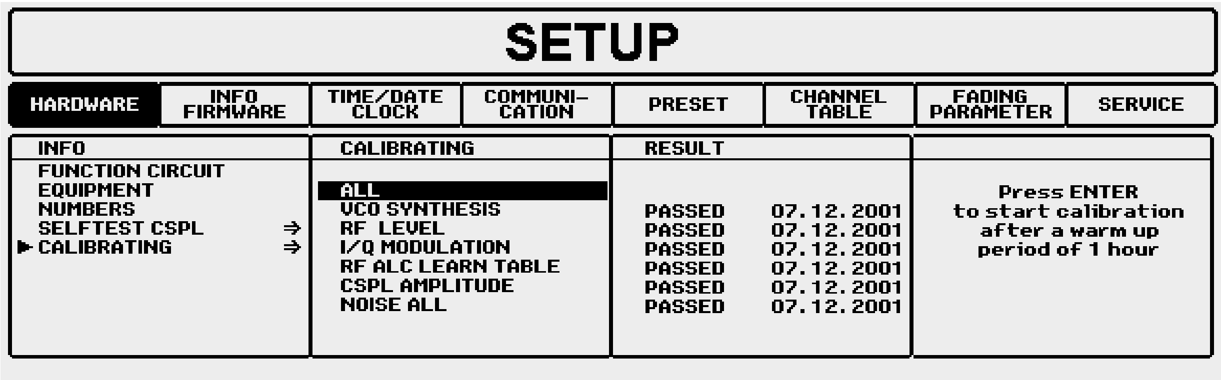
SFQ features several internal calibrations in the SETUP-HARDWARE-CALIBRATING menu (see 2.2.13.1.1).

In addition to ALL, VCO SYNTHESIS, RF LEVEL, LEARN TABLE and NOISE ALL, calibration of I/Q modulator is possible in this menu:

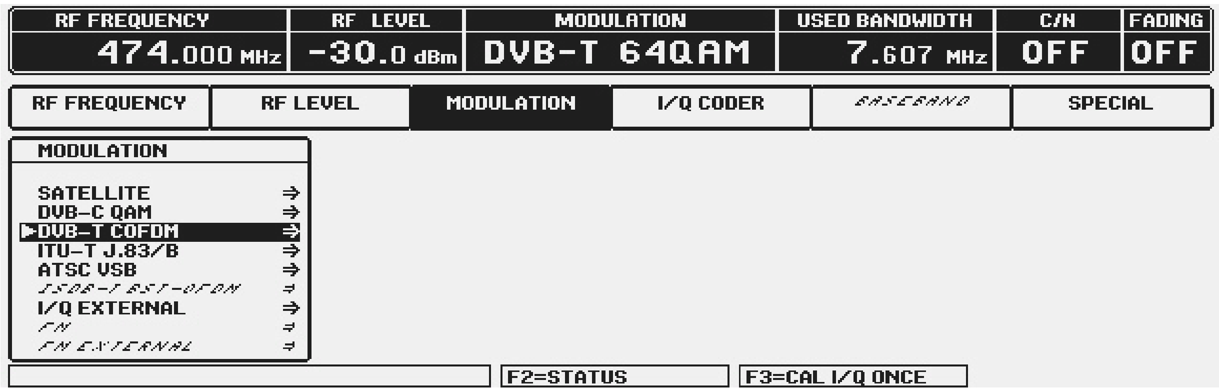
I/Q Modulator:

This calibration is especially important since it serves for optimizing carrier leakage, I/Q imbalance and phase error.

The entire device, i.e. all coders, can be calibrated in the **SETUP-HARDWARE-CALIBRATING** menu (see 2.2.3.1.1).



The I/Q MODULATION calibration can also be performed after selecting the MODULATION menu with the F3 key (CAL I/Q ONCE). In this case, however, only the current device setting is calibrated, i.e. only the active coder with its current symbol rate. The advantage is a considerably shorter calibration time.



C/N calibration:

An internal calibration is provided with optional Noise Generator SFQ-B5 model 03. It can be carried out with the F3 key in the MODULATION-NOISE menu for the selected modulation mode.

Note: *Calibration becomes necessary if the ambient temperature changes by more than 5°C. Moreover, monthly calibration is recommended. Daily calibration is recommended where exacting requirements are placed on accuracy; for extremely critical measurements of high accuracy calibration should be performed immediately before the measurement after all parameters have been set.Allow for at least 1 hour warmup before carrying out a calibration.*

Note: *The " CAL failed! Check SETUP/HARDWARE/CAL " message is displayed in the bottom left-hand corner of the SFQ screen, if one of the SFQ calibrations was not performed successfully. This message does not necessarily refer to the last calibration performed, e.g. noise.*

2.1.4.3 Software Update

A software update can be made with the aid of a PC via the RS232 interface and a null modem cable (see chapter 2.2.12.3).
A software update of a memory card can be started under MEM-SOFTWARE UPDATE (see 2.2.12.3).

2.1.4.4 Enabling Software Options

No extra hardware is required for certain options. These options can be enabled with a code, which depends on the serial number of the SFQ, in the menu SETUP-SERVICE-SOFTWARE OPTIONS (see 2.2.13.7.1.)

2.2 Menu Operation

2.2.1 RF FREQUENCY Menu

2.2.1.1 RF FREQUENCY

Note:	*When using VSB modulation mode see chapter 2.2.1.2*

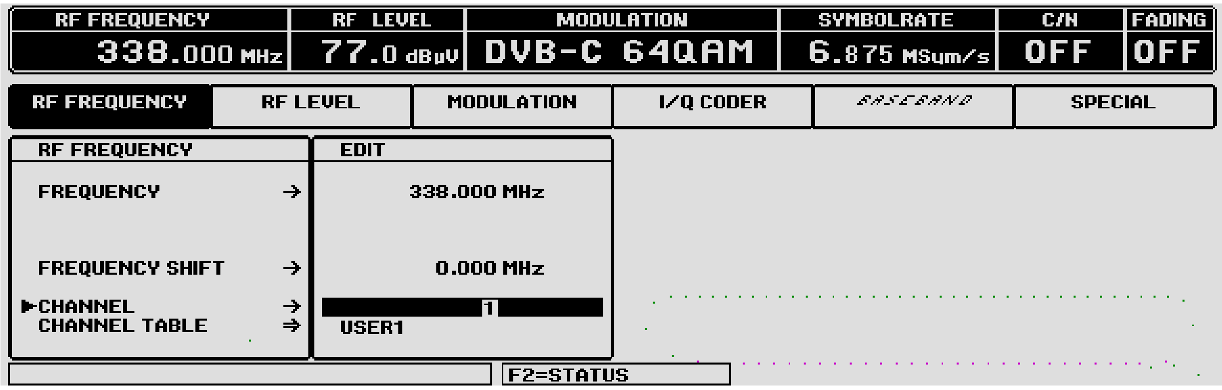


Fig. 2.2-1 RF FREQUENCY

FREQUENCY →

The output frequency of the SFQ can be set in this menu. The output frequency is always set in [MHz].

The frequency can be entered by selecting FREQUENCY with the aid of the cursor keys and then pressing the ENTER key or by entering a number. The user is now in the EDIT window where the frequency value can be entered directly via the numeric keypad. Upon pressing the ENTER key the entered value is confirmed and immediately set. It is also possible to change the frequency value in the EDIT window with the aid of the cursor keys. The new frequency value is set upon each stroke of the cursor key.

Frequencies between 0.300 and 3300.000 MHz can be set.

In the setup menu, the accuracy of the frequency entry can be increased to 1 Hz (from .000 MHz to .000000 MHz).

FREQUENCY SHIFT→:

In this menu, the output frequency of SFQ can be assigned a shift. This modifies the frequency at the SFQ output connector. The frequency shift is always set in [MHz].

Frequencies between 1 Hz and 3300.000 MHz can be set.

In the setup menu, the accuracy of the frequency entry can be increased to 1 Hz (from .000 MHz to .000000 MHz).

CHANNEL →

The frequency can be set indirectly by means of a channel table. In this case the channel number is entered directly or the channels are selected one after the other with the aid of the cursor keys. The channels of the selected table are used.

A table contains a maximum of 100 channels (1 to 100).

Only channels to which a frequency has been assigned can be selected (see section 2.2.8, SETUP / INFO Menu).

Note:	*The frequency tables can also be loaded via the RS232 or IEC/IEEE-bus interfaces (see chapter 3.6).*

CHANNEL TABLE

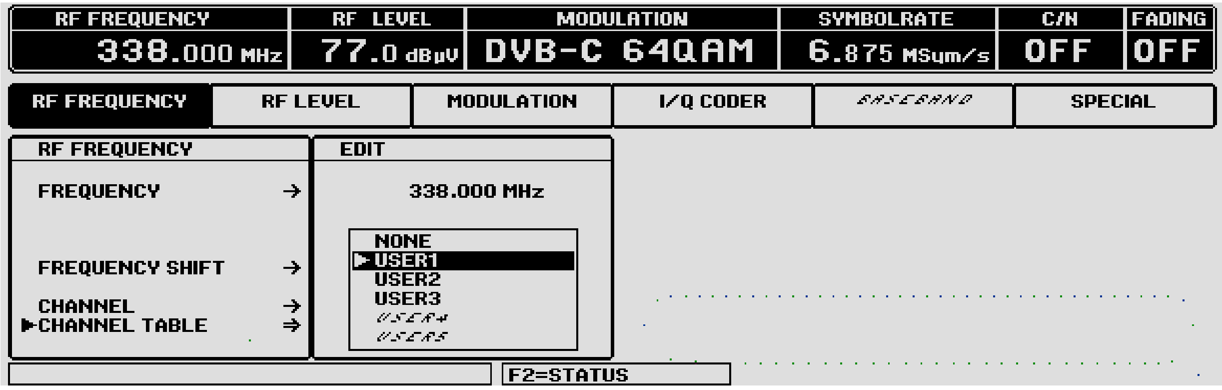


Fig. 2.2-2 CHANNEL TABLE

Here the channel table considered for the channel entry is selected. Either none or one of five available tables can chosen: USER1 to USER5, the name of the table being freely selectable (max. 6 characters). Tables may be prepared by the user in the SETUP menu and assigned a name.

Messages that may be displayed in the message window of the RF FREQUENCY menu:

Message	Meaning	Reason	Remedy
REFEXT	Information	The external reference has been selected via SETUP-PRESET 10 MHz REFERENCE	
NOREF	Error	The external reference selected via SETUP-PRESET-10 MHz REFERENCE is not available	Connect reference signal to rear panel or switch to INTERNAL in SETUP-PRESET-10 MHz REFERENCE.
OOC	Note	Frequency shift caused by modified input clock since last symbol rate setting (only with ATSC and center frequency mode)	Enter frequency again
SHIFT	Note	The frequency was assigned a shift.	

2.2.1.2 RF FREQUENCY (with VSB Modulation)

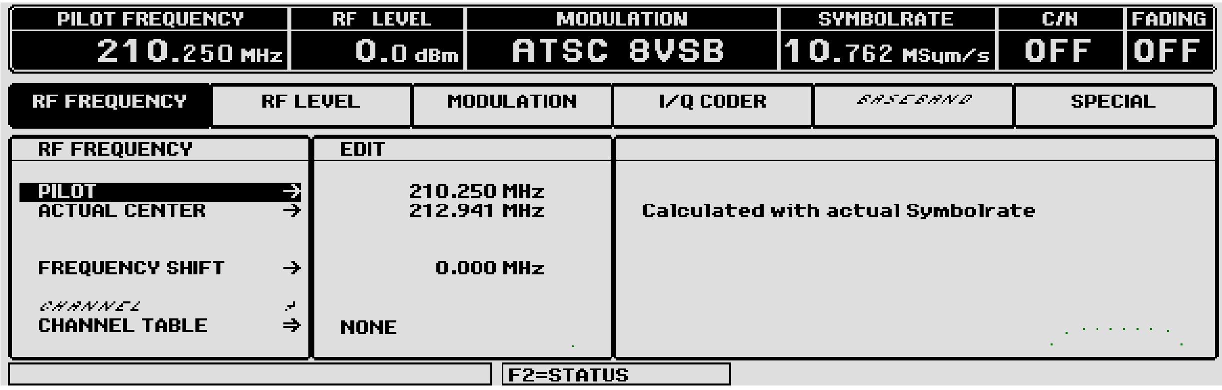


Fig. 2.2-3 RF FREQUENCY (with VSB modulation)

In contrast to all other types of modulation of SFQ, there are up to three different ways of entering the output frequency of the spectrum in the ATSC modulation:

"PILOT FREQUENCY": The pilot frequency in the output spectrum determines the frequency of the output spectrum.

"ACTUAL CENTER": The current symbol rate of the modulator determines the center frequency of the output spectrum.

"NOMINAL CENTER": The standard-conforming symbol rate of 10.7622 Msymb/s determines the frequency of the output spectrum (this menu item is only offered if an external data clock determines the symbol rate of the modulator, i.e. for TS PARALLEL, ASI Ext. Clk, SPI Ext. Clk and SMPTE Ext. Clk).

The special feature of the ATSC signal which allows the output frequency to be specified by up to three different ways is based on the fact that the ATSC output spectrum is a vestigial sideband filtered, i.e. non-symmetrical, output signal which is superimposed by the unmodulated carrier signal (pilot).

There are applications where it is useful to fix the pilot frequency of the output spectrum, but in other cases it is of advantage to characterize the frequency of the output spectrum by its spectrum center.

Due to the vestigial sideband filtering of the output signal the center frequency can be calculated from the pilot frequency and the symbol rate, since the spectrum changes only on one side when the symbol rate of the modulator is modified. The selected center frequency is thus really "centered" only for the current symbol rate on entering the center frequency. When the symbol rate is modified (e.g. by resetting the symbol rate or by modifying the input bit rate in the modes with external clock), the output spectrum is shifted from the calculated center. The status message "out of center" (ooc) in the RF frequency status field or the message "out of center, please reenter frequency" on the right of the center frequency display indicates this case and queries a new entry or a new confirmation of the center frequency. The new symbol rate is taken into account for the calculation of the center frequency and the spectrum is again centered with respect to the displayed frequency.

PILOT →

In this menu the output pilot frequency of the ATSC spectrum can be set. The unit of the set frequency is always [MHz]. In this case, the pilot frequency does not depend on the symbol rate of the modulator since it corresponds to the unmodulated carrier signal.

The frequency can be entered by selecting FREQUENCY with the aid of the cursor keys and then pressing the ENTER key. The user is now in the EDIT window where the frequency value can be entered directly via the numeric keypad. Upon pressing the ENTER key the entered value is confirmed and immediately set. It is also possible to change the frequency value in the EDIT window with the aid of the cursor keys. The new frequency value is set upon each stroke of the cursor key. The frequencies entered in the ACTUAL CENTER and, if available, NOMINAL CENTER fields are updated and the indicated frequency is shown as PILOT FREQENCY in the top left field of the screen.

Frequencies between 0.300 and 3300.000 MHz can be set.

In the setup menu, the accuracy of the frequency entry can be increased to 1 Hz (from .000 MHz to .000000 MHz).

ACTUAL CENTER →

In this menu the center frequency of the output spectrum is the reference for the frequency entry.

Since the ATSC output spectrum is a non-symmetrical output signal (vestigial sideband filtering), the center frequency depends on the set symbol rate. The center frequency of the output frequency can be determined from the pilot frequency using the following formula:

$f_{center} = f_{pilot} + f_{symbol}/4$ for the RF of the output spectrum (I/Q Normal)

$f_{center} = f_{pilot} - f_{symbol}/4$ for the IF of the output spectrum (I/Q Changed)

The frequency can be entered by selecting FREQUENCY with the aid of the cursor keys and then pressing the ENTER key. The user is now in the EDIT window where the frequency value can be entered directly via the numeric keypad. Upon pressing the ENTER key the entered value is confirmed and immediately set. It is also possible to change the frequency value in the EDIT window with the aid of the cursor keys. The new frequency value is set upon each stroke of the cursor key.

After setting of the frequency the message "calculated with actual symbol rate" is displayed to the right of the entered center frequency and indicates that the output spectrum is centered with respect to the entered frequency. The center frequency was calculated from the pilot frequency and the current symbol rate using the above symbol rate formula. At the time the entered frequency is confirmed and set, the current symbol rate is used to calculate the center frequency.

Therefore the message "calculated with actual symbol rate" is displayed to the right of the current center frequency.

If the symbol rate is varied after entering the center frequency, the center frequency of the output spectrum is also shifted.

If the entered center frequency is shifted out of the center due to varying the symbol rate, the message "out of center, please reenter frequency" is displayed to the right of the center frequency and "ooc" (out of center) in the RF frequency status field.

Only if a new entry is made and confirmed by ENTER the current symbol rate will be used for calculating the center frequency and the spectrum be centered again.

The Pilot and Nominal Center (if available) menu items are automatically adapted.

Frequencies between 0.300 and 3300.000 MHz can be set.

The indicated frequency is shown as PILOT FREQENCY in the top left field of the screen.

In the setup menu the accuracy of the frequency entry can be increased to 1 Hz
(from .000 MHz to .000000 MHz).

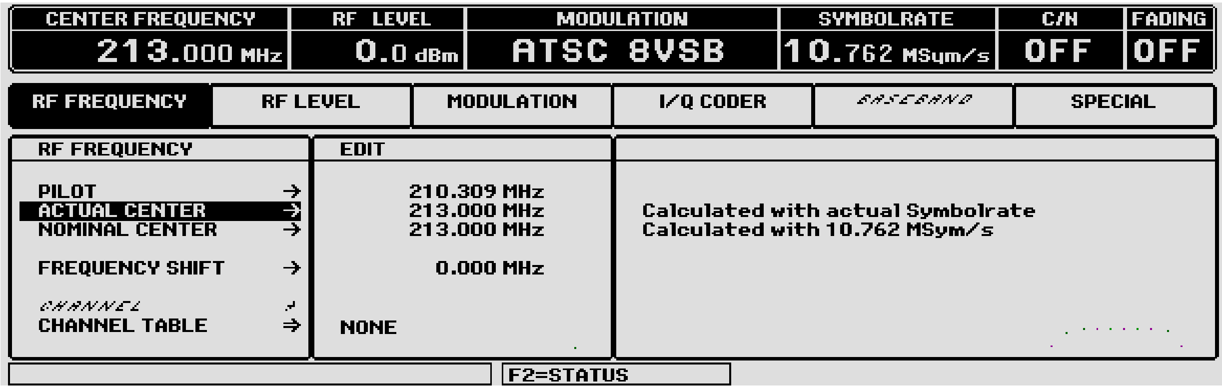


Fig. 2.2-4 NOMINAL CENTER

NOMINAL CENTER →

This frequency entry is offered only in the modes in which an external clock determines the symbol rate of the modulator during data feed. These modes are TS PARALLEL, ASI Ext. Clk, SPI Ext. Clk and SMPTE Ext. Clk.

When the data rate of the transport stream source is modified in TS PARALLEL or if the clock is modified in ASI Ext. Clk, SPI Ext. Clk and SMPTE Ext. Clk, a linear modification of the symbol rate and thus of the bandwidth is obtained. The non-symmetrical spectrum is shifted from its set center position.

In contrast to the ACTUAL CENTER mode, in which the current symbol rate is used for the calculation of the center frequency of the output spectrum, SFQ computes the output frequency independently using always the standard symbol rate of 10.7622 Msymb/s.

The formula is as follows:

$f_{center} = f_{pilot}$ +10.7622 Msymb/s/4 for the RF of the output spectrum (I/Q Normal)

$f_{center} = f_{pilot}$ -10.7622 Msymb/s /4 for the IF of the output spectrum (I/Q Changed)

This means that the output spectrum is centered with respect to the set data rate only if the input data rate yields the standard symbol rate.

With this type of frequency entry the pilot can be inserted in the channel to the standard by entering the center frequency of the desired channel. At the standard symbol rate, the spectrum is centered with respect to the channel, the pilot frequency, however, is standard-conforming in any case independently of the symbol rate.

If the current symbol rate deviates from the nominal symbol rate, "ooc" (out of center) is signalled after confirmation of the input frequency in the RF status field. This can be identified by the fact that the display of the current center frequency (calculated) deviates from the entered nominal frequency.

FREQUENCY SHIFT→:

In this menu, the output frequency of SFQ can be assigned a shift. This modifies the frequency at the SFQ output connector. The frequency shift is always set in [MHz].

Frequencies between 1 Hz and 3300.000 MHz can be set.

In the setup menu, the accuracy of the frequency entry can be increased to 1 Hz
(from .000 MHz to .000000 MHz).

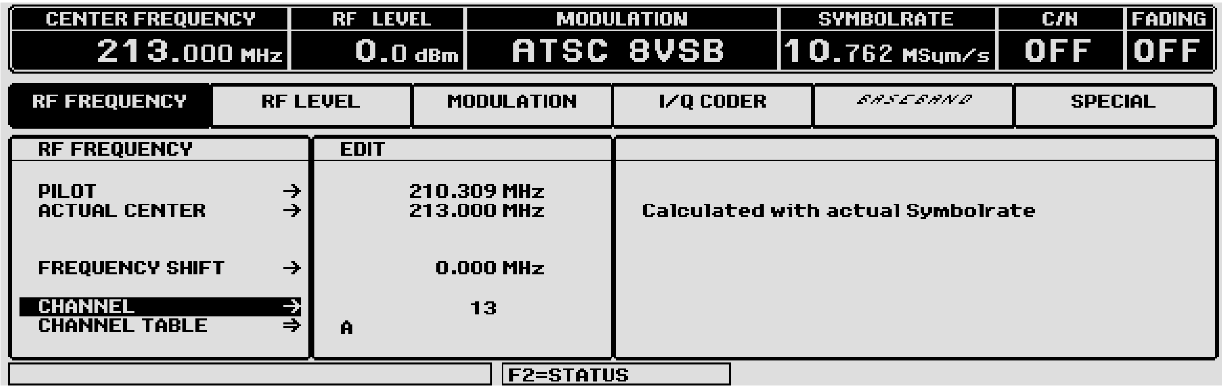


Fig. 2.2-5 CHANNEL

CHANNEL→

The frequency can be set indirectly by means of a channel table. In this case the channel number is entered directly or the channels are selected one after the other with the aid of the cursor keys. The channels of the selected table are used.

A table contains a maximum of 100 channels (1 to 100).

Note:	*The pilot frequencies of the ATSC output spectrum shall be entered into the channel tables. Only channels that have been assigned a frequency can be selected (see chapter 2.2.13 SETUP / INFO Menu).*

CHANNEL TABLE

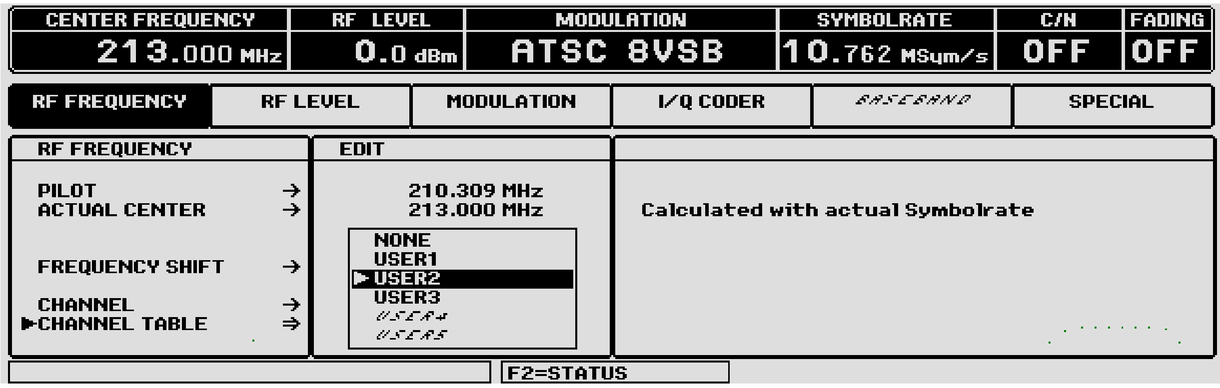


Fig. 2.2-6 CHANNEL TABLE

Here the channel table considered for the channel entry is selected. Either none or one of five available tables can chosen: USER1 to USER5, the name of the table being freely selectable (max. 6 characters). Tables may be prepared by the user in the SETUP menu and assigned a name.

The frequencies entered into the channel tables are pilot frequencies. Therefore, the frequency display always changes to the pilot frequency when a channel is selected, irrespective of the previously entered frequency (e.g. actual center).

2.2.2 RF LEVEL Menu

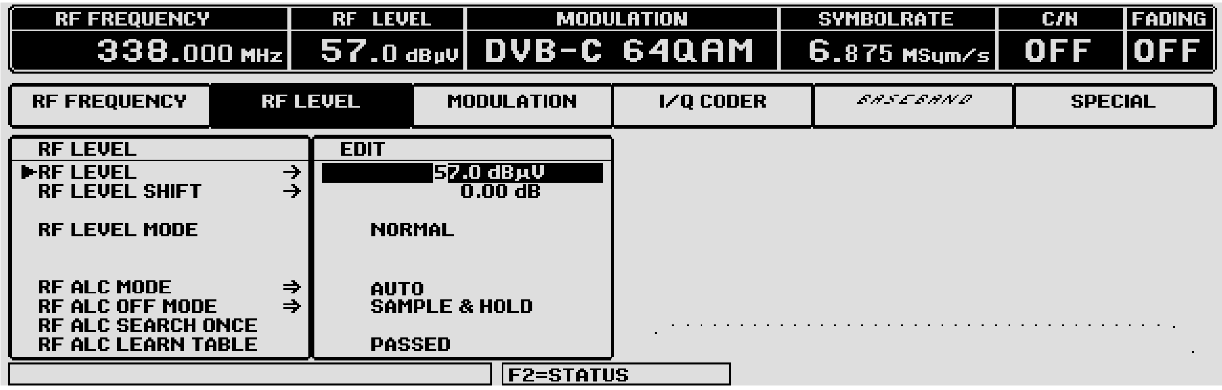


Fig.: 2.2.2-1 RF LEVEL Menu

In the RF LEVEL menu the parameters:

RF LEVEL
RF LEVEL SHIFT
RF FADING POWER
RF LEVEL MODE
RF ALC MODE

can be selected and set.

RF FADING POWER only is displayed, if SETUP/INFO-PRESET-FADING-POWER is set to MAIN and Fading is switched on.

2.2.2.1 RF LEVEL

RF LEVEL →

When **RF LEVEL** is selected, the new level can be set in the EDIT window by means of the numeric keypad and pressing the ENTER key.

It is also possible to place the cursor in the EDIT window on a digit of the currently set level and to vary the value using the up and down keys. The level change is immediately effected.

Note:	*The level unit dBm, dBµV or mV is preselected in the SETUP menu.* *The RF OFF status is indicated in the selection field below RF LEVEL.*

RF LEVEL SHIFT

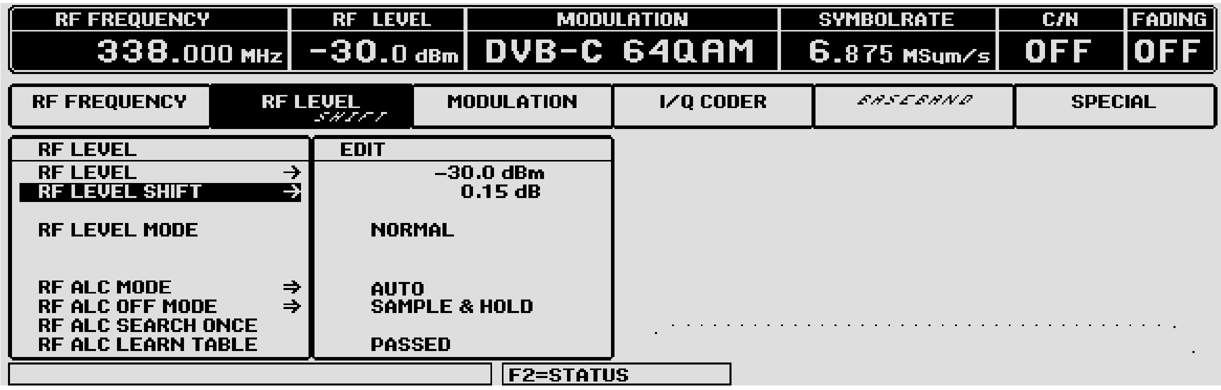


Fig.: 2.2.2-2 RF LEVEL SHIFT

The SFQ allows the user to enter the level shift for a subsequent attenuator/amplifier, if any, in the RF LEVEL SHIFT menu. The entered SHIFT value modifies the RF output signal (N connector on SFQ). This modification is **not** taken into account in RF LEVEL. RF LEVEL indicates the level after the attenuator or after the amplifier.

RF FADING POWER

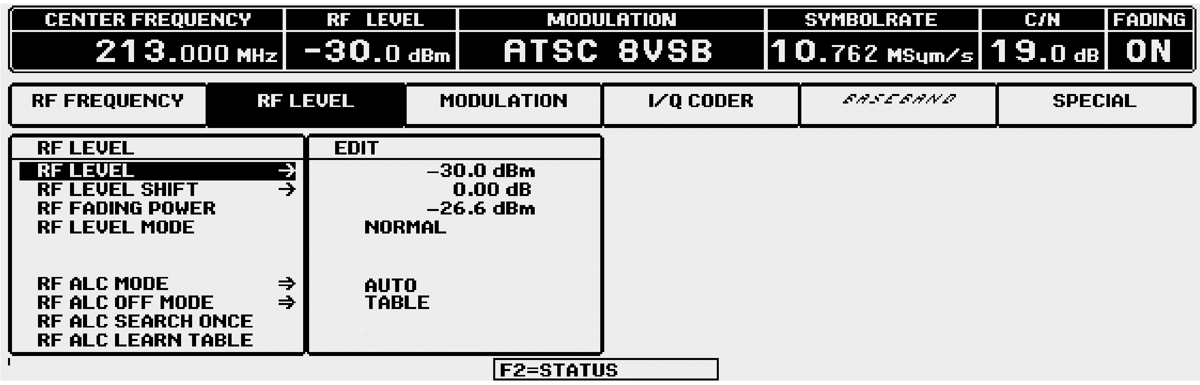


Fig.: 2.2.2-3 RF FADING POWER

RF FADING POWER only is displayed, if SETUP/INFO-PRESET-FADING-POWER is set to MAIN and Fading is switched on.

The RF level displayed in the main screen is the level of the main path (Path with lowest Path Loss). The sum power of all paths involved in the output signal is displayed as RF FADING POWER.

A C/N setting refers the RF level displayed in the main screen therefore the main path.

RF LEVEL MODE

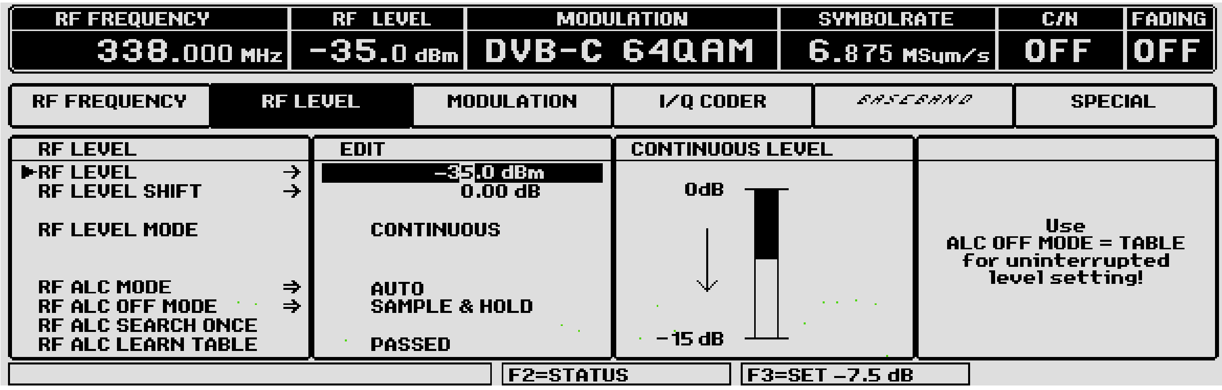


Fig.: 2.2.2-4 RF LEVEL MODE

With RF LEVEL MODE selected, switchover between the NORMAL and CONTINUOUS operating modes is possible by means of the ENTER key.

NORMAL

In the NORMAL mode the RF level is set by means of an internal attenuator and electronic setting circuits. Attenuator setting is in 5-dB steps.

CONTINUOUS (uninterrupted level setting)

In the CONTINUOUS mode, the RF LEVEL is set without a break in a 15-dB range. Electronic setting is used instead of the switching attenuator. The current RF LEVEL can be set to a starting value by means of key **F3 = SET 0 dB** from which the RF level can be reduced.

With the aid of key F4 = SET -7.5 dB the RF LEVEL can be set to the center of the CONTINUOUS LEVEL range (- 7.5 dB).

Note: *With ALC switched off, RF ALC OFF MODE should be set to TABLE to avoid switch-offs in the case of level calibration.*

RF ALC MODE (switching internal ALC on/off)

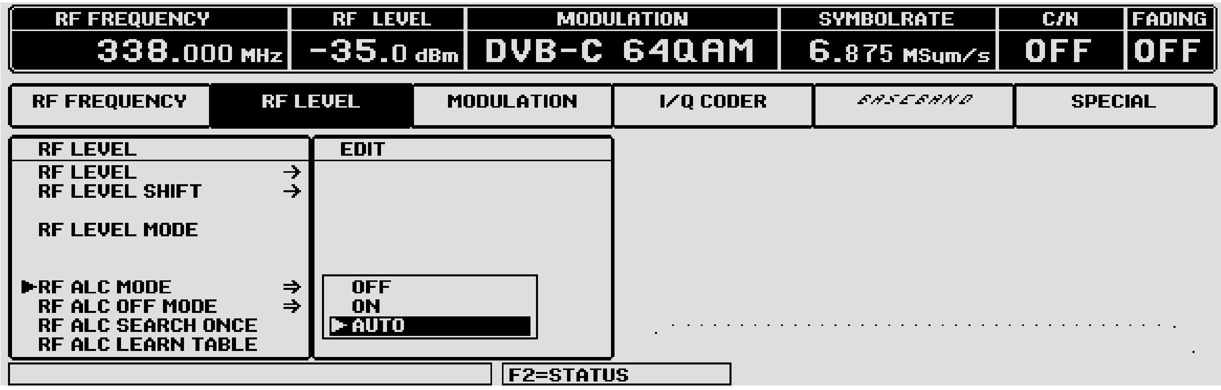


Fig.: 2.2.2-5 RF ALC MODE

In the **RF ALC MODE** menu ALC can be switched off for certain applications. With CW and FM, ALC is normally switched on. Thus the best level accuracy to be obtained. For vector and digital modulation ALC has to be switched off. In this case a selection can be made between SAMPLE & HOLD and TABLE.

In the SAMPLE & HOLD mode the level is recalibrated after each level and frequency setting. To do so the CW mode is selected for a brief period, ALC is switched on and the level control element is set to the value obtained. With the noise generator switched on, the SAMPLE & HOLD mode cannot be selected. An RF LEVEL error is thus prevented. When this calibration is disturbing, the TABLE mode can be selected (level control voltage selected from a table). In this mode, level correction values are taken from a table each time the frequency or level is changed. The table can be regenerated with the aid of the LEARN TABLE function without additional measuring instruments being required.

ALC is preset to AUTO. In this mode level control is automatically adapted to the operating conditions. For certain applications ALC can be fixed to the OFF or ON condition. OFF (level control off) should be selected when the intermodulation suppression is to be improved in the CW mode. ON (level control on) should be selected in case of vector or digital modulation with constant envelope.

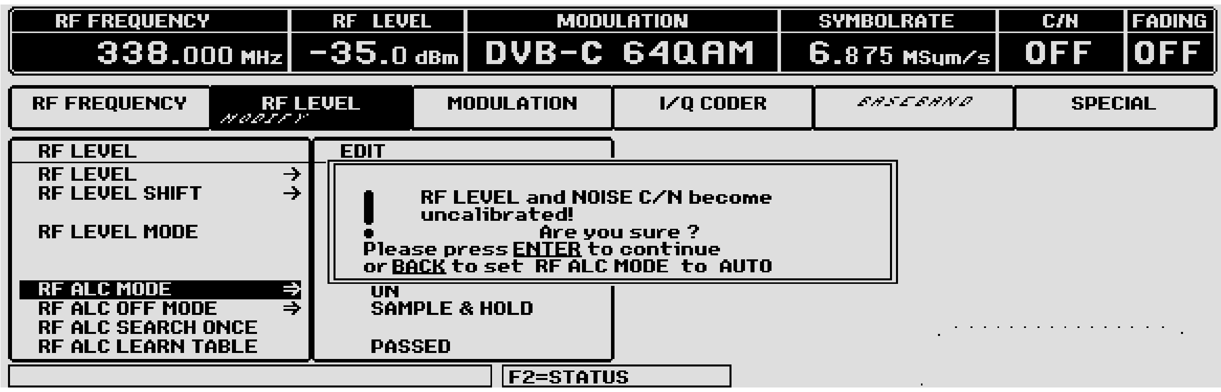


Fig.: 2.2.2-6 ALC MODE Warning

With vector modulation (DVB, ATSC VSB, IQ EXT) a warning is displayed if the RF ALC MODE is switched ON.

In this case RF LEVEL and NOISE are not calibrated.

Menu items:

RF ALC MODE

OFF Internal level control switched off.
ON Internal level control permanently switched on.
AUTO Normal mode. Level control is automatically adapted to operating conditions.

RF ALC OFF MODE

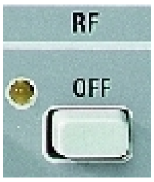
SAMPLE&HOLD Level recalibration in the ALC OFF mode after each level or frequency change.

TABLE Correction values for level setting are taken from a table in the ALC OFF mode.

RF ALC SEARCH ONCE-> Brief manual switch-on of level control for level calibration in the ALC OFF and SAMPLE & HOLD modes.

RF ALC LEARN TABLE -> Regeneration of correction values for function ALC OFF MODE - TABLE (level control voltage taken from table).

Note: *A new ALC table should only be generated after a settling time of approx. 1 hour as well as in case of a change of the ambient temperature (>5 Kelvin).*



The RF output signal is switched on and off with the **RF ON / OFF** key. This has no effect on the current menu. When the output signal is switched off *RF OFF* is displayed in the **RF LEVEL** window. The off state is signalled in addition by an LED.

Resetting the overload protection

SFQ is protected against overloading through an externally applied RF signal. If the external signal is too high the overload protection responds. This status is signalled by *RF OFF* displayed in the status line of the **RF LEVEL** selection window and by an LED.

The overload protection can be reset by pressing the RF ON /OFF key.

The RF output of SFQ is also protected against external DC by a DC BLOCK up to 50 V.

Messages that may be displayed in the message window of the RF LEVEL menu:

Message	Meaning	Reason	Remedy
MODIFY	Warning	RF ALC MODE has not been set to AUTO.	Set RF ALC MODE to AUTO.
OFF	Information	Output level has been switched off via RF OFF key.	
SHIFT	Information	RF LEVEL SHIFT has been entered.	

2.2.3 MODULATION Menu

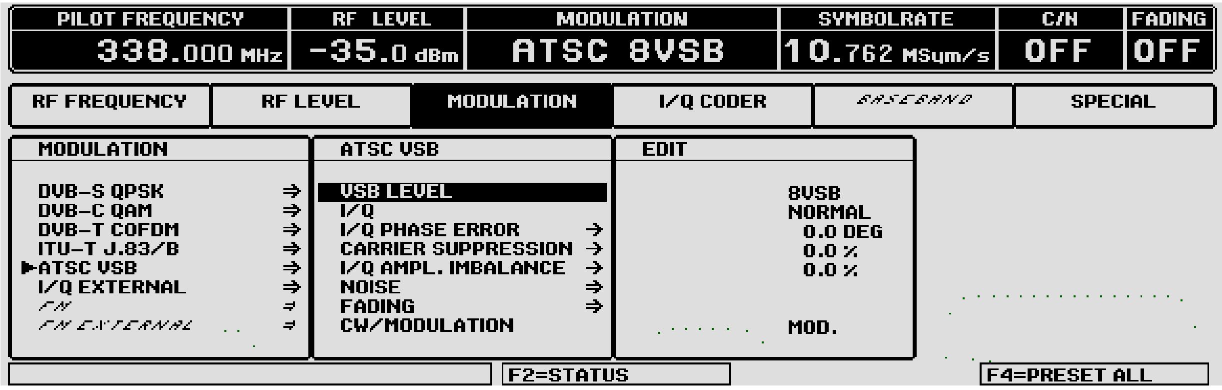


Fig.: 2.2.3-1 MODULATION Menu

In the SFQ the following types of modulation can be selected:

Vector modulation:	**DVB-S QPSK or Satellite**
	DVB-C QAM
	DVB-T COFDM
	ITU-T J.83/B
	ATSC VSB
	I/Q EXTERNAL
Frequency modulation:	**FM**
	FM EXTERNAL

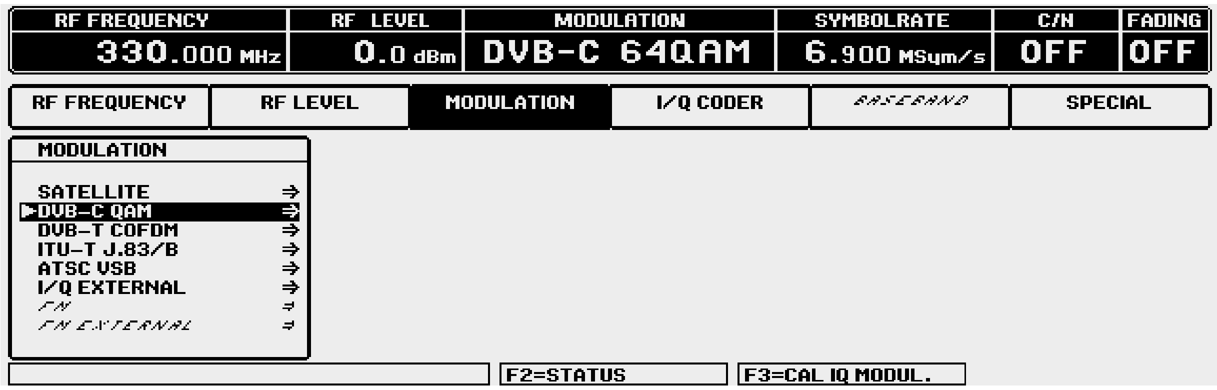


Fig.: 2.2.3-2 CS+ coder menu

"**SATELLITE**" in the first line of the modulation menu indicates that the CS+ coder is fitted (for the previous coder, i.e. the CS coder, the term "**DVB-S**" would be indicated instead).

Same as its predecessor (the CS coder), the CS+ coder meets the hardware requirements of the DVB-C standard (EN 300 429) and the DVB-S standard (EN 300 421). In addition, the DSNG (**d**igital **s**atellite **n**ews **g**athering) standard (EN 301 210) is implemented in the CS+ coder and, very importantly, the CS+ coder is ready for the implementation of turbo codes for satellite transmission.

To select a desired modulation standard, the corresponding software option must be enabled. The software enable function will be found in the SETUP menu under SERVICE - SOFTWARE OPTIONS.

[MOD ON/OFF] key

The different types of modulation can be switched directly by means of the [MOD ON/OFF] key or via the modulation menus. Modulation off is indicated by *OFF* in the status line in the **MODULATION** selection window and also by an LED.

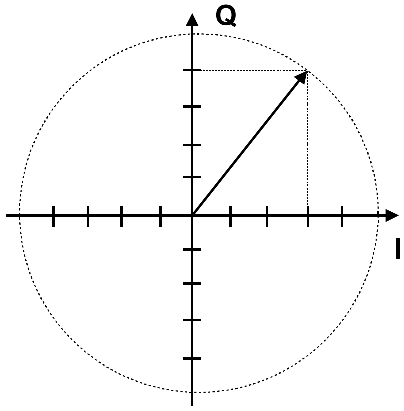
Messages that may be displayed in the message window of the MODULATION menu:

Message	Meaning	Reason	Remedy
MODIFY	Warning	I/Q has been set to CHANGED or a value other than zero has been entered for I/Q PHASE ERROR, CARRIER SUPPRESSION or I/Q AMPL.IMBALANCE or: A fading profile of modified standard or a USER-DEFINED fading profile has been selected.	Reset values
OFF	Information	Modulation has been switched off via the function key on the front panel or switched to CW via MODULATION-xx-CW/MODULATION.	

2.2.3.1 I/Q Vector Modulation

In the vector modulation modes the modulation signals for complex RF carrier modulation are applied by the I and Q inputs of the vector modulator.

Example: Vector modulation



The amplitude and phase of the RF-carrier can be modified in this way. More complex modulations as described in the following chapter are easy to generate in this way.

External modulation signals

In the **I/Q EXTERNAL** mode the modulation signals are applied via the rear **I** and **Q** inputs.

Vector modulation:

The sum vector of

$$\sqrt{I^2 + Q^2} = 0.5\ \mathrm{V}$$

corresponds to the displayed RF level. To avoid overdriving of the I/Q modulator, the sum vector should not exceed 0.5 V for digital modulation with an AM component, e.g. QPSK and QAM.

Note: *The selectable autocalibration of the I/Q modulator allows accurate and reproducible measurements to be made. The calibration routine should be called up before measurements or after temperature variations of more than 5 degrees. The routine is called up in the* **SETUP-HARDWARE CALIBRATION** *menu***.**

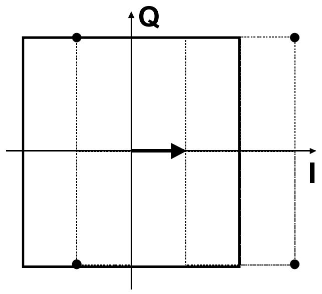
What effects carrier suppression, I/Q amplitude imbalance and phase errors have on vector modulation are shown in the following graphics.

Parameter tuning ranges:

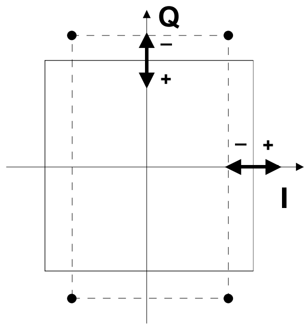
Parameter	Tuning range	Resolution
Carrier suppression	0 to 50 %	0.1 %
Phase error	-10 to +10 °	0.1 °
Ampl. imbalance	-25 to +25 %	0.1 %

Effect of detuning:

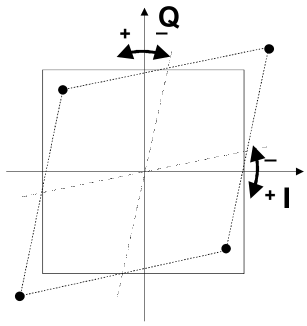
CARRIER SUPPRESSION



AMPL. IMBALANCE



PHASE ERROR



2.2.3.1.1 Satellite

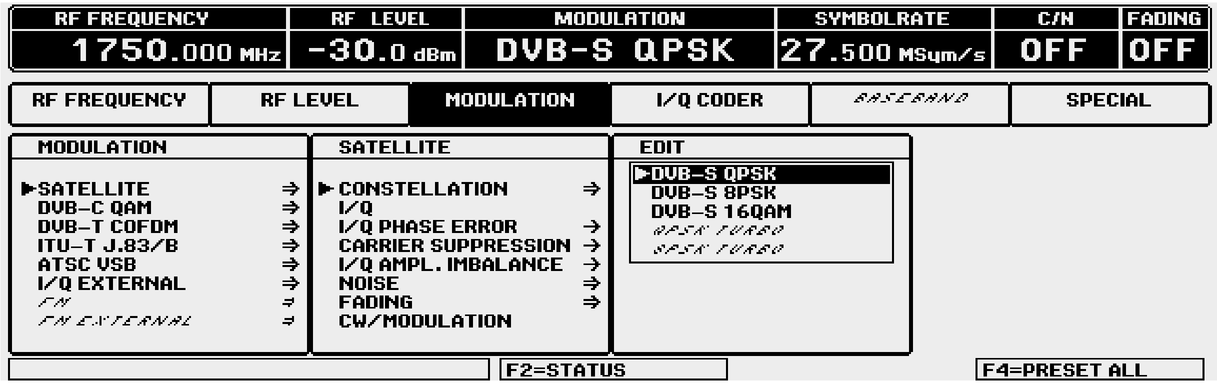


Fig.: 2.2.3-3 Satellite

The **SATELLITE** menu comprises the following items and submenus:

CONSTELLATION:

DVB-S QPSK
Transmission is in line with Standard EN 300 421 and the QPSK mode of Standard EN 301 210 (DSNG).

DVB-S 8PSK
Transmission is in line with the 8PSK mode of Standard EN 301 210 (DSNG).

DVB-S 16QAM
Transmission is in line with the 16QAM mode of Standard EN 301 210 (DSNG).

The CS+ coder is ready for the implementation of further transmission methods, e.g. such using turbo codes.

Any other settings concerning channel coding can be made in the I/Q CODER menu. The menu items in the I/Q CODER menu may differ depending on the option selected under CONSTELLATION.

I/Q:

NORMAL
The I/Q data streams are not interchanged, i.e. the SFQ output spectrum is in the normal (non-inverted) position.

CHANGED
The I/Q data streams are interchanged, i.e. the SFQ output spectrum is inverted.

I/Q PHASE ERROR
Value of phase error

I/Q CARRIER SUPPRESSION
Value of carrier leakage

I/Q AMPL. IMBALANCE
Value of amplitude imbalance of I and Q vectors

NOISE
Input menu for setting a defined C/N (carrier-to-noise) value, see section 2.2.7.

FADING
Input menu for switching on/off the fading simulator and selecting the desired set of fading parameters. See section 2.2.8.

CW/MODULATION:

- MOD. - The output signal is modulated.
- CW - The output signal is a pure sinusoidal carrier (**c**ontinuous **w**ave).

All other settings related to channel coding can be made in the I/Q CODER menu.

2.2.3.1.2 DVB-S QPSK

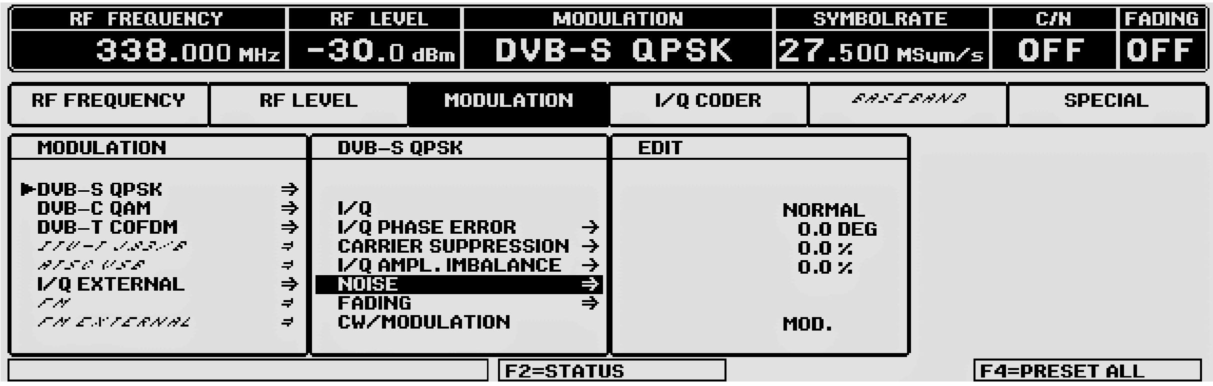


Fig.: 2.2.3-4 DVB-S QPSK

Menu items:

DVB-S QPSK

I/Q NORMAL CHANGED	Selection of normal or changed I/Q modulation. Change of I and Q signals causes the modulation sidebands to be inverted.
I/Q NORMAL	Normal I/Q modulation
I/Q CHANGED	I and Q signals changed
I/Q PHASE ERROR →	Entry of phase error
CARRIER SUPPRESSION →	Entry of carrier leakage
I/Q AMPL. IMBALANCE →	Entry for unequal modulation of I and Q vectors.
NOISE	Entry for setting a defined C/N (carrier-to-noise) value, see section 2.2.7
CW / MODULATION	Switchover between modulated output signal and sinewave carrier.

All other settings related to channel coding can be made in the I/Q CODER menu.

2.2.3.1.3 DVB-C QAM

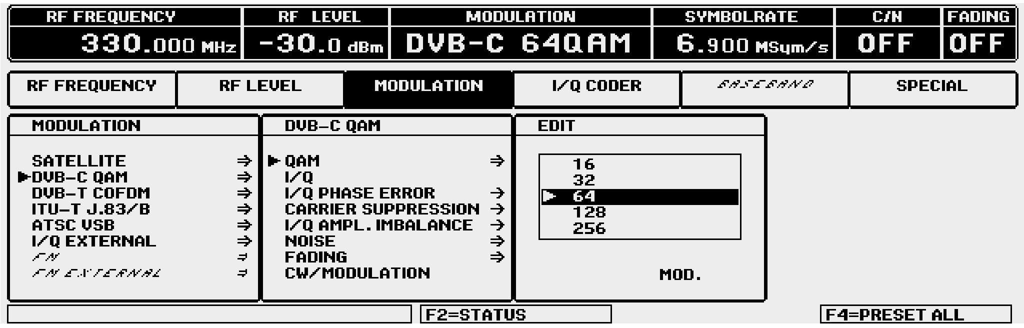


Fig.: 2.2.3-5 DVB-C QAM

If **DVB-C QAM** is selected, transmission is to Standard EN 300 429. The **MODULATION** menu is the same for the CS+ coder and the CS coder (whereas the **I/Q CODER** menu differs for the two coders).

The **DVB-C QAM** menu comprises the following items and submenus:

QAM:

- 16 - Data are transmitted with 16 QAM.
- 32 - Data are transmitted with 32 QAM.
- 64 - Data are transmitted with 64 QAM.
- 128 - Data are transmitted with 128 QAM.
- 256 - Data are transmitted with 256 QAM.

Any other settings concerning channel coding can be made in the I/Q CODER menu.

I/Q:

- **NORMAL**
  The I/Q data streams are not interchanged, i.e. the SFQ output spectrum is in the normal (non-inverted) position.
- **CHANGED**
  The I/Q data streams are interchanged, i.e. the SFQ output spectrum is inverted.

I/Q PHASE ERROR:
Value of phase error

I/Q CARRIER SUPPRESSION:
Value of carrier leakage

I/Q AMPL. IMBALANCE:
Value of amplitude imbalance of I and Q vectors

NOISE:
Input menu for setting a defined C/N (carrier-to-noise) value, see section 2.2.7.

FADING:
Input menu for switching on/off the fading simulator and selecting the desired set of fading parameters (see section 2.2.8).

CW/MODULATION:

- MOD - The output signal is modulated.
- CW - The output signal is a pure sinusoidal carrier (**c**ontinuous **w**ave).

All other settings related to channel coding can be made in the I/Q CODER menu.

2.2.3.1.4 DVB-T COFDM

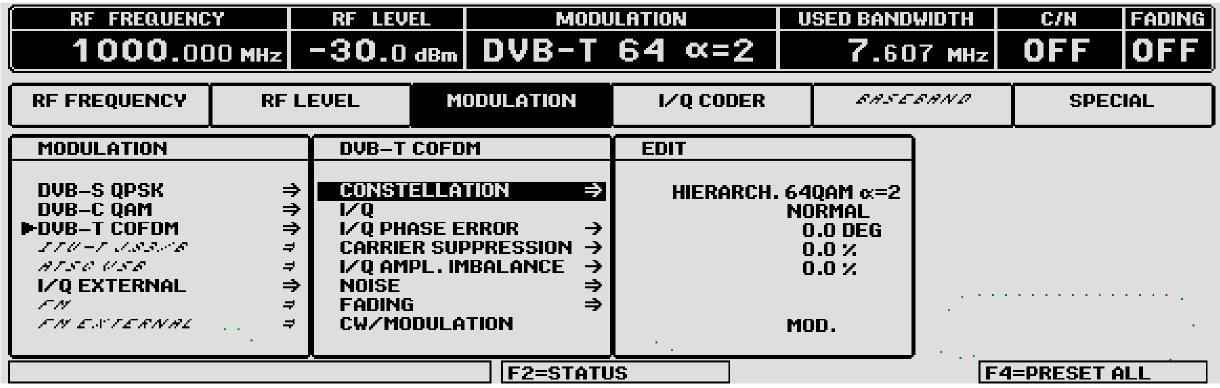


Fig.: 2.2.3-6 DVB-T COFDM

Menu items:

DVB-T COFDM

CONSTELLATION

The type of modulation of the data carrier with COFDM can be selected under this menu item. It is also possible to select whether coding is to be performed non-hierarchically or whether two input data streams are coded hierarchically.

Hierarchical coding is an option. If the option is not fitted, the corresponding menu items are displayed in italics.

With non-hierarchical coding used, data carriers may be QPSK-, 16 QAM- or 64 QAM-modulated.

With hierarchical transmission used, only 16 QAM and 64 QAM are possible modulation methods. But the alpha factor can be selected:

alpha = 1 signifies that all points in a constellation diagram are equally spaced from each other.

alpha = 2 signifies that the quadrants are spaced twice as large as the points within a quadrant.

alpha = 4 signifies that the quadrants are spaced four times as large as the points within a quadrant.

All other settings that might refer to channel coding can be performed under menu item I/Q CODER.

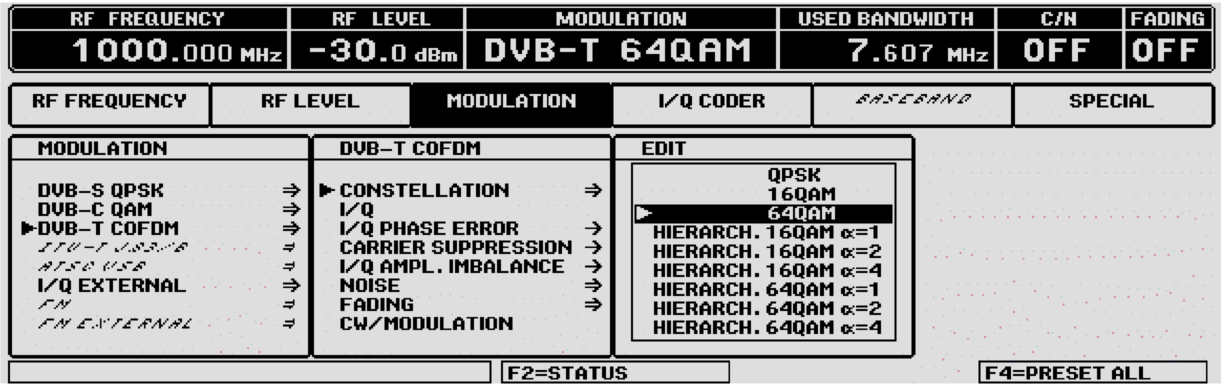


Fig.: 2.2.3-7 CONSTELLATION

Menu items:

Non-hierarchical coding with an input data stream:

- QPSK
- 16 QAM
- 64 QAM

Hierarchical coding with two input data streams:

- 16 QAM with alpha = 1
- 64 QAM with alpha = 1
- 16 QAM with alpha = 2
- 64 QAM with alpha = 2
- 16 QAM with alpha = 4
- 64 QAM with alpha = 4

The constellation selected is always indicated in the header line. If hierarchical coding has been selected, this is also shown in the header line by indication of the alpha value. Constellation and coding fully meet the requirements stipulated in the ETS 300 744 specification.

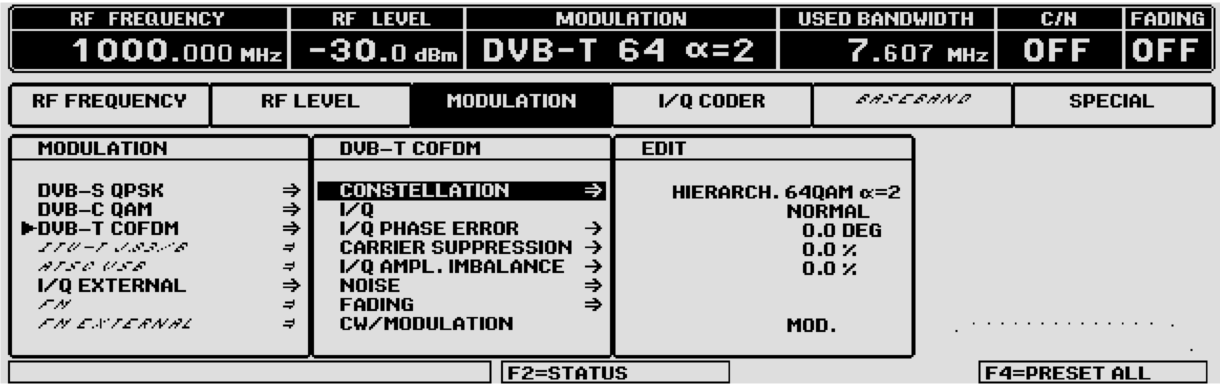


Fig.: 2.2.3-8 CONSTELLATION

The following can also be set:

I/Q NORMAL CHANGED Selection between normal and changed I/Q control. The modulation sidebands are inverted by swapping the I and Q signals.

I/Q NORMAL I/Q control is normal (normal position of spectrum).

I/Q CHANGED I and Q signals are swapped. This means an inverted position of the spectrum.

I/Q PHASE ERROR → Entry of phase error (see 2.2.3.1).

CARRIER SUPPRESSION → Entry of carrier leakage (see 2.2.3.1).

I/Q AMPL. IMBALANCE → Entry for unequal modulation of I and Q vectors (see 2.2.3.1).

NOISE Menu for setting a defined C/N value (carrier to noise), for switch-on/off of noise generator and input of receiver bandwidth (see 2.2.7).

FADING Menu for activation and deactivation of fading simulator. A predefined fading profile can also be selected in this menu (see 2.2.8).

CW / MODULATION Switchover between modulated output signal and sinewave carrier. The effective power of the output signal remains constant.

All other settings related to channel coding can be performed under menu item I/Q CODER.

2.2.3.1.5 ITU-T J.83/B

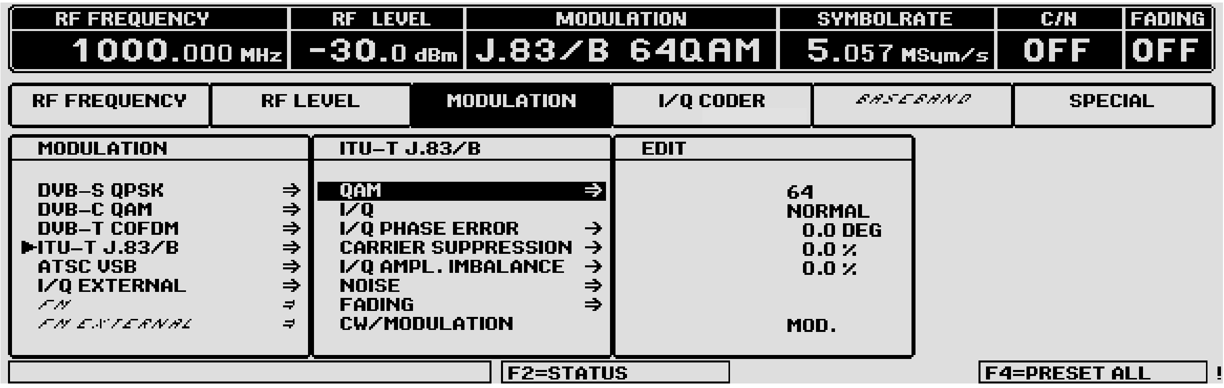


Fig.: 2.2.3-9 ITU-T J.83/B

Menu items:

J.83/B QAM

QAM	Selection between 64 QAM and 256 QAM.
I/Q NORMAL CHANGED	Selection of normal or changed I/Q modulation. Changing the I and Q signals inverts the modulation sidebands.
I/Q NORMAL	Normal I/Q modulation.
I/Q CHANGED	I and Q signals are changed.
I/Q PHASE ERROR →	Entry of phase error with I/Q modulation in degrees (see 2.2.3.1).
CARRIER SUPPRESSION →	Entry of carrier leakage in % (see 2.2.3.1).
I/Q AMPL. IMBALANCE →	Entry of unequal modulation of I and Q vectors (see 2.2.3.1).
NOISE	Entry for setting a defined C/N (carrier-to-noise) value (see 2.2.7).
FADING	Switching the fading simulator on or off and selecting the fading parameter set to be sent (see 2.2.8).
CW / MODULATION	Switchover between modulated output signal and sinewave carrier.

All other settings related to channel coding can be made in the I/Q CODER menu.

2.2.3.1.6 ATSC VSB

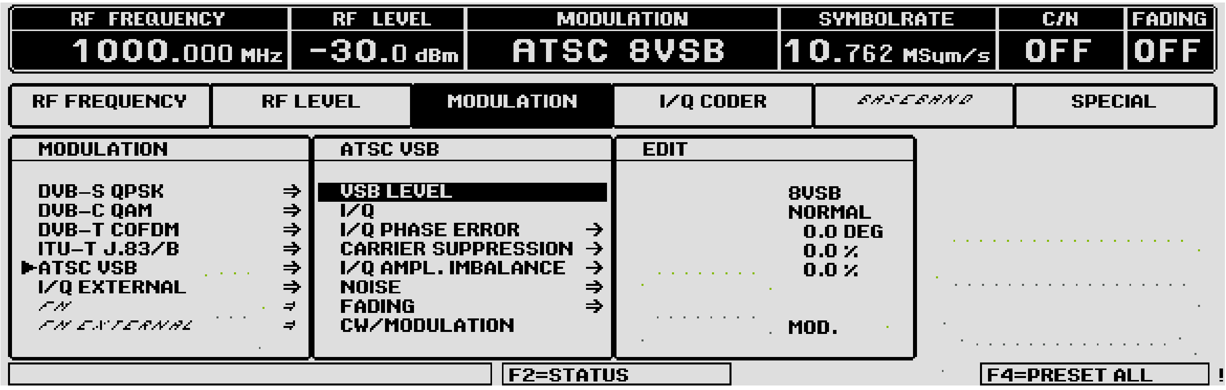


Fig.: 2.2.3-10 ATSC VSB

Menu items:

ATSC VSB

VSB LEVEL	8VSB is supported only.
I/Q NORMAL CHANGED	Selection of normal and changed I/Q signal. By changing the I and Q signal, the modulation side band will invert.
I/Q NORMAL	The I and Q signals are normal (normal frequency position).
I/Q CHANGED	The I and Q signals are changed. This means a reverse frequency position.
I/Q PHASE ERROR →	Entry of phase error with I/Q modulation in degrees (see 2.2.3.1).
CARRIER SUPPRESSION →	Entry of carrier leakage in % (see 2.2.3.1).
I/Q AMPL. IMBALANCE →	Entry of unequal modulation of I and Q vectors (see 2.2.3.1).
NOISE	Entry for setting a defined C/N value see 2.2.7.
FADING	Switch fading simulator on or off and select fading parameter set to be sent (see 2.2.8).
CW / MODULATION	Switchover between modulated output signal and sinewave carrier.

All other settings related to channel coding can be performed under menu item I/Q CODER.

2.2.3.1.7 ISDB-T

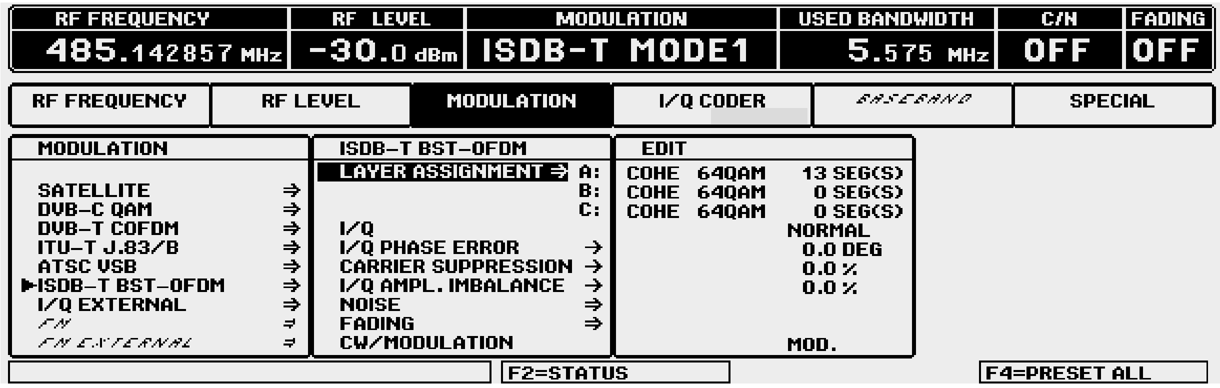


Fig.: 2.2.3-11 Modulation menu

The ISDB-T coder can be selected in the modulation menu. In this menu, **layer assignment** is performed, i.e. the assignment of the type of transmission, the constellation and the number of segments.

The following items can also be set in this menu:

I/Q Switchover between normal and changed I/Q control. The modulation sidebands (the frequency axis) are inverted when the I and Q signals are interchanged.

NORMAL: Normal position of the spectrum

CHANGED: Inverted position of the spectrum

I/Q PHASE ERROR Entry of phase error (see section 2.2.3.1).

CARRIER SUPPRESSION Entry of residual carrier (see section 2.2.3.1).

I/Q AMPL. IMBALANCE Entry of the amplitude imbalance of the I/Q vector (see section 2.2.3.1).

NOISE Menu for operating the noise generator (see section 2.2.7).

FADING Menu for operating the fading simulator (see section 2.2.8).

CW/MODULATION Switchover between modulated output signal and sinusoidal carrier. The rms power of the output signal remains constant.

For the assignment of the **type of transmission**, there are only seven possible combinations that are offered in a menu. The short form **PART** stands for Partial Reception Portion, the short form **DIFF** for Differential Modulation Portion and the short form **COHE** for Coherent Modulation Portion.

The following rules apply to the assignment of the type of transmission:

- There can only be one partial reception portion and it can be placed on layer A only.
- If there is a coherent modulation portion on a layer there can be only one coherent modulation portion on the following layer.

The following combinations result from this:

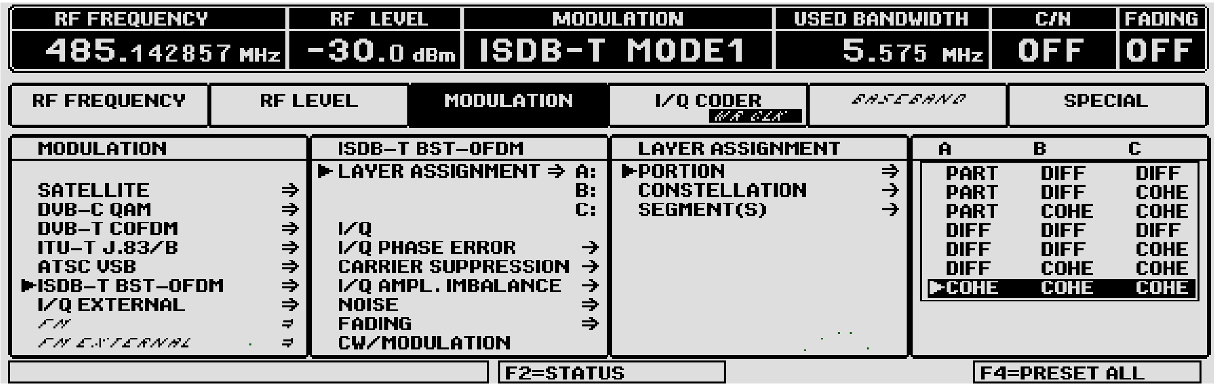


Fig.: 2.2.3-12 Assignment of the type of transmission

Four different **constellations** are available: DQSPK, QPSK, 16QAM and 64QAM. Not every constellation can be used for each type of transmission. The table below shows the possible combinations:

Type of transmission	Constellation
Partial Reception	DQPSK, QPSK, 16QAM, 64QAM
Differential Modulation	DQPSK
Coherent Modulation	QPSK, 16QAM, 64QAM

Table 2.2.3-1 Assignment of the type of transmission

Caution: *The constellation is automatically switched if the type of transmission is changed and the selected constellation is not permissible in the new type of transmission.*

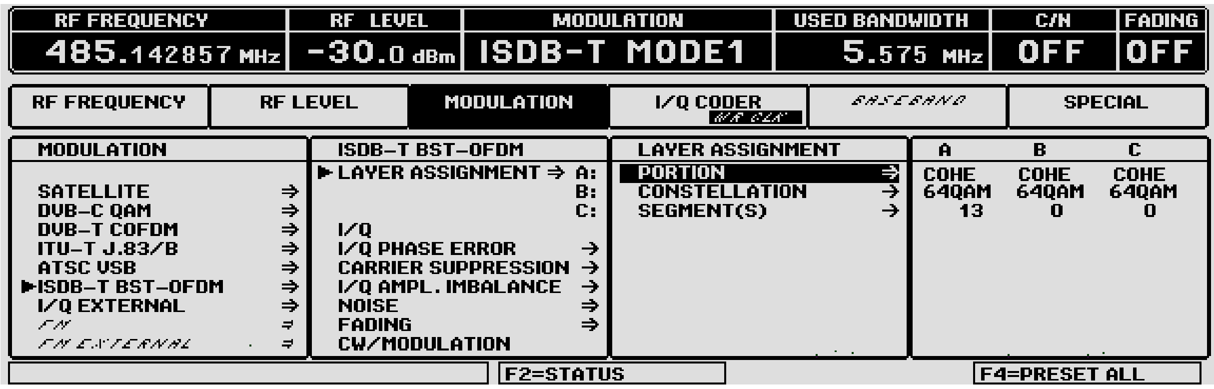


Fig.: 2.2.3-13 Possible constellations

The ISDB-T spectrum consists of 13 (OFDM) **segments**. In the Layer Assignment menu each of the three layers can be assigned the desired number of segments. The operating software always keeps the sum of the number of segments at 13.

A layer can be deactivated by assigning it zero segments. Layer A cannot be deactivated and layer B can only be deactivated if layer C is deactivated. Layer C can only be activated if layer B is activated.

If the type of transmission Partial Reception is selected it is always on layer A which can be assigned exactly one segment.

2.2.3.1.8 I/Q External

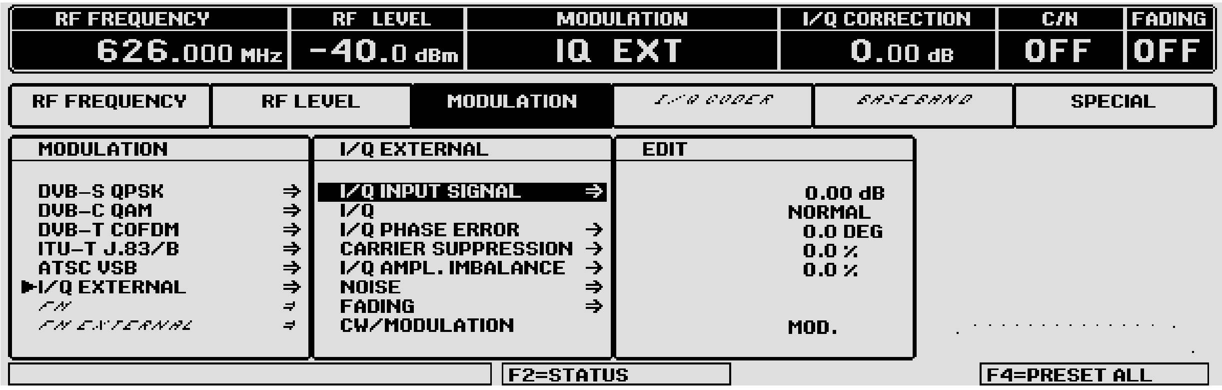


Fig.: 2.2.3-14 I/Q External

In the I/Q EXTERNAL mode, external signals can be applied for a complex modulation of the RF-carrier in the modulation I (X40.1) and Q (X40.2) input.

Menu items:

I/Q EXTERNAL

I/Q INPUT SIGNAL Entry menu for selecting the input signal for the I/Q external mode.

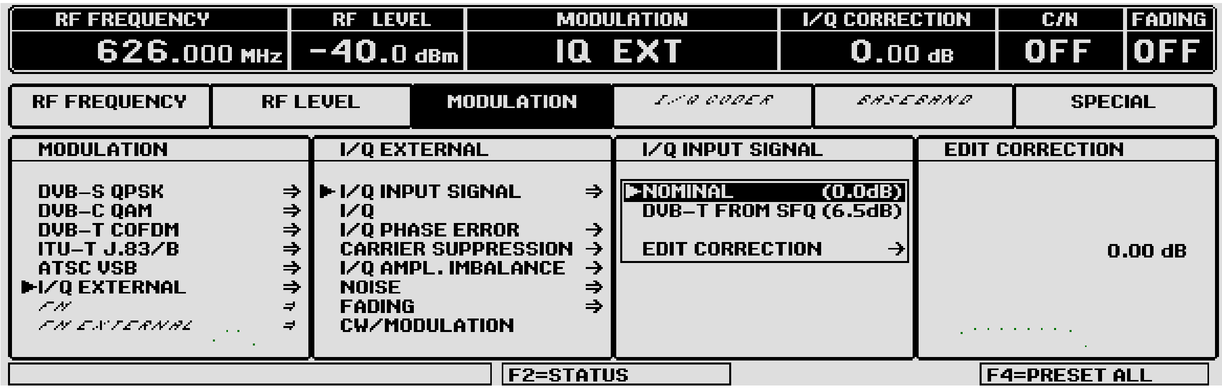


Fig.: 2.2.3-15 I/Q EXTERNAL I/Q INPUT SIGNAL

NOMINAL (0.0 dB) The display of the output level and the set C/N ratio are correct if the nominal input level 0.5 V_{pp} is applied to the external I/Q connectors. (no correction).

DVB-T FROM SFQ (6.5 dB) The display of the output level and the set C/N ratio is correct if another SFQ providing the DVB-T I and Q baseband signals delivers the input signal for the external I/Q connectors. The correction is 6.5 dB here, i.e. the applied signal level of the DVB-T I/Q baseband signal is 6.5 dB lower than the nominal level. This is taken into account in the display of the output level and in the calculation of the C/N ratio. The maximum output level is reduced by the correction factor in this case. Application: test of DVB-T diversity receivers.

EDIT CORRECTION	Input of correction values in the range of 0.00 to 40.00 dB. The correction value refers to the output level and the C/N ratio. The signal level of the applied I/Q baseband signals should not exceed the nominal input level of 0.5 V_{pp}, otherwise the modulator may be overdriven. Thus, only a small level can be applied (and so a positive correction factor can be entered). The maximum output level is reduced by the correction factor in this case.
I/Q NORMAL CHANGED	Selection of normal or changed I/Q modulation. Change of I and Q signals causes the modulation sidebands to be inverted.
I/Q NORMAL	Normal I/Q modulation
I/Q CHANGED	I and Q signals changed
I/Q PHASE ERROR →	Entry of phase error
CARRIER SUPPRESSION →	Entry of carrier leakage
I/Q AMPL. IMBALANCE →	Entry for unequal modulation of I and Q vectors.
NOISE	Entry for setting a defined C/N (carrier-to-noise) value, see section 2.2.7.
FADING	Switch-on/off of fading simulator and selection of fading parameter set to be sent, see 2.2.8.
CW / MODULATION	Switchover between modulated output signal and sinewave carrier.

Notes: *The BNC inputs for the I and Q signals are at the rear of SFQ (X40.1 = I, X40.2 = Q). The input impedance is 50 Ω, the nominal voltage for external vector modulation at the I/Q inputs V_{pp} = 0.5 V.*

External broadband AM is possible via the I input. The input sensitivity is 0.25 V for 100% AM.

2.2.3.2 MODULATION FM

2.2.3.2.1 FM internal

For satellite transmission, frequency-modulated TV signals of the TV standards PAL, SECAM and NTSC are generated by SFQ in the **FM** mode. The modulation signal is a baseband signal which consists of a video signal and one or several sound subcarriers transmitted in the ranch of 5.0 to 9.0 MHz

The video signal is limited to 5 MHz in a group-delay-corrected lowpass filter. For frequency-modulated satellite transmission, each emission must have an energy dispersal. The generated energy dispersal signal, which is a triangular voltage synchronized with the 25 Hz field-repetition frequency (NTSC 30 Hz), is superimposed upon the baseband signal.

If the video is switched off or fails, the energy dispersal deviation is automatically doubled. The video deviation and the sound subcarrier deviations provide the sum deviation displayed in the menu bar under **Σ DEVIATION**. The energy dispersal deviation is not considered in the display.

The sound subcarriers are analog frequency-modulated or digitally processed according to the ASTRA specifications. Two sound carriers are processed in a FM SUBCARRIER or ADR SUBCARRIER module. An internal DSP generates the AUDIO frequencies for the analog FM. The ADR subcarrier is generated with a built-in MUSICAM generator.

Menu items :

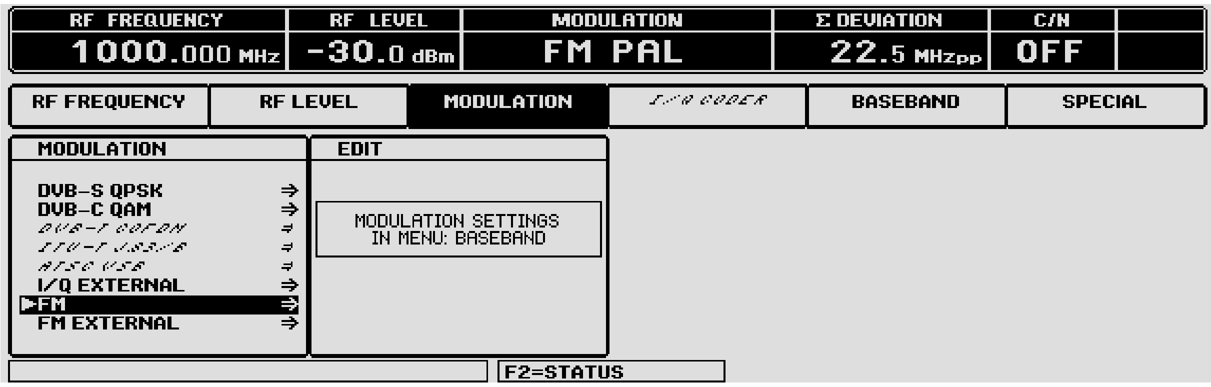


Fig.: 2.2.3-16 MODULATION FM

FM The modulation settings are made in the **BASEBAND**.

2.2.3.2.2 FM EXTERNAL

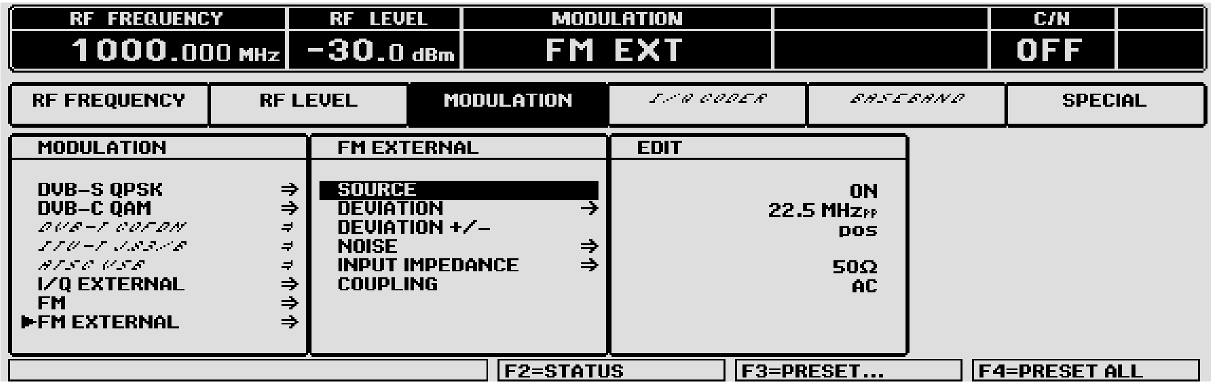


Fig.: 2.2.3-17 FM EXTERNAL

FM EXTERNAL → The menu is opened after selection of FM EXTERNAL and pressing the ENTER key.

SOURCE The input connector X30.4 for FM EXT is located at the rear of the SFQ.

ON /OFF The input for the externally applied frequency can be activated and deactivated.

DEVIATION A value between 1 to 40 MHz can be entered for the frequency deviation. The input level at connector X30.4 is always 1 V_{pp} for the entered deviation.

DEVIATION + / - The direction of deviation can be changed.

NOISE This menu item will be described in the following section.

INPUT IMPEDANCE

COUPLING Under this item the input impedance can be selected:
50 Ω, 75 Ω and high-impedance 10 kΩ.

2.2.4 I/Q CODER Menu

2.2.4.1 Satellite

2.2.4.1.1 DVB-DSNG Coding

Coding and error protection are in line with the European Standard EN 300 421 DVB (**d**igital **v**ideo **b**roadcasting), *"Framing structure, channel coding and modulation for 11/12 GHz satellite services"*.

Scrambler and sync byte inversion:

The incoming MPEG-2 transport stream is scrambled except for the sync word. The scrambler is initialized every eighth transport frame (one MPEG-2 transport frame corresponds to 188 bytes) at the time the sync word appears. The sync word is inverted at the same time (0x47 0xB8), i.e. likewise every eighth frame. This indicates, at the receiver end, the start of a scrambling sequence. Scrambling is performed to distribute energy evenly across the spectrum even with a uniform data structure present at the input.

Reed-Solomon encoder:

After scrambling, conversion of the data rate takes place. For 188 incoming bytes, the Reed-Solomon encoder (204, 188, t = 8) generates 16 additional bytes, which are appended to the 188 bytes. This means that 188 bytes are input to, and 204 bytes output by, the Reed-Solomon encoder per unit of time. The Reed-Solomon decoder at the receiver end is capable of correcting up to eight errored bytes for each frame.

Convolutional interleaver:

Reed-Solomon encoding is followed by a convolutional interleaver with a depth of I = 12 and a basic delay of M = 17. The convolutional interleaver processes the data stream byte by byte. The sync word is always transmitted in the "0" path, i.e. without delay. The deinterleaver at the receiving end operates in synchronism with the interleaver at the transmitter end. Its design is exactly reversed, however, so that identical delay is obtained for each of the 12 paths.

Convolutional encoder and puncturing with DVB-S QPSK:

In the case of DVB-S QPSK, the convolutional interleaver is followed by a convolutional encoder with a constraint length of K = 7 and a code rate of 1/2, i.e. the convolutional encoder has the effect of doubling the data rate.

Next, the data stream is punctured (i.e. data are omitted) in accordance with the puncturing rule (which is dependent on the code rate of the convolutional encoder), and mapped into the I and Q paths. The standard provides for code rates 1/2 (not punctured), 2/3, 3/4, 5/6 and 7/8.

With QPSK modulation, each of the four constellation points carries 2 bits.

"Pragmatic" trellis coding with DVB-S 8PSK and DVB-S 16QAM:

"Pragmatic" trellis coding is used with DVB-S 8PSK and DVB-S 16QAM transmission. In trellis coding there is a coded and a non-coded path. The non-coded path is mapped into the non-coded bits in the constellation diagram in accordance with the mapping table (code rate). The bits of the coded path, after undergoing convolutional encoding and puncturing, are mapped into the coded bits in the constellation diagram.

- For DVB-S 8PSK, the code rates 2/3, 5/6 and 8/9 are provided.
- For DVB-S 16QAM, the code rates 3/4 and 7/8 are provided.
- With 8PSK modulation, each of the eight constellation points carries 3 bits.
- With 16QAM modulation, each of the 16 constellation points carries 4 bits.

Baseband filtering:

In digital transmission, the I and Q baseband signals are pulse-shaped by filtering. As a result, the spectrum is limited and maximum eye aperture is obtained at the sampling points during demodulation.

With DVB-S QPSK, square root raised cosine filtering with a roll-off factor α = 0.35 is used.

With DVB-S 8PSK and DVB-S 16QAM, roll-off factors of α = 0.35 and α = 0.25 are employed.

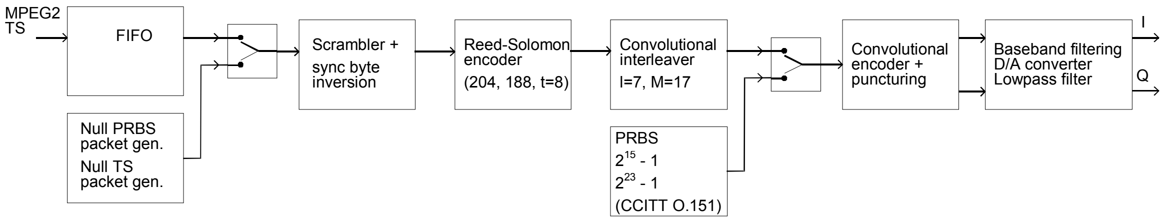


Fig. 2.2.4-1 DVB-S QPSK channel coding

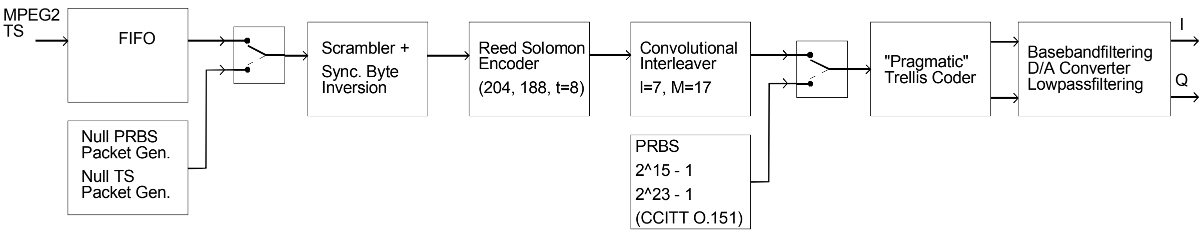


Fig. 2.2.4-2 DVB-S 8PSK and DVB-S 16QAM channel coding

2.2.4.1.2 Description of Menu Items

INPUT SELECT

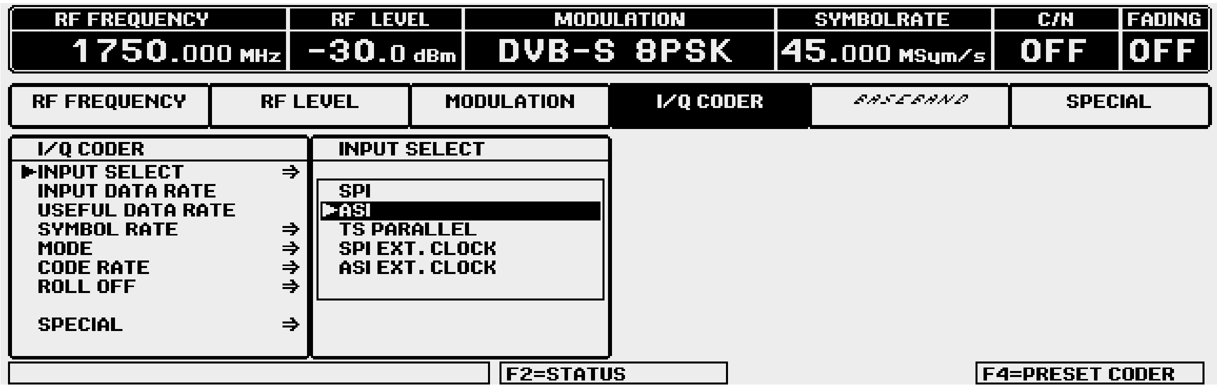


Fig. 2.2.4-3 INPUT SELECT menu

INPUT SELECT:

In this menu, the input interface for the MPEG2 transport stream can be selected. This is, however, possible only if the optional INPUT INTERFACE 2 is fitted.

If the optional INPUT INTERFACE 2 is not fitted, only the TS PARALLEL input interface can be selected.

If the optional INPUT INTERFACE 2 is fitted, all interfaces offered by the menu are available.

TS PARALLEL:

This is a synchronous parallel MPEG-2 interface with LVDS (low voltage differential signalling). It is described in EN 50 083-9.

The interface is implemented as a 25-contact D-Sub connector labelled "TS PARALLEL" on the rear of the unit.

TS PARALLEL does not change the input transport stream. It must, therefore, be ensured that the transport stream applied to SFQ has exactly the displayed (calculated) input data rate. Deviations from this nominal data rate must not exceed ±50 ppm. If a deviation exceeds 50 ppm, the warning "WR CLK" (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low so that the pull-in range is actually exceeded, the warning "UNFLOW" (underflow) or "OVFLOW" (overflow) is output.

SPI:

This is a synchronous parallel MPEG-2 interface with LVDS signalling. It is described in EN 50 083-9.

The "TS PARALLEL" connector is used.

The SPI interface changes the MPEG-2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed, and new null packets are inserted to attain the required data rate. This data rate is calculated from the selected constellation and other transmission parameters, displayed, and automatically generated by INPUT INTERFACE 2.

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

ASI:

This is an asynchronous serial interface implemented by the "ASI" BNC connector on the rear panel. It is described in EN 50 083-9.

The ASI interface changes the MPEG2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed, and new null packets are inserted to attain the required data rate. This data rate is calculated from the selected constellation and other transmission parameters, displayed, and automatically generated by INPUT INTERFACE 2.

The inserted null packets are NULL PRBS PACKETS, see under MODE. A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow. The ASI interface can handle an MPEG-2 date rate (useful data) of max. 216 Mbit/s.

SPI EXT. CLOCK:

This is a synchronous parallel MPEG-2 interface with LVDS signalling. The "TS PARALLEL" connector is used.

The SPI EXT. CLOCK interface changes the MPEG-2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed. The required data rate is determined by the frequency of the clock fed to the "TS CLOCK EXT" connector on the rear of the unit. If required, new null packets are inserted to attain the required data rate.

The clock fed to the "TS CLOCK EXT" connector must not deviate from the calculated data rate by more than ±50 ppm. If the deviation exceeds 50 ppm, the warning "WR CLK" (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low so that the pull-in range is actually exceeded, the warning "UNFLOW" (underflow) or "OVFLOW" (overflow) is output.

In the SETUP - PRESET menu, it can be selected whether the bit clock or the byte clock is to be applied to "TS CLOCK EXT".

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

ASI EXT. CLOCK:

This is an asynchronous serial interface implemented by the "ASI" BNC connector on the rear panel.

The ASI EXT. CLOCK interface changes the MPEG-2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed. The required data rate is determined by the frequency of the clock fed to the "TS CLOCK EXT" connector on the rear of the unit. If required, new null packets are inserted to attain the required data rate.

The clock fed to the "TS CLOCK EXT" connector must not deviate from the calculated data rate by more than ±50 ppm. If the deviation exceeds 50 ppm, the warning "WR CLK" (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO may be exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low so that the pull-in range is actually exceeded, the warning "UNFLOW" (underflow) or "OVFLOW" (overflow) is output.

In the SETUP - PRESET menu, it can be selected whether the bit clock or the byte clock is to be applied to "TS CLOCK EXT".

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

INPUT DATA RATE

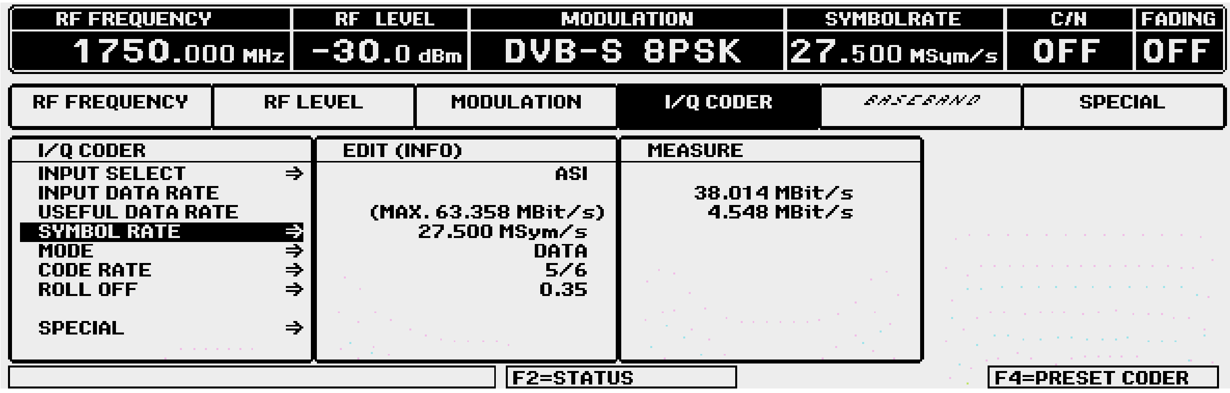


Fig. 2.2.4-4 INPUT DATA RATE

INPUT DATA RATE:

The input data rate is a measured quantity displayed in the "MEASURE" field.

The measured input data rate is displayed only if the optional INPUT INTERFACE 2 is fitted.

If, under INPUT SELECT, the TS PARALLEL input interface is selected, the nominal data rate (data rate expected at the input) is displayed in the "EDIT/(INFO)" field. The actual input data rate must not differ from the nominal data rate by more than ±50 ppm.

The following relationship applies to the input data rate and the output symbol rate, also depending on further parameters:

DR_IN_BIT = SR * (PL / 204) * CR * q

where:

DR_IN_BIT = input data rate in [Mbit/s]

SR = symbol rate in [Msymb/s]

PL = packet length [188, 204]

CR = code rate [1/2, 2/3, 3/4, 5/6, 7/8, 8/9]

q = number of bits per symbol [2, 3, 4] assigned as follows:

Constellation	Bits/symbol (q)
QPSK	2
8PSK	3
16QAM	4

USEFUL DATA RATE:

In the "MEASURE" field, the measured USEFUL DATA RATE is displayed. This is the input data rate after removal of the null packets.

The input data stream is changed by the ASI, SPI, ASI EXT. CLOCK and SPI EXT. CLOCK input interfaces, i.e. the null packets are removed. The relevant data rate, therefore, is the USEFUL DATA RATE. New null packets are added to the signal with the useful data rate to attain the required data rate.

The incoming, measured USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE displayed in the "EDIT/(INFO)" field.

The measured useful data rate is displayed only if the optional INPUT INTERFACE 2 is fitted.

SYMBOL RATE:

Symbol rates from 0.1 Msymb/s to 80 Msymb/s can be set independently of the other transmission parameters.

The symbol rate remains constant if other parameters – for example the code rate – are changed.

Frequency accuracy of symbol rate:

Data transmission (MODE = DATA):

- The frequency accuracy of the symbol rate is determined by the external MPEG2 generator if TS PARALLEL is selected as an input interface (under INPUT SELECT).
- The frequency accuracy of the symbol rate is determined by INPUT INTERFACE 2 if ASI or SPI is selected as an input interface (under INPUT SELECT).
- The frequency accuracy of the symbol rate is determined by an external clock (fed to TS CLOCK EXT) if ASI EXT. CLOCK or SPI EXT. CLOCK is selected as an input interface (under INPUT SELECT).

Internally generated signals (MODE = NULL TS PACKET, NULL PRBS PACKET, PRBS):

- The frequency accuracy of the symbol rate is determined by the reference frequency selected in the I/Q CODER - SPECIAL - PLL (INT. SIG.) menu.

MODE

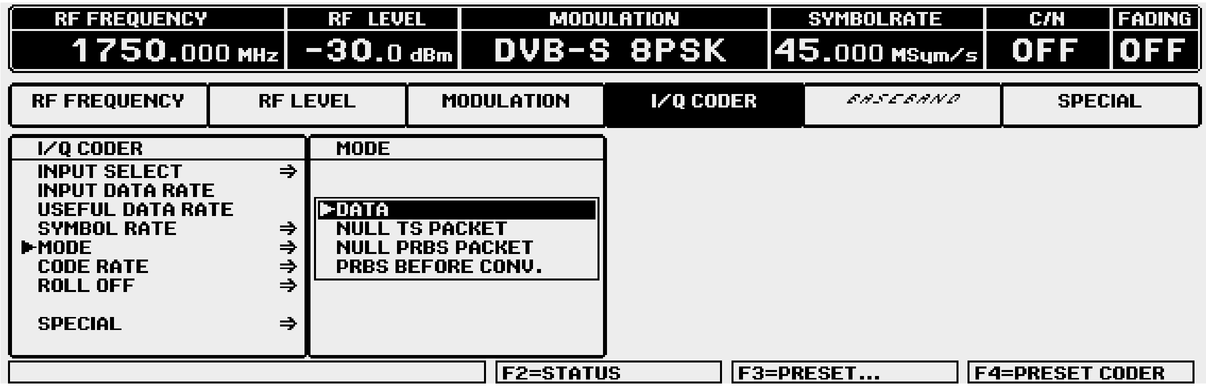


Fig. 2.2.4-5 MODE

MODE:

Under MODE, one of several operating modes can be selected.

DATA:

An externally applied MPEG-2 transport stream is processed and transmitted. If no MPEG-2 transport stream is present, the test transmitter detects the absence of data and automatically switches to PRBS BEFORE CONV. to ensure uniform spectral distribution of the signal. When data are detected at the input again, the test transmitter resumes processing of the external data stream.

NULL TS PACKET:

The internal coder generates null packets with the PID "0x1FFF" and the payload "0x00".

The header of the null packets comprises four bytes as follows:

0x47, 0x1F, 0xFF, 0x10

The header is followed by the 184-byte payload.

NULL PRBS PACKET:

The internal coder generates null packets with the PID "0x1FFF". As a payload, a continuous PRBS (pseudo random bit sequence) is transmitted. The PRBS is transmitted byte by byte, following the DVB principle of "MSB first". A PRBS sequence of 2^{23} - 1 or 2^{15} - 1 (to CCITT O.151) can be selected in the SETUP - PRESET - PRBS SEQUENCE menu.

PRBS BEFORE CONV.:

A PRBS sequence is inserted directly before the convolutional encoder. A PRBS sequence of 2^{23} - 1 or 2^{15} - 1 (to CCITT O.151) can be selected in the SETUP - PRESET - PRBS SEQUENCE menu.

Note:	*The internal NULL TS PACKET and NULL PRBS PACKET signals are valid MPEG2 transport streams. Because these signals are internally generated, no settling time (as a function of the fullness of the FIFO) is required. Any changes to transmission parameters (for example to the symbol rate) necessitating a change of the input data rate are, therefore, completed faster.* *If in doubt which one of the internally generated MPEG2 signals to choose, the NULL PRBS PACKET signal is the preferable choice because it provides a more uniform spectral distribution of energy.*

CODE RATE

CODE RATE for MODULATION - CONSTELLATION = DVB-S QPSK

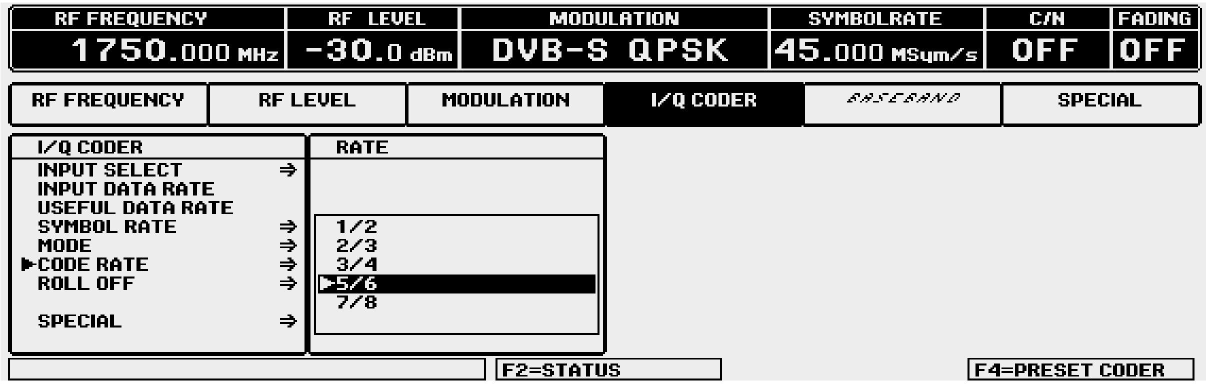


Fig. 2.2.4-6 CODE RATE for MODULATION - CONSTELLATION = DVB-S 8PSK

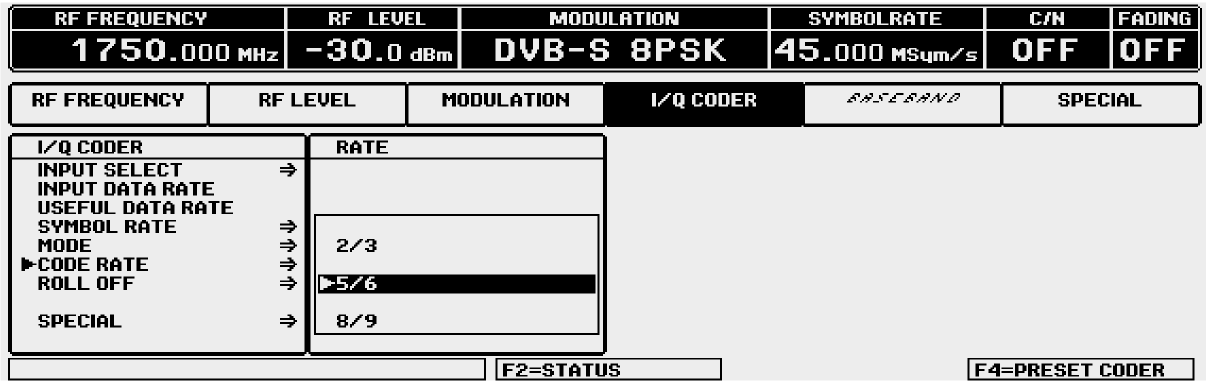


Fig. 2.2.4-7 CODE RATE for MODULATION - CONSTELLATION = DVB-S 16QAM

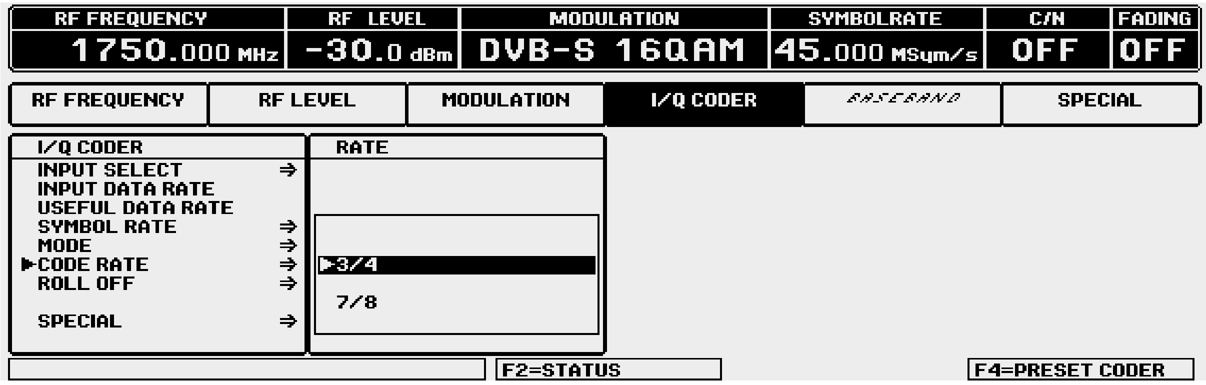


Fig. 2.2.4-8 CODE RATE for MODULATION - CONSTELLATION = DVB-S 16QAM

CODE RATE:

For DVB-S QPSK, the following code rates are selectable:	1/2, 2/3, 3/4, 5/6, 7/8
For DVB-S 8PSK, the following code rates are selectable:	2/3, 5/6, 8/9
For DVB-S 16QAM, the following code rates are selectable:	3/4, 7/8

ROLL OFF

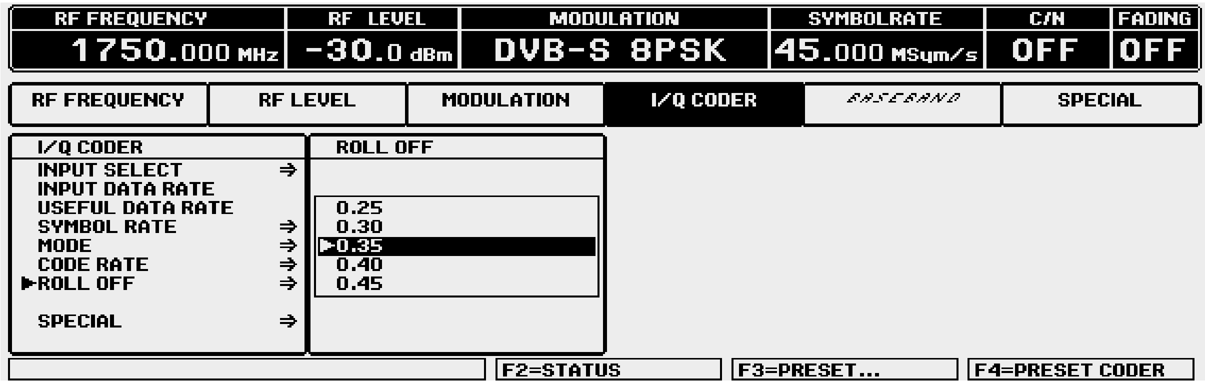


Fig. 2.2.4-9 ROLL OFF

ROLL OFF:

The following roll-off factors can be selected for square root raised cosine filtering:

0.25, 0.30, 0.35, 0.40, 0.45

For DVB-S QPSK, the standard provides for a roll-off factor $\alpha = 0.35$.

For DVB-S 8PSK and DVB-S 16QAM, the standard provides for a roll-off factor $\alpha = 0.25$ or $\alpha = 0.35$.

SPECIAL

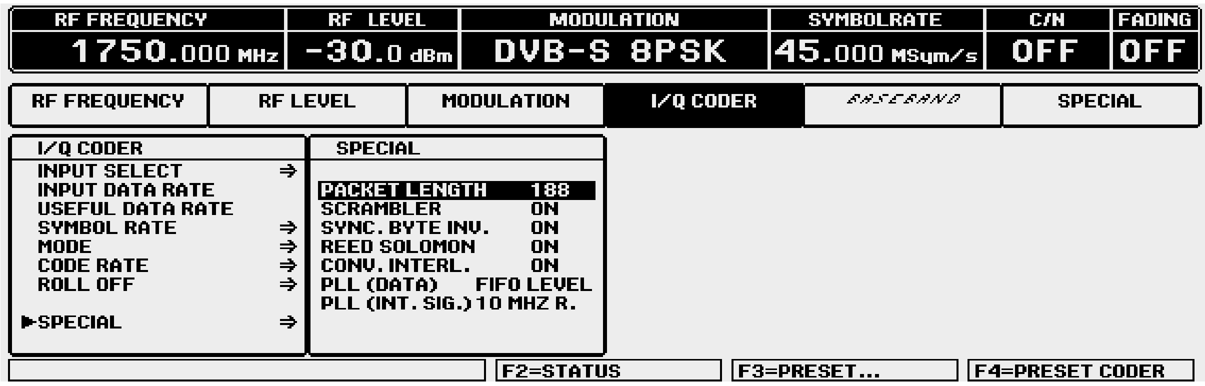


Fig. 2.2.4-10 SPECIAL

SPECIAL:

PACKET LENGTH:

The transport stream fed to the test transmitter normally has a frame length (packet length) of 188 bytes. The frame length can be changed to 204 bytes. The last 16 bytes of each frame are overwritten by the Reed-Solomon encoder. If the actual frame length of the input data stream does not match the packet length set for the coder, the error message "FRM ERR" (frame error) is output in the I/Q CODER field of the menu bar.

The DVALID signal at the TS PARALLEL or SPI input is not evaluated.

SCRAMBLER:

The scrambling function, i.e. energy dispersal, can be switched off. Sync word inversion (0x47 0xB8) in the first of each eight frames of an MPEG2 transport stream is continued, however.

SYNC. BYTE INV:

Sync word inversion (0x47 ⟶ 0xB8) in the first of each eight frames of an MPEG-2 transport stream can be switched off.

REED SOLOMON:

The Reed-Solomon encoder can be switched off. The first 188 bytes of a transport stream are transmitted unchanged, same as with the Reed-Solomon encoder switched on.

For input transport streams with 188 byte frame length, 16 bytes are appended to each frame. If the Reed-Solomon encoder is switched on, the 16 bytes are read from the Reed-Solomon encoder; if it is switched off, the 16 bytes are not defined.

For PACKET LENGTH = 204, the frame length is 204 bytes. If the Reed-Solomon encoder is switched on, the last 16 bytes are overwritten; if it is switched off, the 204 bytes remain unchanged.

For data streams already Reed-Solomon coded, scrambling and sync word inversion must be performed in line with the standard before the data streams are applied to the test transmitter input.

For such data streams, the scrambling function, sync word inversion and Reed-Solomon encoding must be switched off and the packet length set to 204 bytes.

CONV. INTERL.

The convolutional interleaver can be switched off. The incoming data are then routed on unchanged.

PLL (DATA):

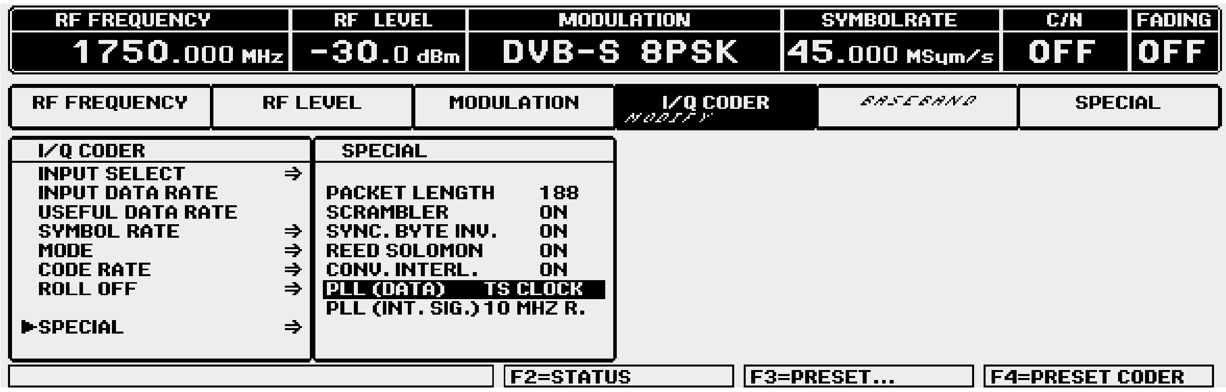


Fig. 2.2.4-11 PLL (DATA)

For data transmission, i.e. if MODE = DATA is selected, the symbol rate must be matched to the input data rate to avoid any overflow or underflow of the input FIFO of the coder. The pull-in range of the VCXO is ±50 ppm. The signals and clock rates determining the frequency accuracy of the symbol rate are described in section SYMBOL RATE.

For data transmission, the symbol clock can be controlled in two ways:

FIFO LEVEL: the symbol clock is controlled so that the FIFO is on average half filled. This is the recommended setting.

TS CLOCK: the input transport stream clock as well as the oscillator clock are divided to give two integer figures. If TS CLOCK is selected, the warning "MODIFY" is output in the I/Q CODER field of the menu bar.

PLL (INT. SIG.):

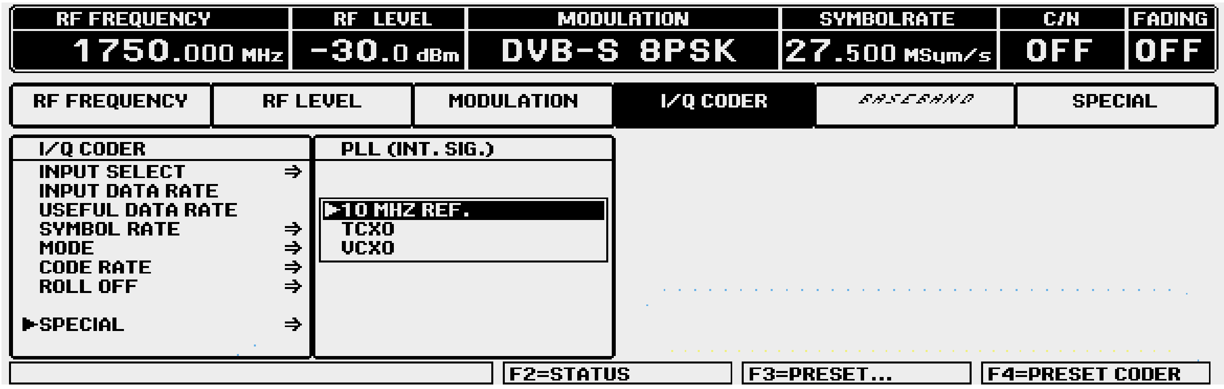


Fig. 2.2.4-12 PLL(INT.SIG.)

With internal signals, i.e. with MODE = NULL TS PACKET, NULL PRBS PACKET or PRBS BEFORE CONV., the symbol rate can be locked to various reference frequencies. The input FIFO of the coder is inactive.

One of three reference frequencies can be selected for internal signals:

10 MHz REF.: The symbol clock is controlled by the 10 MHz reference of SFQ. This is the recommended setting.

The 10 MHz reference of SFQ can itself be used as a reference, or locked to an external 10 MHz reference signal. This can be selected under SETUP - PRESET – 10 MHz REFERENCE: INTERNAL or EXTERNAL.

If the 10 MHz SFQ reference is locked to an external reference signal (pull-in range ±3 ppm) and PLL (INT. SIG.) = 10 MHz REF. is selected, the symbol rate too is locked to the external reference.

Example: *If the external reference is exactly 10 MHz, the symbol rate will be exactly 10 Msymb/s. If the external reference is higher by 1 ppm, i.e. by 10 Hz (resulting in 10000010 Hz), the symbol rate will also be higher by 1 ppm. For a symbol rate of 27.5 Msymb/s, the 1 ppm increase corresponds to +27.5 Hz, so that 27.5000275 Msymb/s is obtained.*

TCXO: The symbol clock is controlled by a TCXO (temperature-compensated crystal oscillator) on the coder module.

VCXO: The symbol clock is controlled by a VCXO (voltage-controlled crystal oscillator) on the coder module, the VCXO being tuned with a fixed input voltage.

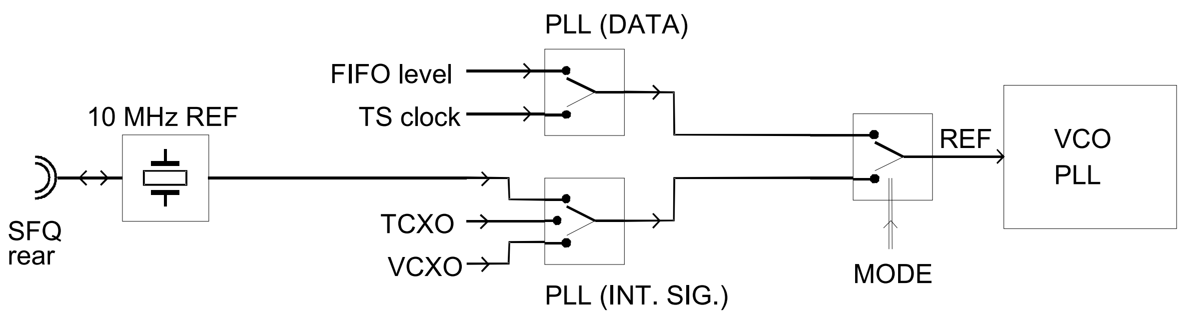


Fig. 2.2.4-13 **Reference clock for CS+ coder**

Error messages and warnings that may be output in the I/Q CODER field of the menu bar:

Message	Meaning	Cause	Remedy
MODIFY	Warning	A setting deviating from the standard was made.	Select the I/Q CODER menu: the PRESET CODER softkey (F4) is available. By pressing this softkey, any settings deviating from the standard are cancelled, and the warning disappears.
NO DAT	Error	No input data is present.	Check if a transport stream is present at the selected MPEG2 input.
NO CLK	Error	No input clock is present.	Check if a transport stream is present at the selected MPEG-2 input. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal is present and if its level (TTL) is high enough.
WR CLK	Warning	Input clock deviates by more than ±50 ppm.	If the TS PARALLEL input interface is selected, check the data rate of the MPEG-2 input transport stream. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
OVFLOW	Error	FIFO overflow	If the TS PARALLEL input interface is selected, check if the MPEG-2 input data rate is high. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
UNFLOW	Error	FIFO underflow	If the TS PARALLEL input interface is selected, check if the MPEG2 input data rate is low. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
FRMERR	Error	Frame error – no valid transport stream is present, i.e. the sync byte is located in the wrong position or is missing.	Check if the packet length of the input transport stream matches the packet length set in the coder.
NO REF	Error	Reference clock is missing if internal signals (MODE ≠ DATA) and PLL (INT. SIG.) = 10 MHz REF. are selected.	Immediate solution: select TCXO or VCXO under I/Q CODER - SPECIAL – PLL (INT. SIG.). Long-term solution: call in service, have cables checked.
UNLOCK	Error	Oscillator (VCO) has not locked.	Call in service.
ERROR	Error	PLL ERROR or DC SUPPLY ERROR	Details see under SETUP/INFO - HARDWARE - SELFTEST CSPL Call in service

Table 2.2.4-1 Error messages and warnings

2.2.4.1.3 Turbo Coding (Option SFQ-B25)

High-order modulation modes (e.g. 8PSK) used to increase bit rates call for higher S/N ratio requirements to be met during transmission. The drawback is the direction from the satellite to the earth since the transmit power of already installed satellites cannot be increased.

The solution to this problem is the use of efficient channel coding methods resulting in a higher coding gain than that of convolutional codes used so far.

The maximum coding gain is obtained by making use of turbo codes which allow what is currently the most powerful decoding method, also known as iterative decoding.

Turbo codes result in a coding gain that increases transmission capacity to within a few tenths of dB of the channel capacity defined by Shannon.

The turbo coder implemented in the R&S SFQ is based on a proprietary method of STMicroelectronics.

Turbo coding

Inner and outer error correction:

To protect data during error-prone satellite transmission, all satellite standards consist of a concatenated error correction mechanism divided into inner and outer error correction.

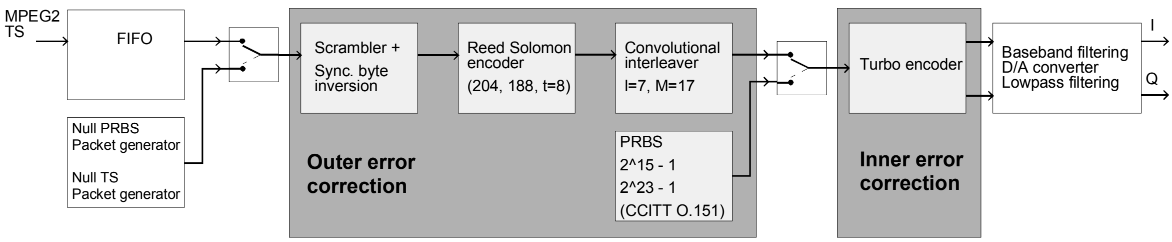


Fig. 2.2.4-14 Channel coding in Turbo mode

Outer error protection (identical to DVB-DSNG)

Scrambler and sync byte inversion:

The entire incoming MPEG2 transport stream except for the sync word is scrambled. The scrambler continues to run. The scrambler is initialized every eight transport frames (one MPEG2 transport frame corresponds to 188 bytes) at the time the sync word appears. This sync word is inverted at the same time (0x47 becomes 0xB8). To the receiver end, this indicates the start of a scrambling sequence. Scrambling is performed to distribute energy evenly across the spectrum even if a very uniform data structure is present at the input.

Reed Solomon encoder:

After scrambling, conversion of the data rate takes place. For 188 incoming bytes, the Reed-Solomon encoder (204, 188, t = 8) generates 16 additional bytes, which are appended to the 188 bytes. This means that 188 bytes are input to and 204 bytes are output by the Reed-Solomon encoder per unit of time. The Reed-Solomon decoder at the receiver end is capable of correcting up to eight erroneous bytes for each frame.

Convolutional interleaver:

Reed-Solomon encoding is followed by a convolutional interleaver with a depth of I = 12 and a basic delay of M = 17. The convolutional interleaver processes the data stream bytewise. The sync word is always transmitted in the "0" path, i.e. without delay. A deinterleaver at the receiving end operates in synchronism with the interleaver at the transmitter end. Its design is exactly reversed, however, so that identical delay is obtained for each of the 12 paths.

Inner error correction (turbo coding)

Turbo encoder and puncturing in the QPSK turbo and 8PSK turbo modes:

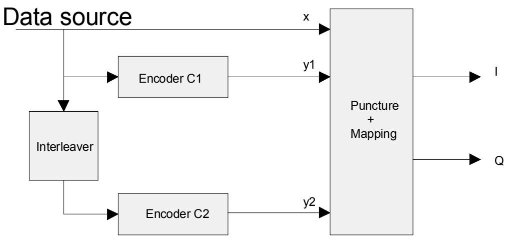


Fig. 2.2.4-15 Structure of turbo encoder

The structure of the turbo coder consists of two parallel recursive convolutional coders and a pseudo random block interleaver (see Fig. 2.2.4-15).

An information block is fed to the first encoder and coded (y1). The original data block is written to an interleaver whose output is the input for the second encoder (output y2). The right interleaver algorithm plays an important role in overall coder performance.

A pseudo random block interleaver (according to an algorithm of Berrou, Glavieux) is used for which information is written in line-by-line but read out in a quasi-random sequence.

The interleaver decouples the code words generated by the two encoders and thus allows you to determine separate decoding probabilities for the two decoder paths in the receiver.

The interleaver also ensures that the set of code words generated by the encoders is of favourable weight. This reduces the probability of the decoder determining incorrect code words.

The original data block (in systematic path x) and the outputs from the encoders (y1 and y2) are multiplexed, punctured, mapped and transmitted in the traffic channel.

The symbol stream is packetized to speed up receiver synchronization. The size of the symbol packet is variable and determined by the interleaver memory depth (2048 bits) and puncturing. A symbol packet starts with four syncmotif symbols which pass through a fixed sequence in the constellation diagram.

Modulation modes

Modulation modes QPSK-Turbo and 8PSK-Turbo are available in the Turbo mode.

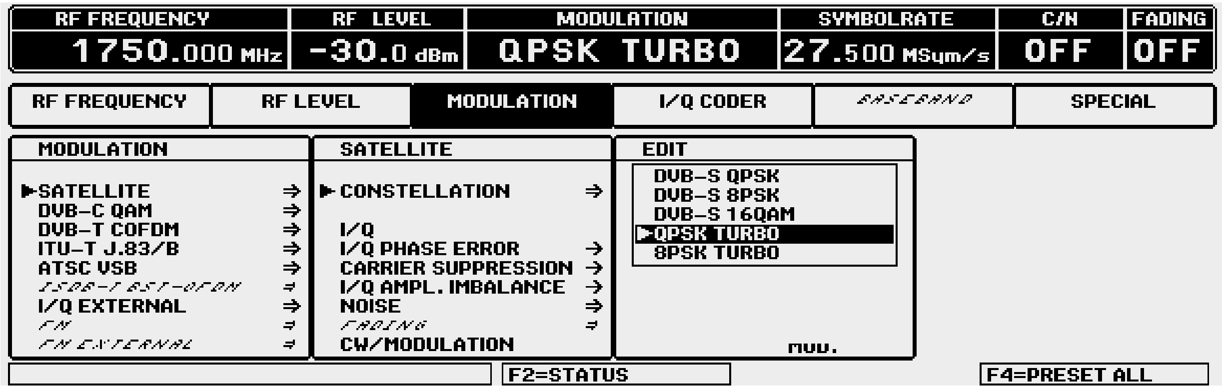


Fig. 2.2.4-16

- Code rates 2/3, 3/4 are implemented for QPSK-Turbo.
- Code rates 1/3, 2/3, 3/4 and 8/9 are implemented for 8PSK-Turbo.
- With 8PSK-Turbo modulation, each of the eight constellation points carries 3 bits.
- With QPSK-Turbo modulation, each of the eight constellation points carries 2 bits.

Baseband filtering:

In digital transmission, the I and Q baseband signals are pulse-shaped by filtering. As a result, the spectrum is limited and maximum eye aperture is obtained at the sampling points during demodulation.

2.2.4.1.4 Description of Menu Items

INPUT SELECT

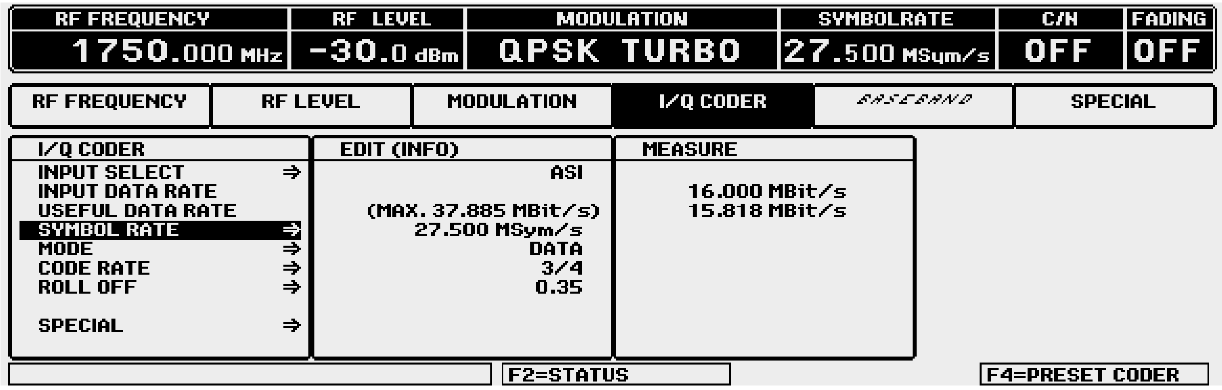


Fig. 2.2.4-17 INPUT SELECT menu

INPUT SELECT:

In this menu, the input interface for the MPEG2 transport stream can be selected. This is possible, however, only if the optional INPUT INTERFACE 2 is installed.

If the optional INPUT INTERFACE 2 is not installed, only the TS PARALLEL input interface can be selected.

If the optional INPUT INTERFACE 2 is installed, all interfaces offered by the menu are available.

TS PARALLEL:

This is a synchronous parallel MPEG2 interface with LVDS (low voltage differential signalling). It is described in EN 50 083-9.

The interface is implemented as a 25-contact D-Sub connector labelled TS PARALLEL on the rear of the unit.

TS PARALLEL does not change the applied transport stream. It must, therefore, be ensured that the transport stream applied to SFQ has exactly the displayed (calculated) input data rate. Deviations from this nominal data rate must not exceed +-50 ppm. If a deviation exceeds 50 ppm, the warning WR CLK (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low, thus causing the pull-in range to be exceeded, the warning UNFLOW (underflow) or OVFLOW (overflow) is output.

SPI:

This is a synchronous parallel MPEG2 interface with LVDS. It is described in EN 50 083-9.

The TS PARALLEL connector is used.

Selection of the SPI interface changes the MPEG2 transport stream. The incoming null packets (PID = 0x1FFF) are removed, and new null packets are inserted to attain the required data rate. This data rate is calculated from the selected constellation and other transmission parameters, displayed, and automatically generated by INPUT INTERFACE 2.

The inserted null packets are NULL PRBS PACKETS; see MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, because, otherwise, the FIFO will overflow.

ASI:

This is an asynchronous serial interface implemented by the ASI BNC connector on the rear panel. It is described in EN 50 083-9.

Selection of the API interface changes the MPEG2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed, and new null packets are inserted to attain the required data rate. This data rate is calculated from the selected constellation and other transmission parameters, displayed, and automatically generated by INPUT INTERFACE 2.

The inserted null packets are NULL PRBS PACKETS; see MODE. A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, because, otherwise, the FIFO will overflow. The ASI interface can handle a maximum MPEG2 date rate (useful data) of 216 Mbit/s.

SPI EXT. CLOCK:

This is a synchronous parallel MPEG2 interface with LVDS. The TS PARALLEL connector is used.

Selection of the SPI EXT. CLOCK interface changes the MPEG2 transport stream. The incoming null packets (PID = 0x1FFF) are removed. The required data rate is determined by the frequency of the clock fed to the TS CLOCK EXT (connector on the rear of the unit). If required, new null packets are inserted to attain the required data rate.

The clock fed to the TS CLOCK EXT connector must not deviate from the calculated data rate by more than ±50 ppm. If a deviation exceeds 50 ppm, the warning WR CLK (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low, thus causing the pull-in range to be exceeded, the warning UNFLOW (underflow) or OVFLOW (overflow) is output.

From the SETUP - PRESET menu, you can select whether the bit clock or the byte clock is to be fed to the TS CLOCK EXT connector.

The inserted null packets are NULL PRBS PACKETS; see MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, because, otherwise, the FIFO will overflow.

ASI EXT. CLOCK:

This is an asynchronous serial interface implemented by the ASI BNC connector on the rear panel.

The SPI EXT. CLOCK interface changes the MPEG2 transport stream. The incoming null packets (PID = 0x1FFF) are removed. The required data rate is determined by the frequency of the clock fed to the TS CLOCK EXT (connector on the rear of the unit). If required, new null packets are inserted to attain the required data rate.

The clock fed to the TS CLOCK EXT connector must not deviate from the calculated data rate by more than ±50 ppm. If a deviation exceeds 50 ppm, the warning WR CLK (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low, thus causing the pull-in range to be exceeded, the warning UNFLOW (underflow) or OVFLOW (overflow) is output.

From the SETUP - PRESET menu, you can select whether the bit clock or the byte clock is to be fed to the TS CLOCK EXT connector.

The inserted null packets are NULL PRBS PACKETS; see MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, because, otherwise, the FIFO will overflow.

INPUT DATA RATE

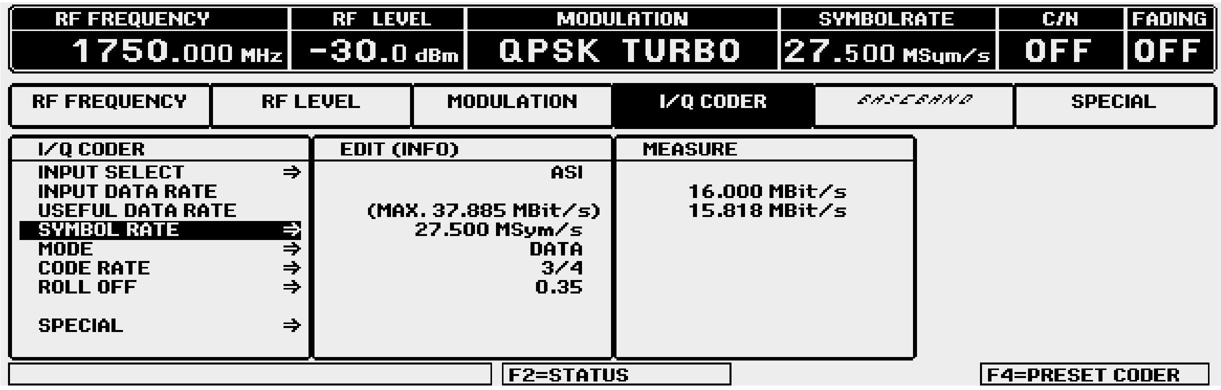


Fig. 2.2.4-18 INPUT DATA RATE

INPUT DATA RATE:

The input data rate is a measured quantity displayed in the MEASURE field.

The measured input data rate is displayed only if the optional INPUT INTERFACE 2 is installed.

If, under INPUT SELECT, the TS PARALLEL input interface is selected, the nominal data rate (data rate expected at the input) is displayed in the EDIT/(INFO) field. The actual input data rate must not differ from the nominal data rate by more than ±50 ppm.

The following relationship applies to the input data rate and the output symbol rate, also depending on further parameters:

DR_IN_BIT = SR * (PL / 204) * CR * q * m_Turbo

The following applies to the m_Turbo variable:

m_turbo =2048/[(ceil(2048/(CR *q)) + SML) * q]

SML: SyncMotifLength = const. = 4

DR_IN_BIT: input data rate in [MBit/s]

SR: symbol rate in [MS/s]

PL: packet length [188, 204]

CR: code rate [1/2, 2/3, 3/4, 8/9]

q: number of bits per symbol [2, 3]

Constellation	Bits/symbol q
QPSK	2
8 PSK	3

USEFUL DATA RATE:

In the MEASURE field, the measured USEFUL DATA RATE is displayed. This is the input data rate after removal of the null packets.

The ASI, SPI, ASI EXT. CLOCK and SPI EXT. CLOCK change the data stream, i.e. the null packets are removed. Therefore, the USEFUL DATA RATE is a crucial factor. New null packets are added to the signal with the useful data rate to attain the required data rate.

The incoming, measured USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE displayed in the EDIT/(INFO) field.

The measured useful data rate is displayed only if the optional INPUT INTERFACE 2 is installed.

SYMBOL RATE

Symbol rates from 0.1 Msymb/s to 80 Msymb/s can be set independently of the other transmission parameters.

The symbol rate remains constant if other parameters – for example, the code rate – are changed.

Frequency accuracy of symbol rate:

For data transmission (MODE = DATA):

- The frequency accuracy of the symbol rate is determined by the external MPEG2 generator if TS PARALLEL is selected as an input interface (under INPUT SELECT).
- The frequency accuracy of the symbol rate is determined by INPUT INTERFACE 2 if ASI or SPI is selected as an input interface (under INPUT SELECT).
- The frequency accuracy of the symbol rate is determined by the applied clock (TS EXT. CLOCK) if ASI EXT CLOCK or SPI EXT CLOCK is selected as an input interface (INPUT SELECT).

For internally generated signals (MODE = NULL TS PACKET, NULL PRBS PACKET, PRBS), the frequency accuracy of the symbol rate is determined by the reference frequency selected in the I/Q CODER - SPECIAL - PLL (INT. SIG.) menu.

MODE

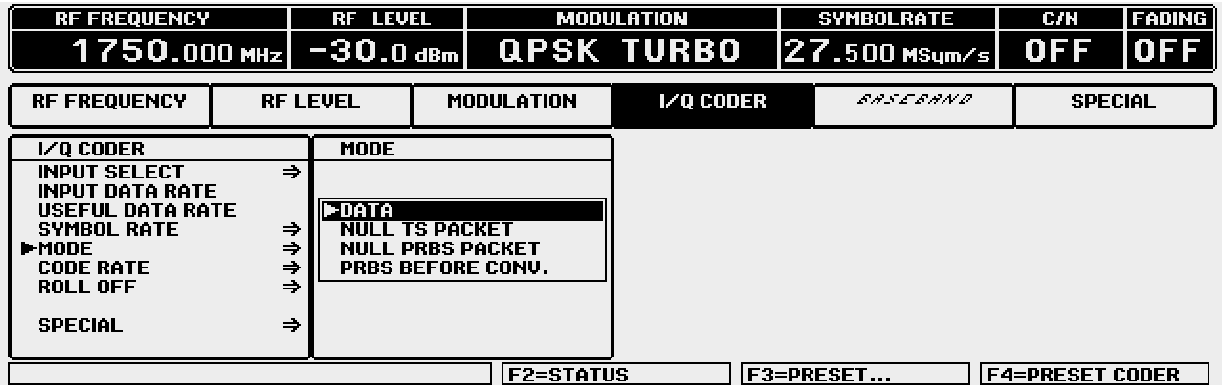


Fig. 2.2.4-19 MODE

MODE:

Under MODE, one of several operating modes can be selected.

DATA: An externally applied MPEG2 transport stream is processed and transmitted. If no MPEG2 transport stream is present, the test transmitter detects the absence of data and automatically switches to PRBS BEFORE CONV. to ensure uniform spectral distribution of the signal. When data is detected at the input again, the test transmitter resumes processing of the external data stream.

NULL TS PACKET:

The internal coder generates null packets with the PID 0x1FFF and the payload 0x00.

The header of the null packets consists of four bytes as follows:

0x47, 0x1F, 0xFF, 0x10

The header is followed by the 184-byte payload.

NULL PRBS PACKET:

The internal coder generates null packets with the PID 0x1FFF. The payload of the packets is filled with a continuous PRBS (pseudo random bit sequence). The PRBS is transmitted bytewise, following the DVB principle of "MSB first". A PRBS sequence of 2^{23} - 1 or 2^{15} - 1 (in accordance with CCITT O.151) can be selected in the SETUP - PRESET - PRBS SEQUENCE menu.

PRBS BEFORE CONV.:

A PRBS sequence is inserted directly before the convolutional encoder. A PRBS sequence of 2^{23} - 1 or 2^{15} - 1 (in accordance with CCITT O.151) can be selected in the SETUP - PRESET - PRBS SEQUENCE menu.

Note:	*The internal NULL TS PACKET and NULL PRBS PACKET signals are valid MPEG2 transport streams. Since these signals are internally generated, no settling time (as a function of the FIFO fill level) is required. Any changes to transmission parameters (for example, to the symbol rate) necessitating a change to the input data rate are, therefore, completed faster.* *If you are unsure which of the internally generated MPEG2 signals to choose, the NULL PRBS PACKET signal is the preferable choice because it provides a more uniform spectral distribution of energy.*

CODE RATE

CODE RATE for MODULATION - CONSTELLATION = DVB-S QPSK

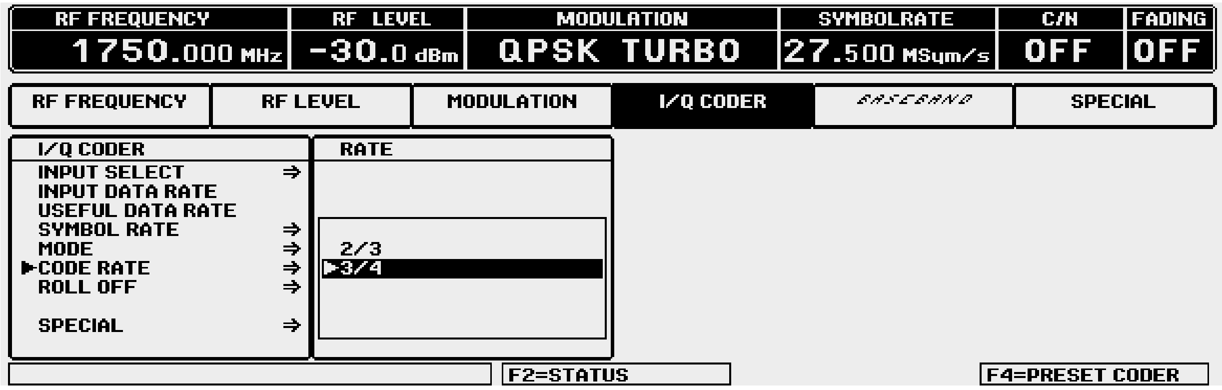


Fig. 2.2.4-20 CODE RATE if MODULATION - CONSTELLATION = QPSK-TURBO

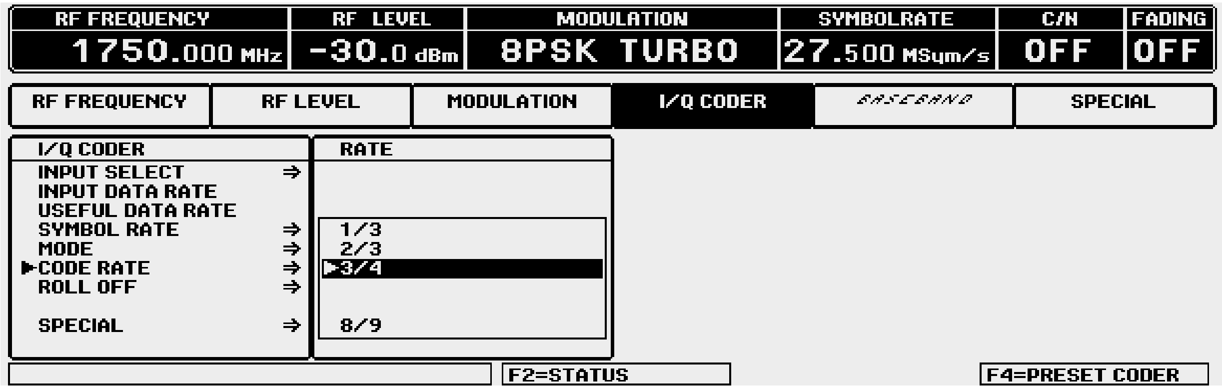


Fig. 2.2.4-21 CODE RATE if MODULATION - CONSTELLATION = 8PSK-TURBO

CODE RATE:

The following coder rates can be set for QPSK-Turbo: 2/3, 3/4

The following coder rates can be set for 8PSK-Turbo: 1/3, 2/3, 3/4, 8/9

ROLL OFF

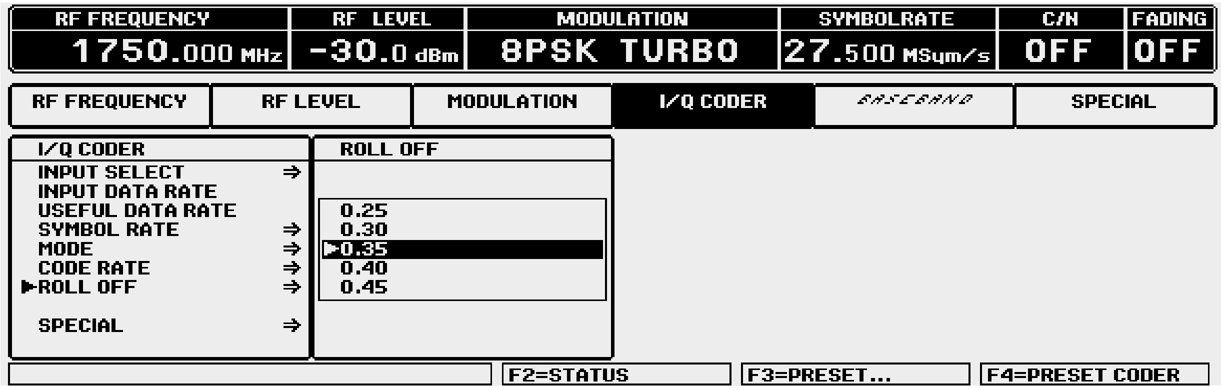


Fig. 2.2.4-22 ROLL OFF

ROLL OFF:

The following roll-off factors can be selected for square root raised cosine filtering:

0.25, 0.30, 0.35, 0.40, 0.45

SPECIAL

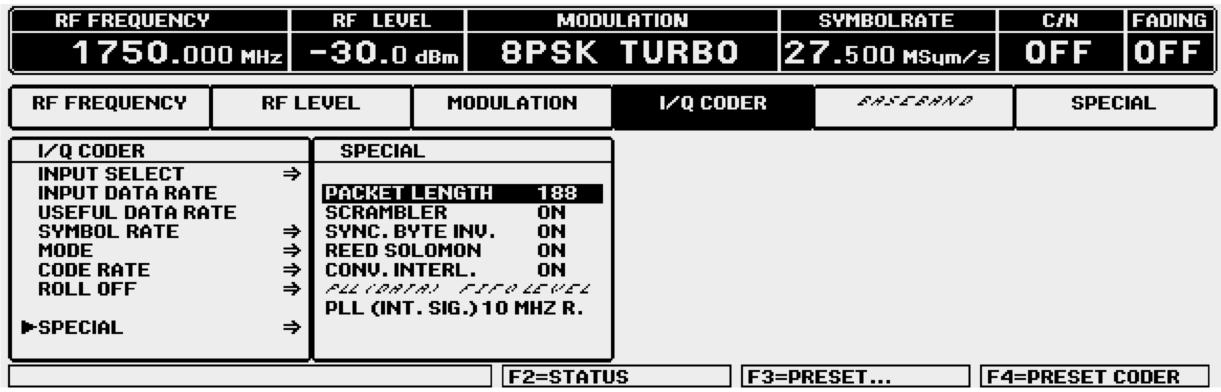


Fig. 2.2.4-23 SPECIAL

SPECIAL:

PACKET LENGTH:

The transport stream fed to the test transmitter normally has a frame length of 188 bytes. The frame length can be changed to 204 bytes. The last 16 bytes of each frame are overwritten by the Reed-Solomon encoder. If the actual frame length of the input data stream does not match the packet length set for the coder, the error message FRM ERR (frame error) is output in the I/Q CODER field of the menu bar.

The DVALID signal at the TS PARALLEL or SPI input is not evaluated.

SCRAMBLER:

The scrambling function, i.e. energy dispersal, can be switched off. Sync word inversion (0x47 -> 0xB8) in the first of each eight frames of an MPEG2 transport stream is continued, however.

SYNC. BYTE INV:

Sync word inversion (0x47 ⟶ 0xB8) in the first of each eight frames of an MPEG2 transport stream can be switched off.

REED SOLOMON:

The Reed-Solomon encoder can be switched off. The first 188 bytes of the transport stream are transmitted unchanged, the same as with the Reed-Solomon encoder switched on.

For input transport streams with 188 byte frame length, 16 bytes are appended to each frame. If the Reed-Solomon encoder is switched on, the 16 bytes are read from the Reed-Solomon encoder; if it is switched off, the 16 bytes are not defined.

For PACKET LENGTH = 204, the frame length is 204 bytes. If the Reed-Solomon encoder is switched on, the last 16 bytes are overwritten; if it is switched off, the 204 bytes remain unchanged.

For data streams already Reed-Solomon coded, scrambling and sync word inversion must be performed in line with the standard before the data streams are applied to the test transmitter input.

The scrambler, sync word inversion and the Reed-Solomon encoder must then be switched off. The packet length must be set to 204 byte.

CONV.INTERL.

The convolutional interleaver can be switched off. The incoming data are then forwarded unchanged.

PLL(DATA) FIFO LEVEL:

For data transmission, i.e. if MODE = DATA is selected, the symbol rate has to be matched to the input data rate to avoid overflow or underflow of the input FIFO of the coder. The pull-in range of the VCXO is ±50 ppm. The signals and clock rates determining the frequency accuracy of the symbol rate are described in ⟶ section SYMBOL RATE.

In the Turbo Coder mode, operation is always adjusted to the FIFO fill level: the symbol clock is adjusted so that the FIFO is on average half full.

PLL(INT.SIG.):

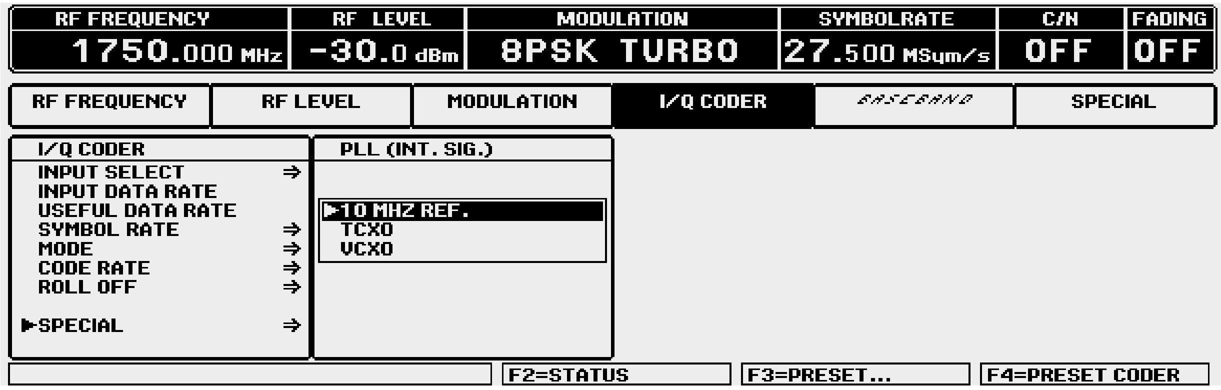


Fig. 2.2.4-24 PLL(INT.SIG.)

With internal signals, i.e. with MODE = NULL TS PACKET, NULL PRBS PACKET or PRBS BEFORE CONV. selected, the symbol rate can be locked to various reference frequencies. The input FIFO of the coder is inactive.

One of three reference frequencies can be selected for internal signals:

10 MHz REF.: The symbol clock is controlled by the 10 MHz reference of the R&S SFQ. This is the recommended setting.

The 10 MHz reference of the R&S SFQ can itself be used as a reference, or locked to an external 10 MHz reference signal. This can be selected under SETUP - PRESET – 10 MHz REFERENCE: INTERNAL or EXTERNAL.

If the 10 MHz SFQ reference is locked to an external reference signal (pull-in range ±3 ppm) and PLL (INT. SIG.) = 10 MHz REF. is selected, the symbol rate is also locked to the external reference.

Example: *If the external reference is exactly 10 MHz, the symbol rate will be exactly 10 Msymb/s. If the external reference is 1 ppm too high, i.e. 10 Hz (resulting in 10000010 Hz), the symbol rate will also be 1 ppm too high. For a symbol rate of 27.5 Msymb/s, this means +27.5 Hz, thus yielding 27.5000275 Msymb/s.*

TCXO: The symbol clock is controlled by a TCXO (temperature-compensated crystal oscillator) on the coder module.

VCXO: The symbol clock is controlled by a VCXO (voltage-controlled crystal oscillator) on the coder module, where the VCXO is tuned with a fixed input voltage.

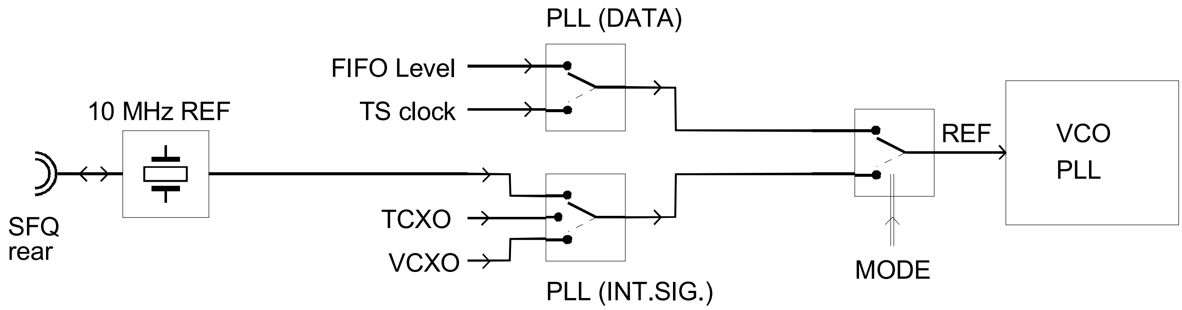


Fig. 2.2.4-25 Reference clock of CS+ coder

Error messages and warnings that may be output in the I/Q CODER field of the menu bar:

Error messages and warnings	Meaning	Cause	Remedy
MODIFY	Warning	A setting deviating from the standard was made.	Select the I/Q CODER menu: the PRESET CODER softkey (F4) is available. By pressing this softkey, any settings deviating from the standard are cancelled, and the warning disappears.
NO DAT	Error	No input data is present.	Check if a transport stream is present at the selected MPEG2 input.
NO CLK	Error	No clock at the input.	Check if a transport stream is present at the selected MPEG2 input. If the ASI EXT. CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal is present and if its level (TTL) is high enough.
WR CLK	Warning	Input clock deviates by >50 ppm.	If the TS PARALLEL input interface is selected, check the data rate of the applied MPEG2 transport stream. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
OVFLOW	Error	FIFO overflow	If the TS PARALLEL input interface is selected, check if the applied MPEG2 data rate is too high. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
UNFLOW	*Error*	*FIFO underflow*	*If the TS PARALLEL input interface is selected, check if the applied MPEG2 data rate is too low. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.*
FRMERR	*Error*	*Frame error – no valid transport stream is present, i.e. the sync byte is located in the wrong position or is missing.*	*Check if the packet length of the applied transport stream matches the packet length set in the coder.*
NO REF	*Error*	*Reference signal is missing if internal signals (MODE != DATA) and PLL (INT. SIG.) = 10 MHz REF. are selected.*	*Stopgap solution: select TCXO or VCXO under I/Q CODER - SPECIAL – PLL (INT. SIG.). Long-term solution: call for service; have cables checked.*
UNLOCK	Error	Oscillator (VCO) has not locked.	Call for service.
ERROR	Error	PLL ERROR or DC SUPPLY ERROR	For more detailed information, see SETUP/INFO - HARDWARE - SELFTEST CSPL. Call for service.

Table 2.2.4-1 Error messages and warnings

2.2.4.2 DVB-C QAM

2.2.4.2.1 Coding

Coding and error protection are in line with the European Standard EN 300 429 DVB (**d**igital **v**ideo **b**roadcasting), *"Framing structure, channel coding and modulation for cable systems"*.

Scrambler and sync byte inversion:

The incoming MPEG-2 transport stream is scrambled except for the sync word. The scrambler is initialized every eighth transport frame (one MPEG-2 transport frame corresponds to 188 bytes) at the time the sync word appears. The sync word is inverted at the same time (0x47 0xB8). This indicates, at the receiver end, the start of a scrambling sequence. Scrambling is performed to distribute energy evenly across the spectrum even with a uniform data structure present at the input.

Reed-Solomon encoder:

After scrambling, conversion of the data rate takes place. For 188 incoming bytes, the Reed-Solomon encoder (204, 188, t = 8) generates 16 additional bytes, which are appended to the 188 bytes. This means that 188 bytes are input to, and 204 bytes output by, the Reed-Solomon encoder per unit of time. The Reed-Solomon decoder at the receiver end is capable of correcting up to eight errored bytes for each frame.

Convolutional interleaver:

Reed-Solomon encoding is followed by a convolutional interleaver with a depth of I = 12 and a basic delay of M = 17. The convolutional interleaver processes the data stream byte by byte. The sync word is always transmitted in the "0" path, i.e. without delay. The deinterleaver at the receiving end operates in synchronism with the interleaver at the transmitter end. Its design is exactly reversed, however, so that identical delay is obtained for each of the 12 paths.

Mapping:

The bytes output by the convolutional interleaver are mapped into symbols depending on the order of QAM.

For 16QAM, each of the 16 constellation points carries 4 bits.
For 32QAM, each of the 32 constellation points carries 5 bits.
For 64QAM, each of the 64 constellation points carries 6 bits.
For 128QAM, each of the 128 constellation points carries 7 bits.
For 256QAM, each of the 256 constellation points carries 8 bits.

Baseband filtering:

In digital transmission, the I and Q baseband signals are pulse-shaped by filtering. As a result, the spectrum is limited and maximum eye aperture is obtained at the sampling points during demodulation.

With DVB-C QAM, square root raised cosine filtering with a roll-off factor α = 0.15 is used.

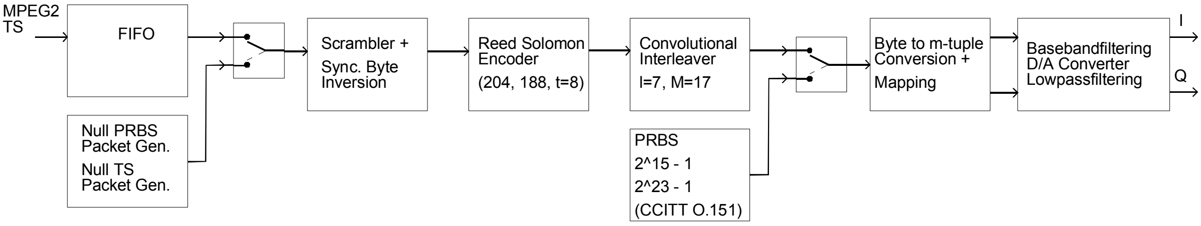


Fig.: 2.2.4-26 DVB-C QAM channel coding

2.2.4.2.2 Description of Menu Items

INPUT SELECT

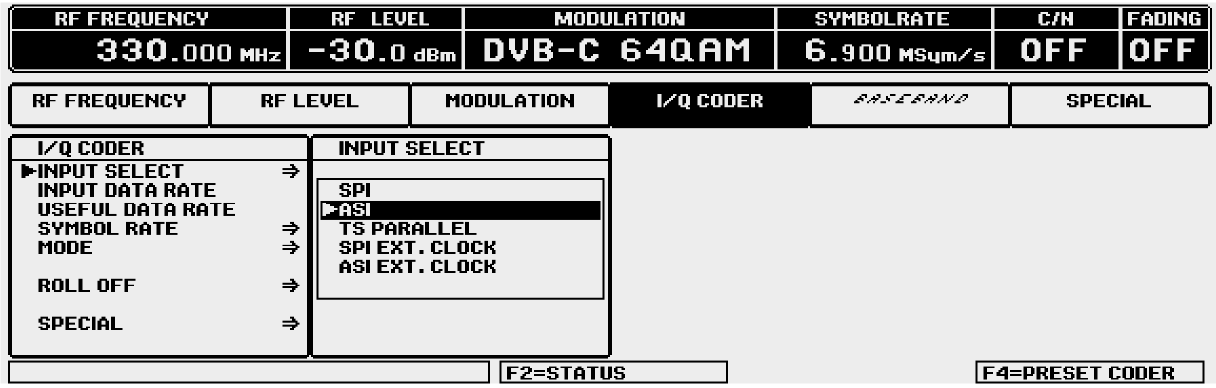


Fig.: 2.2.4-27

INPUT SELECT:

In this menu, the input interface for the MPEG-2 transport stream can be selected. This is, however, possible only if the optional INPUT INTERFACE 2 is fitted.

If the optional INPUT INTERFACE 2 is not fitted, only the TS PARALLEL input interface can be selected.

If the optional INPUT INTERFACE 2 is fitted, all interfaces offered by the menu are available.

TS PARALLEL:

This is a synchronous parallel MPEG-2 interface with LVDS (low voltage differential signalling). It is described in EN 50 083-9.

The interface is implemented as a 25-contact D-Sub connector labelled "TS PARALLEL" on the rear of the unit.

TS PARALLEL does not change the input transport stream. It must, therefore, be ensured that the transport stream applied to SFQ has exactly the displayed (calculated) input data rate. Deviations from this nominal data rate must not exceed ±50 ppm. If a deviation exceeds 50 ppm, the warning "WR CLK" (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low so that the pull-in range is actually exceeded, the warning "UNFLOW" (underflow) or "OVFLOW" (overflow) is output.

SPI:

This is a synchronous parallel MPEG-2 interface with LVDS signalling. It is described in EN 50 083-9.

The "TS PARALLEL" connector is used.

The SPI interface changes the MPEG-2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed, and new null packets are inserted to attain the required data rate. This data rate is calculated from the selected constellation and other transmission parameters, displayed, and automatically generated by INPUT INTERFACE 2.

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

ASI:

This is an asynchronous serial interface implemented by the "ASI" BNC connector on the rear panel.

It is described in EN 50 083-9.

The ASI interface changes the MPEG-2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed, and new null packets are inserted to attain the required data rate. This data rate is calculated from the selected constellation and other transmission parameters, displayed, and automatically generated by INPUT INTERFACE 2.

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

SPI EXT. CLOCK:

This is a synchronous parallel MPEG-2 interface with LVDS signalling. The "TS PARALLEL" connector is used.

The SPI EXT. CLOCK interface changes the MPEG-2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed. The required data rate is determined by the frequency of the clock fed to the "TS CLOCK EXT" connector on the rear of the unit. If required, new null packets are inserted to attain the required data rate.

The clock fed to the "TS CLOCK EXT" connector must not deviate from the calculated data rate by more than ±50 ppm. If a deviation exceeds 50 ppm, the warning "WR CLK" (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low so that the pull-in range is actually exceeded, the warning "UNFLOW" (underflow) or "OVFLOW" (overflow) is output.

In the SETUP - PRESET menu, it can be selected whether the bit clock or the byte clock is to be fed to the "TS CLOCK EXT" connector.

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

ASI EXT. CLOCK:

This is an asynchronous serial interface implemented by the "ASI" BNC connector on the rear panel.

The ASI EXT. CLOCK interface changes the MPEG2 input transport stream. The incoming null packets (PID = 0x1FFF) are removed. The required data rate is determined by the frequency of the clock fed to the "TS CLOCK EXT" connector on the rear of the unit. If required, new null packets are inserted to attain the required data rate.

The clock fed to the "TS CLOCK EXT" connector must not deviate from the calculated data rate by more than ±50 ppm. If a deviation exceeds 50 ppm, the warning "WR CLK" (wrong clock) is output in the I/Q CODER field of the menu bar. The guaranteed pull-in range of the VCXO is exceeded, and overflow or underflow of the FIFO must be expected. If the clock frequency is too high or too low so that the pull-in range is actually exceeded, the warning "UNFLOW" (underflow) or "OVFLOW" (overflow) is output.

In the SETUP - PRESET menu, it can be selected whether the bit clock or the byte clock is to be fed to the "TS CLOCK EXT" connector.

The inserted null packets are NULL PRBS PACKETS, see under MODE.

A correction of the PCR values is performed.

The incoming USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE, otherwise the FIFO will overflow.

INPUT DATA RATE

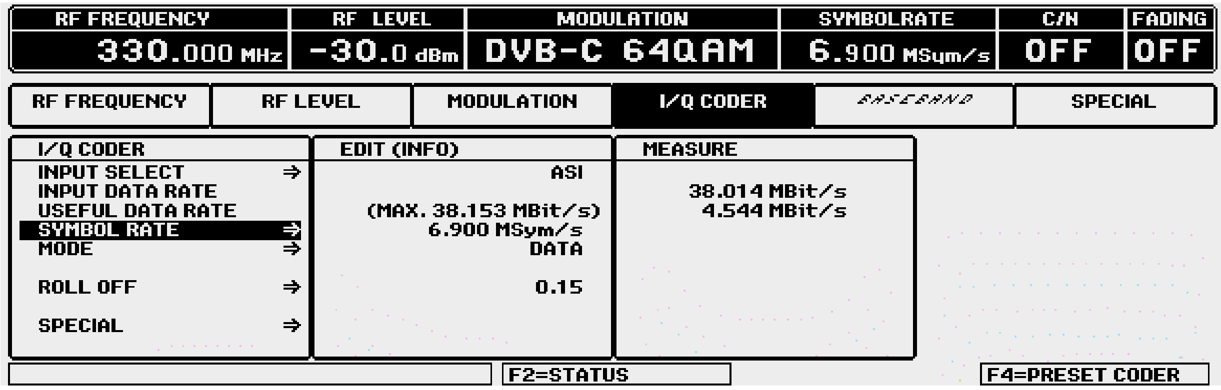


Fig.: 2.2.4-28

INPUT DATA RATE:

The input data rate is a measured quantity displayed in the "MEASURE" field.

The measured input data rate is displayed only if the optional INPUT INTERFACE 2 is fitted.

If, under INPUT SELECT, the TS PARALLEL input interface is selected, the nominal data rate (data rate expected at the input) is displayed in the "EDIT/(INFO)" field. The actual input data rate must not differ from the nominal data rate by more than ±50 ppm.

The following relationship applies to the input data rate and the output symbol rate, also depending on further parameters:

DR_IN_BIT = SR * (PL / 204) * q

where:

DR_IN_BIT = input data rate in [Mbit/s]

SR = symbol rate in [Msymb/s]

PL = packet length [188, 204]

q = number of bits per symbol [4, 5, 6, 7, 8] assigned as follows:

Constellation	Bits/symbol (q)
16QAM	4
32QAM	5
64QAM	6
128QAM	7
256QAM	8

USEFUL DATA RATE

USEFUL DATA RATE:

In the "MEASURE" field, the measured USEFUL DATA RATE is displayed. This is the input data rate after removal of the null packets.

The input data stream is changed by the ASI, SPI, ASI EXT. CLOCK and SPI EXT. CLOCK input interfaces, i.e. the null packets are removed. The relevant data rate, therefore, is the USEFUL DATA RATE. New null packets are added to the signal with the useful data rate to attain the required data rate.

The incoming, measured USEFUL DATA RATE must be lower than the calculated MAX. USEFUL DATA RATE displayed in the "EDIT/(INFO)" field.

The measured useful data rate is displayed only if the optional INPUT INTERFACE 2 is fitted.

SYMBOL RATE

SYMBOL RATE:

Symbol rates from 0.1 Msymb/s to 8 Msymb/s can be set.

The symbol rate remains constant if other parameters – for example the packet length – are changed.

Frequency accuracy of symbol rate:

Data transmission (MODE = DATA):

- The frequency accuracy of the symbol rate is determined by the external MPEG2 generator if TS PARALLEL is selected as an input interface (under INPUT SELECT).
- The frequency accuracy of the symbol rate is determined by INPUT INTERFACE 2 if ASI or SPI is selected as an input interface (under INPUT SELECT).
- The frequency accuracy of the symbol rate is determined by an external clock (fed to TS CLOCK EXT) if ASI EXT. CLOCK or SPI EXT. CLOCK is selected as an input interface (under INPUT SELECT).

Internally generated signals (MODE = NULL TS PACKET, NULL PRBS PACKET, PRBS):

- The frequency accuracy of the symbol rate is determined by the reference frequency selected in the I/Q CODER - SPECIAL - PLL (INT. SIG.) menu.

MODE

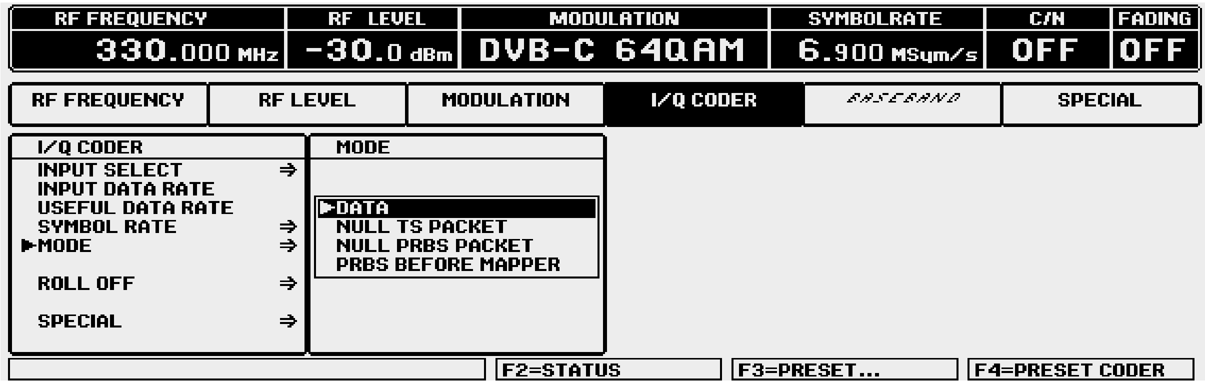


Fig.: 2.2.4-29

MODE:

Under MODE, one of several operating modes can be selected.

DATA:

An externally applied MPEG2 transport stream is processed and transmitted. If no MPEG2 transport stream is present, the test transmitter detects the absence of data and automatically switches to PRBS BEFORE MAPPER to ensure uniform spectral distribution of the signal. When data are detected at the input again, the test transmitter resumes processing of the external data stream.

NULL TS PACKET:

The internal coder generates null packets with the PID "0x1FFF" and the payload "0x00".

The header of the null packets comprises four bytes as follows:

0x47, 0x1F, 0xFF, 0x10

The header is followed by the 184-byte payload.

NULL PRBS PACKET:

The internal coder generates null packets with the PID "0x1FFF". As a payload, a continuous PRBS (pseudo random bit sequence) is transmitted. The PRBS is transmitted byte by byte, following the DVB principle of "MSB first". A PRBS sequence of 2^{23} - 1 or 2^{15} - 1 (to CCITT O.151) can be selected in the SETUP - PRESET - PRBS SEQUENCE menu.

PRBS BEFORE MAPPER:

A PRBS sequence is inserted directly before the mapper. A PRBS sequence of 2^{23} - 1 or 2^{15} - 1 (to CCITT O.151) can be selected in the SETUP - PRESET - PRBS SEQUENCE menu.

Note:	*The internal NULL TS PACKET and NULL PRBS PACKET signals are valid MPEG2 transport streams. Because these signals are internally generated, no settling time (as a function of the fullness of the FIFO) is required. Any changes to transmission parameters (for example to the symbol rate) necessitating a change of the input data rate are, therefore, completed faster.* *If in doubt which one of the internally generated MPEG2 signals to choose, the NULL PRBS PACKET signal is the preferable choice because it provides a more uniform spectral distribution of energy.*

ROLL OFF

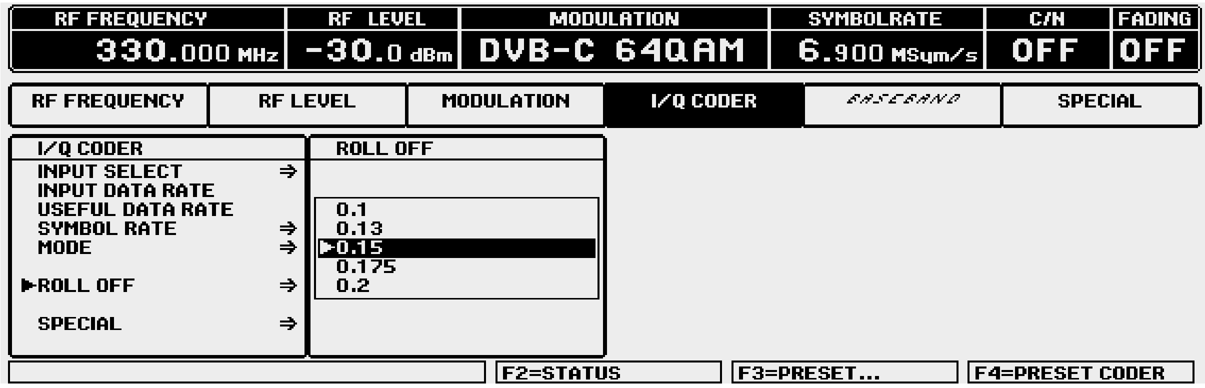


Fig.: 2.2.4-30

ROLL OFF:

The following roll-off factors can be selected for square root raised cosine filtering:

0.1, 0.13, 0.15, 0.175, 0.2

For DVB-C QAM, the standard provides for a roll-off factor α = 0.15.

SPECIAL

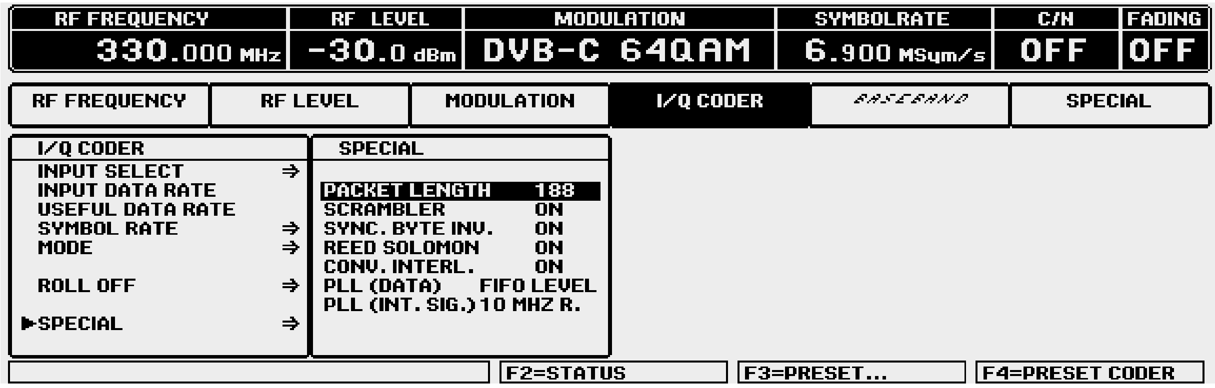


Fig.: 2.2.4-31

SPECIAL:

PACKET LENGTH:

The transport stream fed to the test transmitter normally has a frame length of 188 byte. The frame length can be changed to 204 bytes. The last 16 bytes of each frame are overwritten by the Reed-Solomon encoder. If the actual frame length of the input data stream does not match the packet length set for the coder, the error message "FRM ERR" (frame error) is output in the I/Q CODER field of the menu bar.

The DVALID signal at the TS PARALLEL or SPI input is not evaluated.

SCRAMBLER:

The scrambling function, i.e. energy dispersal, can be switched off. Sync word inversion (0x47 0xB8) in the first of each eight frames of an MPEG2 transport stream is continued, however.

SYNC. BYTE INV:

Sync word inversion (0x47 0xB8) in the first of each eight frames of an MPEG-2 transport stream can be switched off.

REED SOLOMON:

The Reed-Solomon encoder can be switched off. The first 188 bytes of a transport stream are transmitted unchanged, same as with the Reed-Solomon encoder switched on.

For input transport streams with 188 byte frame length, 16 bytes are appended to each frame. If the Reed-Solomon encoder is switched on, the 16 bytes are read from the Reed-Solomon encoder; if it is switched off, the 16 bytes are not defined.

For PACKET LENGTH = 204, the frame length is 204 bytes. If the Reed-Solomon encoder is switched on, the last 16 bytes are overwritten; if it is switched off, the 204 bytes remain unchanged.

For data streams already Reed-Solomon coded, scrambling and sync word inversion must be performed in line with the standard before the data streams are applied to the test transmitter input.

The scrambling function, sync word inversion and Reed-Solomon encoding must be switched off for such data streams, and the packet length set to 204 bytes.

CONV. INTERL.

The convolutional interleaver can be switched off. The incoming data are then routed on unchanged.

PLL (DATA):

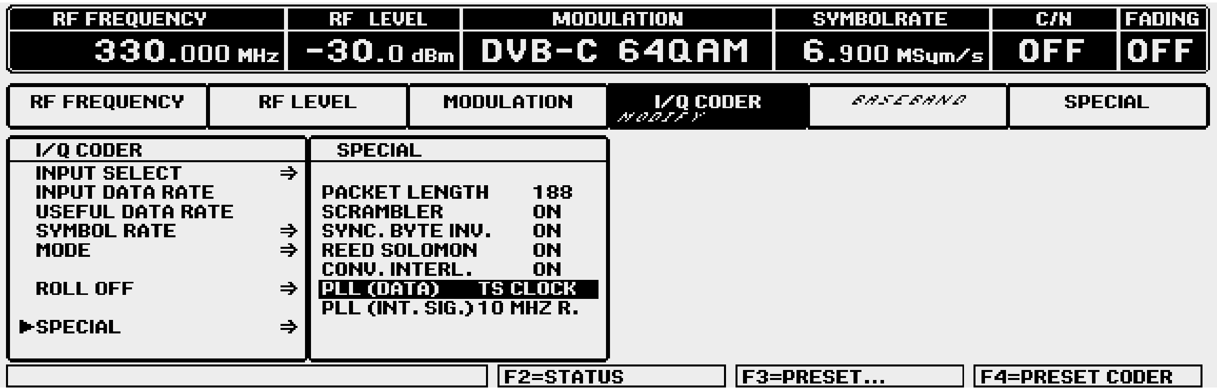


Fig.: 2.2.4-32

For data transmission, i.e. if MODE = DATA is selected, the symbol rate has to be matched to the input data rate to avoid any overflow or underflow of the input FIFO of the coder. The pull-in range of the VCXO is ±50 ppm. The signals and clock rates determining the frequency accuracy of the symbol rate are described in section SYMBOL RATE.

For data transmission, the symbol clock can be controlled in two ways:

FIFO LEVEL: the symbol clock is controlled so that the FIFO is on average half filled. This is the recommended setting.

TS CLOCK: the input transport stream clock as well as the oscillator clock are divided to give two integer figures. If TS CLOCK is selected, the warning "MODIFY" is output in the I/Q CODER field of the menu bar.

PLL (INT. SIG.):

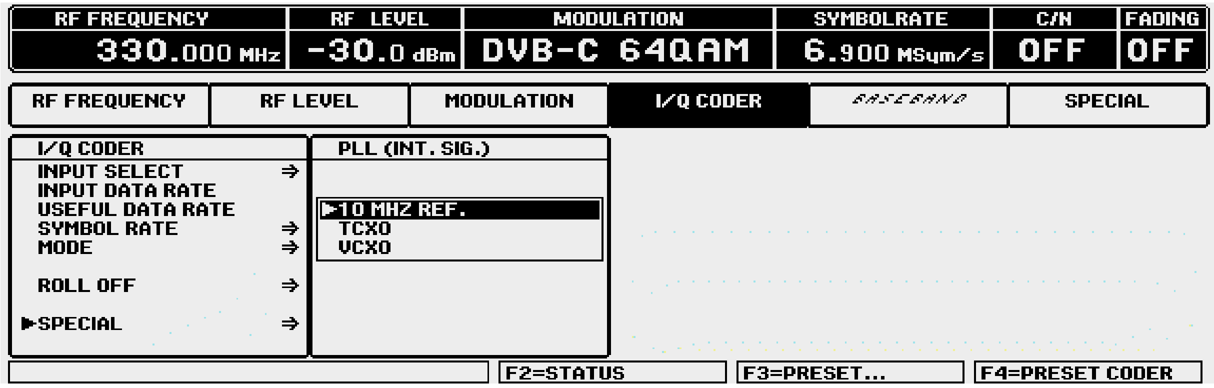


Fig.: 2.2.4-33

With internal signals, i.e. with MODE = NULL TS PACKET, NULL PRBS PACKET or PRBS BEFORE MAPPER, the symbol rate can be locked to various reference frequencies. The input FIFO of the coder is inactive.

One of three reference frequencies can be selected for internal signals:

10 MHz REF.: The symbol clock is controlled by the 10 MHz reference of SFQ. This is the recommended setting.

The 10 MHz reference of SFQ can itself be used as a reference, or locked to an external 10 MHz reference signal. This can be selected under SETUP - PRESET – 10 MHz REFERENCE: INTERNAL or EXTERNAL.

If the 10 MHz SFQ reference is locked to an external reference signal (pull-in range ±3 ppm) and PLL (INT. SIG.) = 10 MHz REF. is selected, the symbol rate too is locked to the external reference.

Example: *If the external reference is exactly 10 MHz, the symbol rate will be exactly 10 Msymb/s. If the external reference is higher by 1 ppm, i.e. 10 Hz (resulting in 10000010 Hz), the symbol rate will also be higher by 1 ppm. For a symbol rate of 6.9 Msymb/s, this means +6.9 Hz, so that 6.9000069 Msymb/s are obtained.*

TCXO: The symbol clock is controlled by a TCXO (temperature-compensated crystal oscillator) on the coder module.

VCXO: The symbol clock is controlled by a VCXO (voltage-controlled crystal oscillator) on the coder module, the VCXO being tuned with a fixed input voltage.

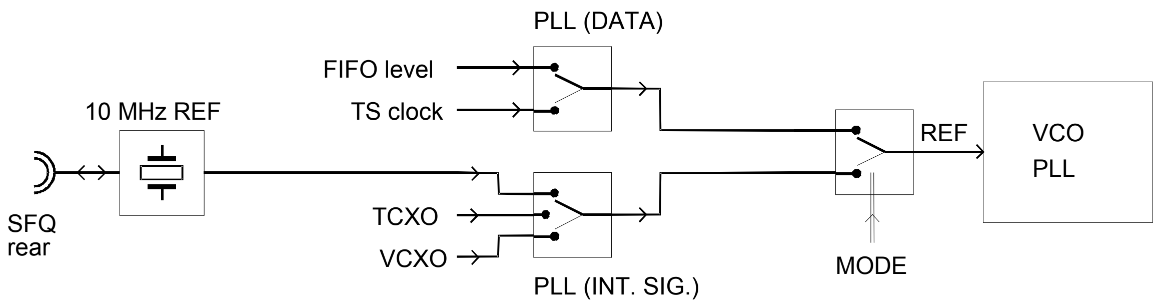


Fig.: 2.2.4-34

Error messages and warnings that may be output in the I/Q CODER field of the menu bar:

Message	Meaning	Cause	Remedy
MODIFY	Warning	A setting deviating from the standard was made.	Select the I/Q CODER menu: the PRESET CODER softkey (F4) is available. By pressing this softkey, any settings deviating from the standard are cancelled, and the warning disappears.
NO DAT	Error	No input data is present.	Check if a transport stream is present at the selected MPEG2 input.
NO CLK	Error	No input clock is present.	Check if a transport stream is present at the selected MPEG2 input. If the ASI EXT. CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal is present and if its level (TTL) is high enough.
WR CLK	Warning	Input clock deviates by more than ±50 ppm.	If the TS PARALLEL input interface is selected, check the data rate of the MPEG2 input transport stream. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
OVFLOW	Error	FIFO overflow	If the TS PARALLEL input interface is selected, check if the MPEG2 input data rate is high. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
UNFLOW	Error	FIFO underflow	If the TS PARALLEL input interface is selected, check if the MPEG2 input data rate is low. If the ASI EXT.CLOCK or the SPI EXT. CLOCK input interface is selected, check if the external TS CLOCK signal has the right frequency. In the SETUP - PRESET menu, check if a bit clock or a byte clock is to be applied.
FRMERR	Error	Frame error – no valid transport stream is present, i.e. the sync byte is located in the wrong position or is missing.	Check if the packet length of the input transport stream matches the packet length set in the coder.
NO REF	Error	Reference clock is missing if internal signals (MODE ≠ DATA) and PLL (INT. SIG.) = 10 MHz REF. are selected.	Immediate solution: select TCXO or VCXO under I/Q CODER - SPECIAL – PLL (INT. SIG.). Long-term solution: call in service, have cables checked.
UNLOCK	Error	Oscillator (VCO) has not locked.	Call in service.
ERROR	Error	PLL ERROR or DC SUPPLY ERROR	Details see under SETUP/INFO - HARDWARE - SELFTEST CSPL Call in service

2.2.4.3 DVB-S and DVB-C

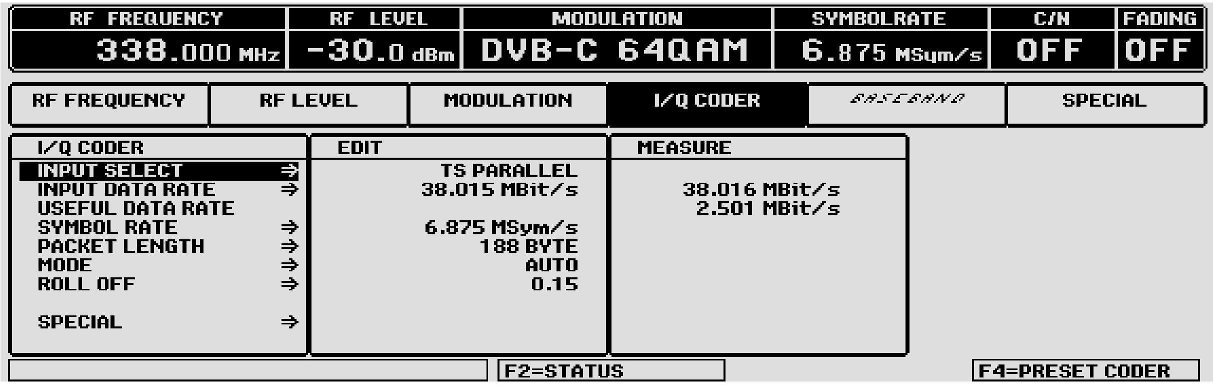


Fig.: 2.2.4-35 I/Q CODER Menu

Under this menu item, all settings concerning coding and error protection of the MPEG-2 transport stream (MPEG = Moving Pictures Experts Group) can be made. The submenus differ only slightly depending on the selected I/Q modulation mode. The description below indicates when a menu item is available in one mode only or setting ranges are different. If no specific information is given, the description applies to both QAM (quadrature amplitude modulation) and QPSK (quadrature phase shift keying).

2.2.4.3.1 Coding

Coding and error protection for QPSK, i.e. satellite transmission, are in line with ETS 300429, for QAM transmission on cables with ETS 300421.

This means that the incoming transport stream is scrambled (energy dispersal); sync words are not scrambled but the scrambler continues to run. The polynominal 1 + x(14) + x(15) is used. The scrambler is initialized (100 101 010 000 000) by means of a sync word. The synchronization is repeated every 8 transport frames. The first of 8 sync words is inverted in addition (47(hex) -> B8(hex)) which indicates the beginning of a scrambler sequence. The first bit at the output of the PRBS generator is linked to the first data bit sent after the inverted sync word.

After energy dispersal and sync word inversion an abbreviated Reed Solomon code (204, 188, t=8) is provided for outer error protection, i.e. 16 bytes containing the redundancy for correcting 8 errored bytes of the frame are added to the incoming 188 data bytes of the frame.

Subsequently, a convolutional interleaver with a depth of I = 12 and a base delay of M = 17 ensures that the inverted and the non-inverted sync words are always transmitted in path 0, i.e. without delay.

Data coding up to this point is the same for QAM and QPSK.

With QAM the following is carried out after the convolutional interleaver:

A symbol word conversion (byte-to-m-tuple conversion) is performed. The data bits are combined to symbols depending on the selected QAM mode.

The two MSBs (most significant bits) of each symbol are difference-coded.

Pulse filtering with a square root cosine factor of α = 0.15 is performed for QAM; factors of 0.1, 0.13, 0.175 and 0.2 can also be set.

With QPSK the following is carried out after the convolutional interleaver:

Coding is performed by a convolutional encoder with a rate of 1/2, a constrained length of K 7 and the generator polynominals 171 (octal) and 133 (octal). A puncturing rate of 1/2 (not punctured), 2/3, 3/4, 5/6 and 7/8 can be set next.

With QPSK pulse filtering is performed with the square root cosine factor of α = 0.35; factors of 0.25, 0.30, 0.40 and 0.45 can also be set.

If settings are not in conformance with standard coding procedures, the warning *MODIFY* is displayed in the I/Q CODER selection field. When the PRESET CODER key (F4) is pressed all non-standard settings are replaced by standard values.

The warning *NO DAT* is displayed in the same field in the absence of input data, or *NO CLK* when the clock signals at the input is missing.

If the received MPEG2 transport stream is not valid, the warning *FRMERR* (frame error) is displayed.

In the event that the received input data rate deviates by more than 0.5% from the set data rate, the user is warned with *UNLOCK* (SFQ ≥10%). After the cursor has been placed on the INPUT DATA RATE field, the measured input data rate can be taken as the setting rate by means of key

F3 = ACCEPT

A list of possible warnings is given in the I/Q CODER menu field:

NO CLK:	no clock
NO DAT:	no data
FRMERR:	data stream not valid or incorrect packet length (frame error)
UNLOCK:	set data rate differs from incoming data rate (>0.5%)
MODIFY:	coder setting not to standard

The currently set status is displayed when the STATUS key (F2) is pressed. The status information is displayed below the submenu items and the setting windows.

With the INPUT INTERFACE option fitted, SFQ has two different input interfaces: an *Asynchronous Serial Interface* (ASI) and a *Synchronous Parallel Interface* (SPI). The interfaces comply with DVB specifications and cover most of the applications. The interfaces are given equal priority by the INPUT INTERFACE option, which converts the serial ASI data into parallel data as those of the SPI interface.

To this end, the input data rate and the packet length of the transport stream are measured and displayed. Then an internal output data stream is generated from the input data stream. The data rate of the internal output data stream is linked to the output symbol rate of SFQ. To effect this conversion of data rate, any null packets contained in the data stream are removed. The data rate thus obtained is the minimum output data rate of the module. The desired output data rate is obtained by adding null packets. The added null packets contain as a payload a pseudo random binary sequence (PRBS) in line with ITU-T O.151 ($2^{23} - 1$ or $2^{15} - 1$ depending on the setting in the PRESET-PRBS SEQUENCE menu), which can be used for measuring the bit error rate. In the TS PARALLEL mode, data rate conversion is disabled and SFQ operates same as if the INPUT INTERFACE was not fitted.

If a transport stream is modified by removing and adding null packets, the position of the MPEG2 packets relative to each other changes as well because the positions of the null packets in the transport stream change. This however means that the program clock reference (PCR) values in the data stream are no longer correct. The PCR values are corrected by the INPUT INTERFACE. The jitter produced by correction is far below the specified DVB limit value.

2.2.4.3.2 Menu description

INPUT SELECT:

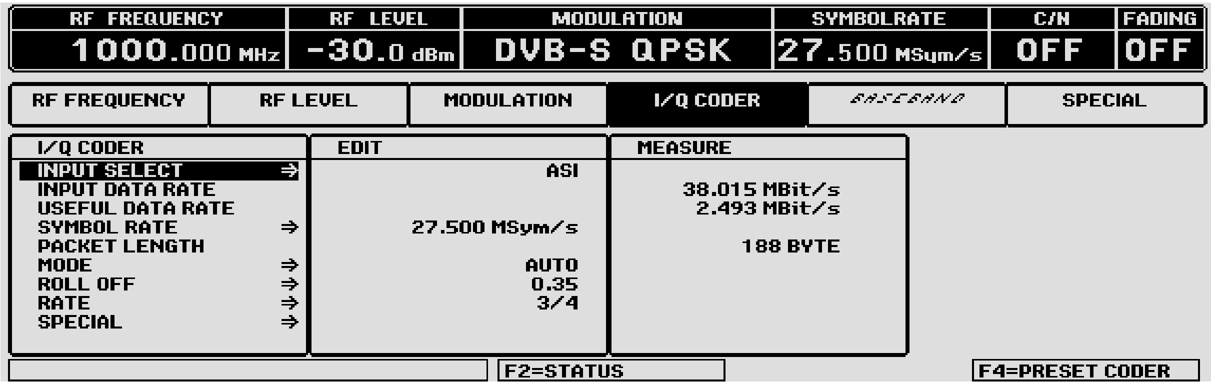


Fig.: 2.2.4-36 INPUT SELECT

INPUT SELECT:
Under this menu item the input interface for the MPEG-2 transport stream can be selected provided the INPUT INTERFACE option is fitted.

If the INPUT INTERFACE option is not fitted, the following MPEG-2 transport stream input interface is available:

TS PARALLEL (synchronous parallel) in LVDS (low voltage differential signalling) format. This interface is described in EN50083-9. The corresponding 25contact sub-D connector is available at the rear of the instrument.

If the INPUT INTERFACE option is fitted, the user can choose among several input interfaces. The TS PARALLEL input interface is still available. In contrast to the other four interfaces, the TS PARALLEL input interface does not change the input data stream. If one of the other input interfaces is selected, the clock rate of the data stream is changed. This offers the advantage that the output symbol rate of SFQ can be selected independently of the input data rate; the required corrections are performed by the INPUT INTERFACE.

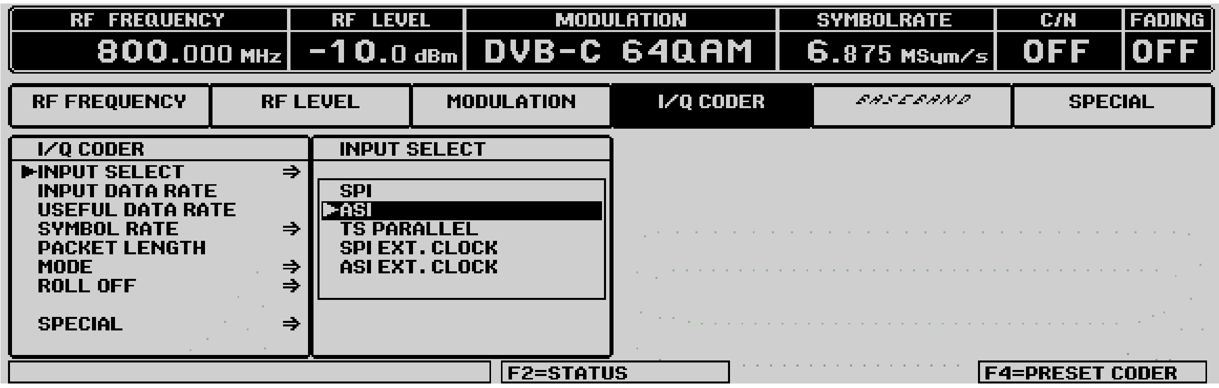


Fig.: 2.2.4-37 SPI / ASI

SPI:
The *Synchronous Parallel Interface* is provided by the 25-contact TS PARALLEL sub-D connector on the rear panel. The clock rate of the data stream is changed. The output data rate is determined by an internal clock generator which can be set in the SYMBOL RATE menu.

ASI:
The *Asynchronous Serial Interface* is provided by the ASI BNC connector on the rear panel. The clock rate of the data stream is changed. The output data rate is determined by an internal clock generator which can be set in the SYMBOL RATE menu.

SPI EXT. CLOCK:
The *Synchronous Parallel Interface* is provided by the 25-contact TS PARALLEL sub-D connector on the rear panel. The clock rate of the data stream is changed. The output data rate is determined by a clock signal applied to the TS CLOCK EXT BNC connector on the rear panel. If jumper X8 on the INPUT INTERFACE module is connected in position 1-2 (factory setting), the clock signal applied is the output bit clock of the module. If the jumper is connected in position 2-3, an output byte clock is applied.

ASI EXT. CLOCK:
The *Asynchronous Serial Interface* is provided by the ASI BNC connector on the rear panel. The clock rate of the data stream is changed. The output data rate is determined by a clock signal applied to the TS CLOCK EXT BNC connector on the rear panel. If jumper X8 on the INPUT INTERFACE module is connected in position 1-2 (factory setting), the clock signal applied is the output bit clock of the module. If the jumper is connected in position 2-3, an output byte clock is applied.

INPUT DATA RATE:

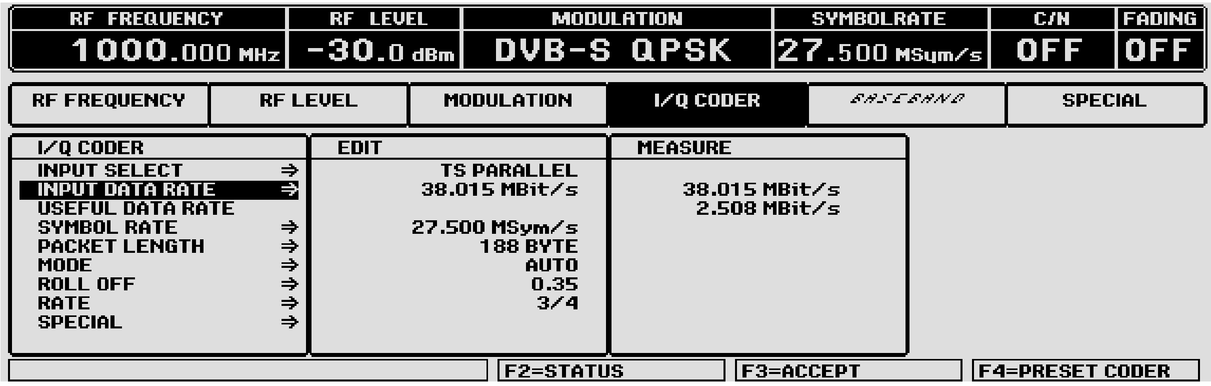


Fig.: 2.2.4-38 INPUT DATA RATE

If the ASI or the SPI input interface is selected (with an internal or external clock), the INPUT DATA RATE is measured and displayed - setting of the input data rate is not possible. The INPUT DATA RATE is understood to be the (gross) data rate comprising all bits received.

In the TS PARALLEL mode, an input data rate between 2.000 and 60.000 Mbit/s can be set. The input data rate refers to the transport stream applied to the coder.

With menu item INPUT DATA RATE selected, the measured input data rate is displayed in the window at the right of the set data rate. Whereas the SFQ does not evaluate the DVALID signal in the TS PARALLEL mode, i.e. partial transport streams are not supported, only the data where DVALID = 1 are valid in the SPI mode. (see 2.2.4.5 Input Interface).

If a new transport stream is applied to the input, the displayed measured value can be accepted as the set value by pressing key

F3 = ACCEPT

If the measured data rate is not within the permissible setting range, only underscores will be displayed (_ _ _ _).

The set input data rate is not necessarily identical with the actual rate at which data are received, as the setting is merely a preselection of oscillator ranges. The oscillators synchronize to the incoming signal. If there is a measurement/setting deviation of more than 0.5 %, the warning UNLOCK is displayed in the menu bar in the I/Q CODER field. This warning goes out as soon as the deviation becomes smaller.

Note: *The oscillators in SFQ lock at deviations of up to approx. 10 %. However, the receivers to be tested usually require an accurate symbol rate.*

If no transport stream is applied, SFQ automatically switches to internal data rate matching, thus generating a clock signal that corresponds to the set data rate. In this case the warning NO CLK is displayed in the menu bar in the I/Q CODER field. If the cursor is positioned on the INPUT DATA RATE field, dashes (-----) are displayed as the measurement result. When a transport stream is applied, SFQ identifies it as such and switches back to normal operation. Caution: Internal data rate matching is only a provisional function. Accuracy here is in the 10 kHz range. For accurate internal data rate matching, the INPUT INTERFACE option is required.

The symbol rate is calculated from the input data rate, the modulation type and the coder settings and is displayed in the header line in the top right corner.

The desired symbol rate can also be entered directly in Megasymbols per second. SFQ then calculates the required input data rate as a function of the other parameters. If the limits of the permissible input data rate (2 to 60 Mbit/s) are exceeded, the user is warned and the minimum or maximum possible symbol rate indicated.

The user has to make sure the calculated input data rate is applied to the SFQ.

The symbol rate is a function of the input data rate in the following way:

$$\text{TS\_data rate} = \text{symbol rate}\ \frac{\text{PL}}{204} \cdot \text{rate}\ \text{q}$$

$$\text{Symbol rate} = \text{TS\_data rate}\ \frac{204}{\text{PL}} \cdot \frac{1}{\text{rate}} \cdot \frac{1}{\text{q}}$$

where

TS_data rate corresponding to the input data rate, to be set in [Mbit/s],

PL being the packet length which may be 188 or 204 [Byte],

Rate corresponding to the rate of the convolutional encoder. A rate of 1/2, 2/3, 3/4, 5/6 or 7/8 can be selected for QPSK. Since no convolutional encoder is used with QAM, the rate is set to 1.

Symbol rate in [Msymb/s]

q corresponding to the order of I/Q modulation which can be seen from the table below:

Modulation:	q:
QPSK	2
16QAM	4
32QAM	5
64QAM	6
128QAM	7
256QAM	8

The symbol data rate of 7.000 Msymb/s for QAM should not be exceeded. The minimum rate for QAM should be greater than 1.5 Msymb/s. Lower symbol rates can be used with restrictions.

With QPSK, symbol rates between 2 and 45 Msymb/s are useful. With certain restrictions higher or lower rates can also be set.

A table showing the relationship between TS-input data rate and symbol rate is enclosed at the end of the manual.

If ASI or SPI is selected as input interface with an external clock, the SYMBOL RATE is measured and can be adopted by pressing **F3 = ACCEPT**.

USEFUL DATA RATE:

If the INPUT INTERFACE option is available, the USEFUL DATA RATE is measured and displayed. USEFUL DATA RATE is understood to mean the total data rate of all transport-stream packets carrying information. It is measured after the null packets have been eliminated.

PACKET LENGTH:

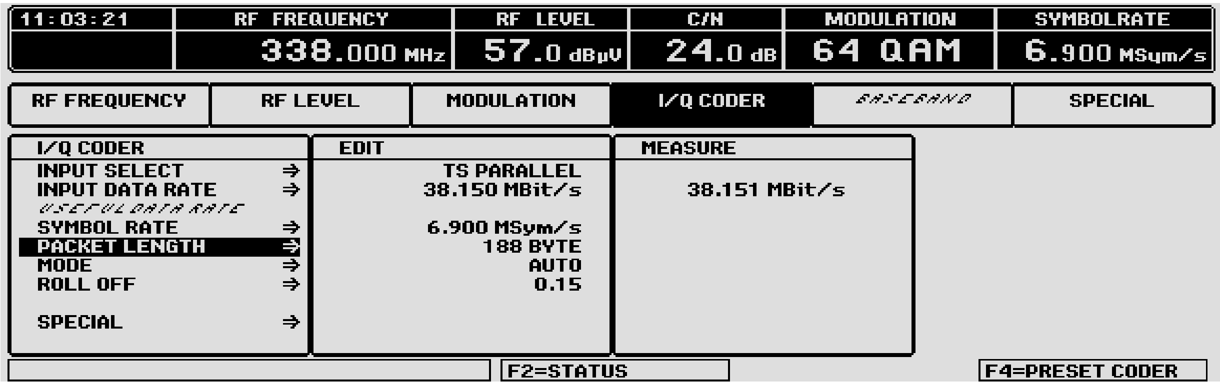


Fig.: 2.2.4-39 PACKET LENGTH

A packet length of 188 or 204 bytes can be selected (toggle function).

It corresponds to the frame length of the applied transport stream. Normally a 188-byte frame is applied and a 204-byte frame is obtained in the coder after the Reed Solomon error protection.

When a frame length of 188 byte is set, the SFQ expects a sync word in the first byte of each frame (47 hexadecimal).

When a frame length of 204 bytes is set, the first byte must again be a sync word. The last 16 bytes of the frame are overwritten by the Reed Solomon encoder. If this is not desired, the Reed Solomon encoder should be switched off in the SPECIAL submenu.

If the INPUT INTERFACE option is fitted, the PACKET LENGTH is measured. Setting of the PACKET LENGTH is not possible.

MODE:

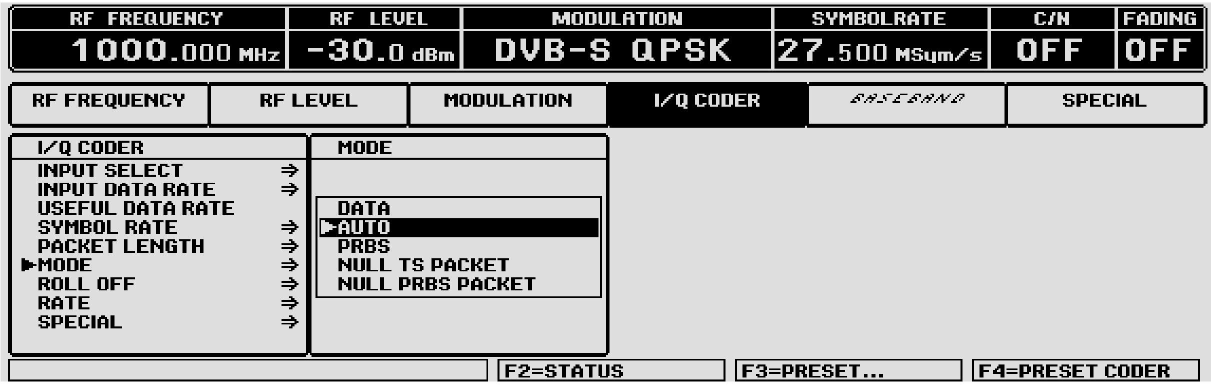


Fig.: 2.2.4-40 MODE

Under this menu item one of several operating modes can be selected:

DATA: In this mode the externally applied transport stream is conditioned. If invalid data are received or no data at all, the data (or zeros in the case of no data) are forwarded unmodified to the error protection coder, interleaver, etc and then to the modulator.

AUTO: This mode is identical with the DATA mode as long as a transport stream is received. In the absence of a transport stream, when the frame is faulty or other faults have occurred, SFQ automatically switches to an internal PRBS sequence. When a valid transport stream is identified again, the received data are conditioned.

PRBS: In this mode an internal PRBS sequence is automatically selected irrespective of whether a transport stream is received or not.

NULL TS PACKET: In this mode a test transport stream consisting of a sync word, identification bytes and zeros as a payload is generated in the SFQ and transmitted. This test transport stream is described in the DVB Measurement Guidelines (ETR 290). The null transport stream packets are conditioned like any externally applied transport stream.

NULL PRBS PACKET: When set to NULL PRBS PACKET, which is only possible if the input interface option is available, SFQ generates null packets (PID 1FFFhex), whose payloads are filled with a pseudo random binary sequence (PRBS) according to ITU-T O.151 (2^{23} – 1 or 2^{15}-1 depending on the setting in the PRESET-PRBS SEQUENCE menu). The PRBS is transmitted in the transport stream byte by byte (MSB first).

Note:	*Also if the signals used have been generated internally, as for example NULL TS PACKET, applying an external clock (via the synchronous parallel interface) is still useful, because the SFQ oscillator will lock to it (-> symbol rate accuracy). If the INPUT INTERFACE option is used, this is not necessary.*

ROLL OFF:

Under this menu item pulse shaping can be set. The selectable roll-off factors differ depending on the selected modulation mode. A square root cosine roll-off factor is used.

The following roll-off factors may be selected for QAM:

0.1 / 0.13 / 0.15 (standard value for DVB-C) / 0.175 / 0.2

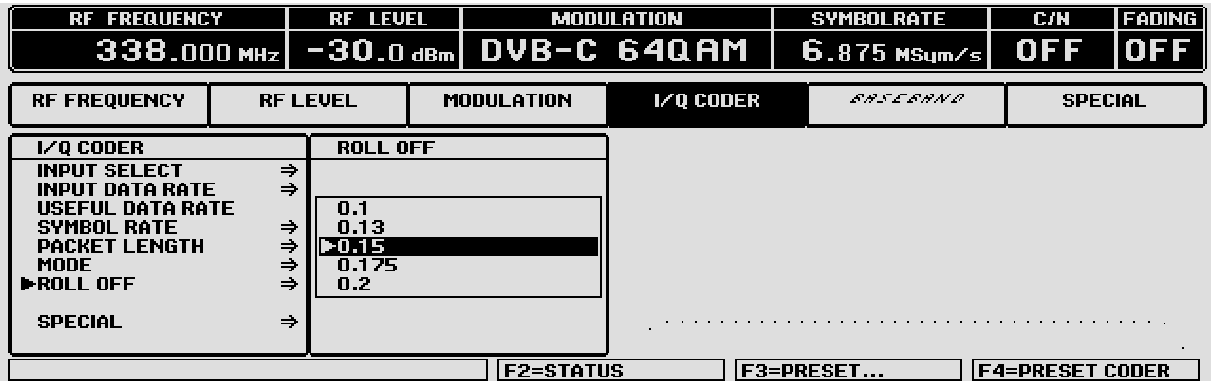


Fig.: 2.2.4-41 ROLL OFF

The following roll-off factors may be selected for QPSK:
0.25 / 0.3 / 0.35 (standard value for DVB-S) / 0.4 / 0.45

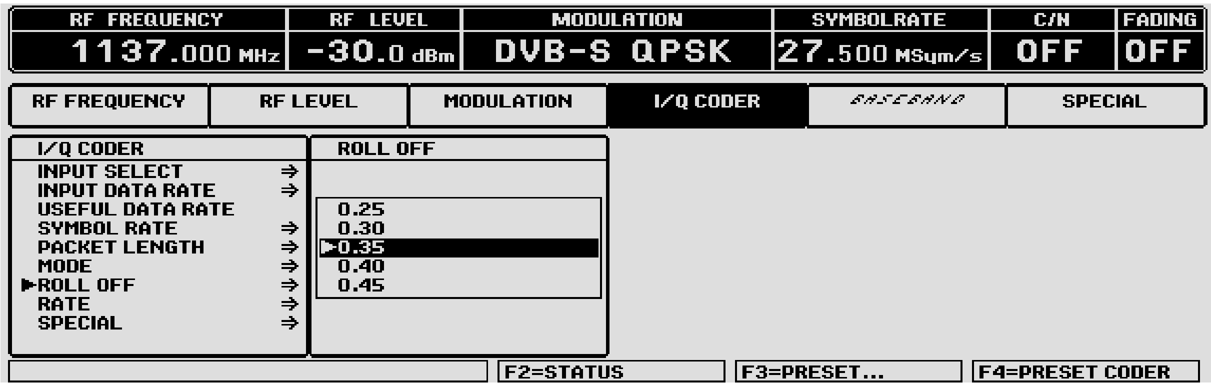


Fig.: 2.2.4-42 Standard value for DVB-S

RATE:

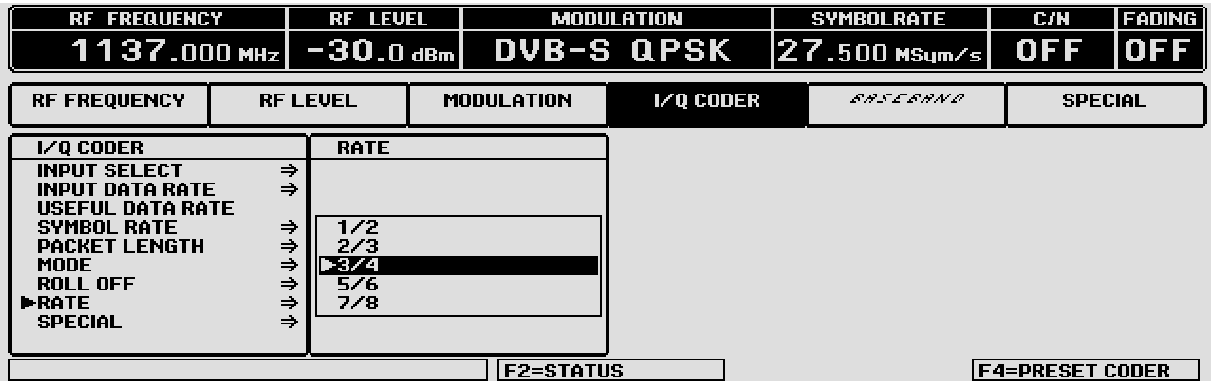


Fig.: 2.2.4-43 RATE

This menu item is only available with QPSK, the item is not displayed in the QAM mode.

In the case of satellite transmission (QPSK) convolutional encoding with subsequent puncturing is performed after the convolutional interleaver. The rate 1/2 means that puncturing is not performed.

The following puncturing rates can be selected:

1/2, 2/3, 3/4, 5/6, 7/8

SPECIAL:

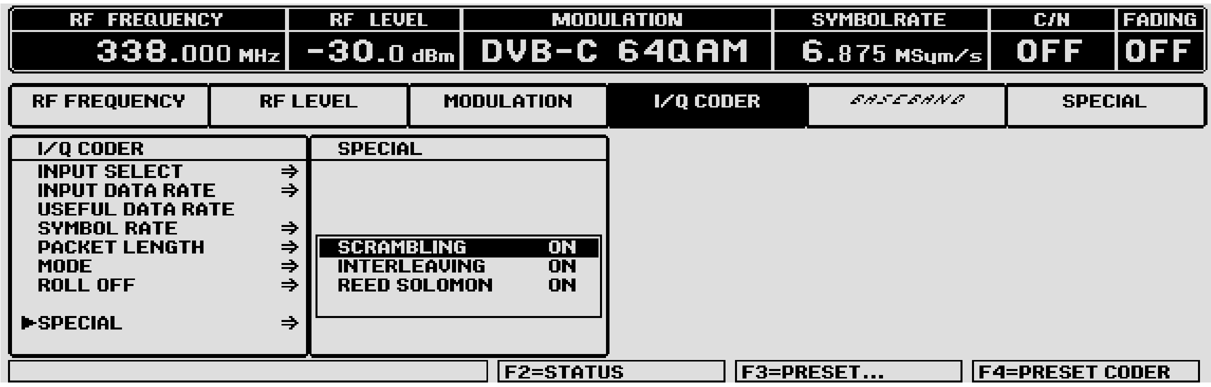


Fig.: 2.2.4-44 SPECIAL

Under this menu item some parts of the encoder and the error protection facilities can be disabled. This however considerably impairs the transmission and should be used for testing only. If some of the functions are switched off, the warning MODIFY is displayed in the I/Q CODER selection field.

Functions that can be switched off in the SFQ (toggle function):

SCRAMBLING: Energy dispersal is disabled but the sync inversion remains active.

INTERLEAVING: With the interleaver switched off, data are directly transmitted.

REED SOLOMON: With the Reed-Solomon encoder switched off, the frame length is extended to 204 bytes. The 16 bytes added when PACKET LENGTH: 188 BYTE is selected are filled with invalid data.

2.2.4.4 DVB-T CODER

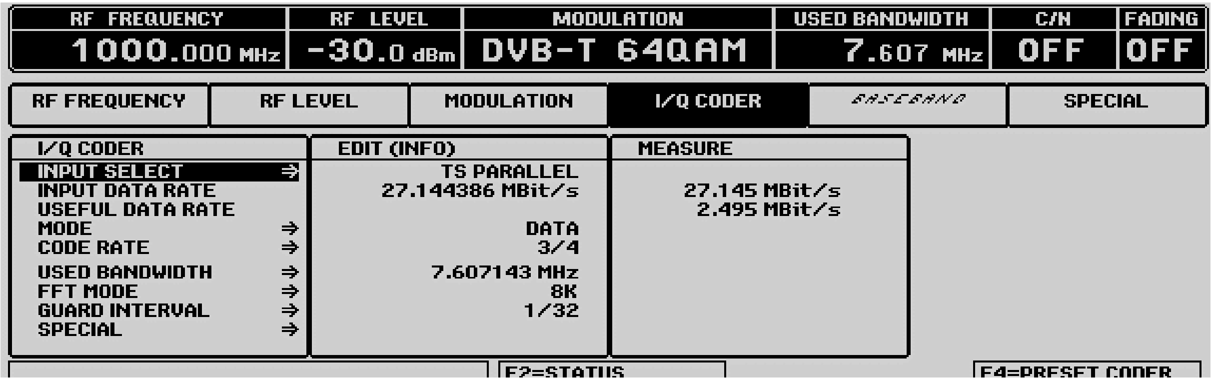


Fig.: 2.2.4-45 DVB-T CODER

If DVB-T is selected in the modulation menu, then settings can be made for the DVB-T coder in the I/Q CODER menu.

Settings affecting the modulation of the data carrier (constellation) and the decision as to whether coding should be non-hierarchical with one input data stream or hierarchical with two data streams should be made already in the modulation menu.

The coding and error protection corresponds to specification ETS 300 744.

2.2.4.4.1 Non-hierarchical Coding

Input:

The coder expects an MPEG2 transport stream packet for its input signal. For non-hierarchical coding the coder possesses a parallel MPEG2 transport stream input in LVDS format (TS PARALLEL = SPI without stuffing). The packet sync signal must be present. The associated connector (25 contact, Sub-D) is located on the rear panel and is labelled X60 TS PARALLEL.

With the input interface option built in, a different MPEG2 transport stream input may be selected in the non-hierarchical coding mode (ASI, SPI, ASI with external clock, SPI with external clock).

Scrambler and sync byte inversion:

The MPEG2 input data stream is first buffered in a FIFO.

The input signal is then scrambled in a scrambler (2^{15} - 1) which is initiated with the prescribed value after every 8th transport frame. Although the sync byte (47hex) is excluded from the scrambling process, the scrambler continues to operate during this time. The sync byte is inverted (47hex -> B8hex) along with the initialization of the scrambler.

Reed-Solomon encoder:

A Reed-Solomon encoder (204, 188, t=8) is now next. 16 bytes are appended to the 188 bytes. The code redundancy allows a Reed-Solomon decoder to correct up to 8 faulty bytes within a frame.

Convolutional interleaver:

The convolution interleaver with a depth I = 12 and basic delay of M = 17 delays the incoming bytes at different rates. The sync bytes are transferred in the "0" branch without any delay. After passing through the deinterleaver, all bytes show the same delay. Transmission errors will be spread over a lot of small errors which can then be more easily corrected by the Reed-Solomon decoder than an error of long duration.

Convolutional encoder and puncturing:

The convolutional interleaver is followed by the convolutional encoder with constraint length K=7. The generator polynomials are 171 (octal) and 133 (octal). A choice of different puncturing rates are available: 1/2 (not punctured), 2/3, 3/4, 5/6, 7/8.
The rate 2/3 means for example that 3 output bits can be generated from 2 input bits in the convolutional encoder with puncturing.

Bit interleaver:

In the bit interleaver that follows next, the input data stream is split up into several (v) data substreams by demultiplexing in non-hierarchical coding:

- with QPSK constellation in v=2 substreams
- with 16 QAM constellation in v=4 substreams
- with 64 QAM constellation in v=6 substreams.

Demultiplexing is defined in terms of a mapping rule.

Each substream is now passed though its own bit interleaver. The block size of all bit interleavers is 126 bits. In mode 2k, 12 blocks are used per OFDM symbol. In mode 8k, there are exactly 48 blocks per OFDM symbol.

Every bit interleaver is assigned with a linear input bit vector. The output bit vectors are defined by means of various permutations functions.

The outputs of v-bit interleavers each form a v-bit word.

Symbol interleaver:

Subsequently the symbols are scrambled in a symbol interleaver. This interleaver allocates all v-bit words to the 1512 data carriers in the 2k mode and to 6048 data carriers in the 8k mode.

The 1512 or 6048 v-bit words of an OFDM symbol are once read into the symbol interleaver linearly and read out with a permutation function. The next OFDM symbol is then read into the symbol interleaver and read out linearly. The process is then repeated.

Mapper:

The constellation of the data carrier can be QPSK, 16 QAM or 64 QAM for non-hierarchical coding. The v-bit words allocated to the data carriers in the symbol interleaver are mapped with the aid of a Gray mapping rule.

OFDM frame structure:

The output signals are organized in frames. Each frame contains 68 OFDM symbols. Every OFDM symbol is made up of K=1705 carriers in the 2k mode and K=6817 carriers in the 8k mode. Each OFDM symbol is of duration Ts which comprises of a useful part Tu and a guard interval. The latter is sent prior to the useful part and is a cyclic continuation of the useful part.

Guard intervals of 1/4, 1/8, 1/16 and 1/32 of the useful part Tu are provided.

The frequency spacing of the carriers to one another is 1/Tu.

The used bandwidth is equal to the spacing of the outermost carrier (K-1)/Tu.
The used bandwidth for the 2k mode is the same as that for the 8k mode because the carrier spacing in the 2k mode is four times as large as in the 8k mode. However the number of carriers in the 2k mode is only a quarter of the 8k mode.

Data can however be transmitted in the 2k mode in just the same volumes as in the 8k mode since the OFDM symbols are of shorter duration in the 2k mode (Tu in the 2k mode is a quarter of the corresponding value in the 8k mode).

An OFDM frame is comprised of pilot carriers (scattered pilots and continual pilots) and TPS carriers (transmission parameter signalling) in addition to the data carriers.

The pilots for frame synchronization, time synchronization, channel estimate, transmission mode detection and phase noise equalization can be used in the receiver.

The TPS carriers serve for transferring the following parameters:

- Modulation and the alpha value for hierarchical coding
- Information about the hierarchy
- Guard interval
- Code rates
- FFT mode
- Number of frames in a superframe

The TPS information is defined over 68 consecutive OFDM symbols (correspond to a frame). One bit is contained per OFDM symbol; there are thus 68 bits per frame (1 initialization bit, 16 synchronization bits, 37 information bits, 14 redundancy bits for error control).

Channel bandwidths and key parameters:

6 MHz channel:
Fundamental frequency: 48/7 MHz

Parameter	8k mode	2k mode
Number of carriers K	6817	1705
Number of data carriers	6048	1512
Duration of useful part of a OFDM symbol Tu	1194.667 µs	298.6667 µs
Frequency spacing between two neighbouring carriers 1/Tu	0.837054 kHz	3.348214 kHz
Used bandwidth (K-1)/Tu	5.705357 MHz	5.705357 MHz

7 MHz channel:
Fundamental frequency: 64/8 MHz

Parameter	8k mode	2k mode
Number of carriers K	6817	1705
Number of data carriers	6048	1512
Duration of useful part of a OFDM symbol Tu	1024 µs	256 µs
Frequency spacing between two neighbouring carriers 1/Tu	0.976563 kHz	3.90625 kHz
Used bandwidth (K-1)/Tu	6.656250 MHz	6.656250 MHz

8 MHz channel:
Fundamental frequency: 64/7 MHz

Parameter	8k mode	2k mode
Number of carriers K	6817	1705
Number of data carriers	6048	1512
Duration of useful part of a OFDM symbol Tu	896 µs	224 µs
Frequency spacing between two neighbouring carriers 1/Tu	1.116 kHz	4.464 kHz
Used bandwidth (K-1)/Tu	7.607143 MHz	7.607143 MHz

The relationship between used bandwidth and input data rate for non-hierarchical coding:

f_in = (987/1207) * rate * [1/(1+ guard interval)] * m * (PL/188) * BW_used

where	f_in:		input data rate [MBit/s]
	BW_used:		used bandwidth [MHz]
	Rate:		code rate [1/2, 2/3, 3/4, 5/6 or 7/8]
	Guard interval:		guard interval [1/4, 1/8, 1/16, 1/32, (off=0)]
	m:		bits per carrier constellation
	QPSK	->	m=2
	16 QAM	->	m=4
	64 QAM	->	m=6
	PL:		number of packets per frame (packet length) [188 or 204]

2.2.4.4.2 Hierarchical Coding

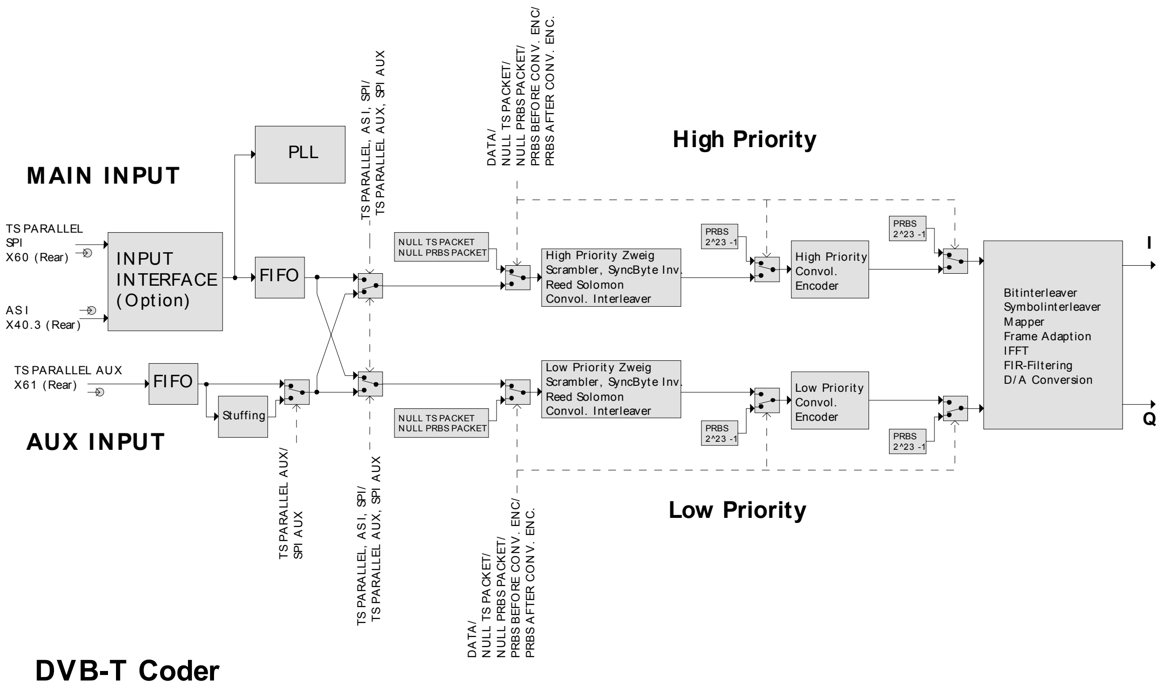


Fig.: 2.2.4-46 Block diagram with input interface and hierarchical coding options

Input:

The coder expects an MPEG2 transport stream packet for its input signal. For hierarchical coding the coder possesses two parallel MPEG2 transport stream inputs in LVDS format. The packet sync signal must be present. The two inputs are located on the rear panel. One input is labelled X60 TS PARALLEL, the other X61 TS PARALLEL. Input X60 TS PARALLEL is the main input (MAIN) and forms the reference for the clock coupling. Input X61 TS PARALLEL AUX is the auxiliary input (AUX).

With the input interface option built in, an MPEG2 transport stream input other than TS PARALLEL (SPI without stuffing) may be selected (ASI, SPI, ASI with external clock, SPI with external clock).

The different inputs are divided into two groups. One group (MAIN) consists of TS PARALLEL, ASI, SPI, ASI with external clock and SPI with external clock (without input interface option the MAIN group comprises only TS PARALLEL). The other group (AUX) consists of TS PARALLEL AUX and SPI AUX. (TS PARALLEL = SPI without stuffing, SPI with stuffing). The stuffing function is built into the coder at the auxiliary input. A correction of the PCR values that may be necessary is not made however. .

The selection of an input with a particular path (high priority or low priority) is made under the INPUT menu item. Specifying an input for a path has the effect of fixing the input group for the other path.

The coder's PLL always uses the clock of the MAIN group as reference. If TS PARALLEL AUX is selected as the auxiliary input, the data rate of TS PARALLEL AUX input must be exact and coupled with the clock of the MAIN group input. If this coupling is not given, the FIFO would overflow or underflow with the path connected with the AUX group input.

External clock coupling is not necessary if an internally generated signal, e.g. NULL TS PACKET, NULL PRBS PACKET or PRBS instead of an external MPEG2 transport stream is applied to the path assigned with the AUX group. For these internal signals, the clock rates are internally coupled.

It is also possible to select any input of the MAIN group. If SPI AUX is selected for the AUX group, then the clock coupling is in force.

Scrambler and sync byte inversion:

The MPEG2 input data streams are buffered in their own FIFOs independent of each other. The operation of the two paths (high and low priority) is also independent as regards coding.

The input signals are each scrambled in a scrambler (2^15 - 1) which is initiated with the prescribed value after every 8th transport frame. Although the sync byte (47hex) is excluded from the scrambling process, the scrambler continues to operate during this time. The sync byte is inverted (47hex -> B8hex) along with the initialization of the scrambler.

Reed-Solomon encoder:

A Reed-Solomon encoder (204, 188, t=8) is provided for each path. The encoders in the two paths operate independently of each other. 16 bytes are appended to the 188 bytes. The first 188 bytes remain unchanged. The code redundancy allows a Reed-Solomon decoder to correct up to 8 faulty bytes within a frame.

Convolutional interleaver:

In each path a convolutional interleaver with a depth I = 12 and basic delay of M = 17 delays the incoming bytes at different rates. The sync bytes are transferred in the "0" branch without any delay. After passing through the deinterleaver, all bytes show the same delay. Transmission errors will be spread over a lot of small errors which can then be more easily corrected by the Reed-Solomon decoder than an error of long duration.

Convolutional encoder and puncturing:

The convolutional interleaver is followed in each path by the convolutional encoder with constraint length K=7. The generator polynomials are 171 (octal) and 133 (octal). A choice of different puncturing rates are available: 1/2 (not punctured), 2/3, 3/4, 5/6, 7/8.
The rate 2/3 means for example that 3 output bits can be generated from 2 input bits in the convolutional encoder with puncturing.
Different code rates can be set in the two paths (high and low priority).

Bit interleaver:

In the bit interleaver that follows next, the input data stream is split up into several (v) data substreams by demultiplexing in hierarchical coding:

- with16 QAM constellation: high and low priority data streams each in two substreams
- with 64 QAM constellation: high and low priority data streams each in four substreams

Demultiplexing is defined in terms of a mapping rule.

Each substream is now passed though its own bit interleaver. The block size of all bit interleavers is 126 bits. In mode 2k, 12 blocks are used per OFDM symbol. In mode 8k, there are exactly 48 blocks per OFDM symbol.

Every bit interleaver is assigned with a linear input bit vector. The output bit vectors are defined by means of various permutations functions.

The outputs of v-bit interleavers each form a v-bit word. The low and high priority data streams are thus combined after the bit interleaver.

The following stages such as the symbol interleaver, mapper. OFDM frame structure are identical to those of non-hierarchical coding.

The relationship between used bandwidth and input data rate for hierarchical coding:

Constellation = 16 QAM:

f_in_HP = (987/1207) * rate_HP * (1/(1+ guard interval)) * (4/2) * (PL_HP/188) * BW_used
f_in_LP = (987/1207) * rate_LP * (1/(1+ guard interval)) * (4/2) * (PL_LP/188) * BW_used

Constellation = 64 QAM:

f_in_HP = (987/1207) * rate_HP * (1/(1+ guard interval)) * (6/3) * (PL_HP/188) * BW_used
f_in_LP = (987/1207) * rate_LP * (1/(1+ guard interval)) * (12/3) * (PL_LP/188) * BW_used

where	f_in_HP:	input data rate of high priority path [MBit/s]
	f_in_LP:	input data rate of low priority path [MBit/s]
	BW_used:	used bandwidth [MHz]
	Rate_HP:	code rate of high priority path [1/2, 2/3, 3/4, 5/6 or 7/8]
	Rate_LP:	code rate of low priority path [1/2, 2/3, 3/4, 5/6 or 7/8]
	Guard interval:	guard interval [1/4, 1/8, 1/16, 1/32, (off=0)]
	PL_HP:	packet length of high priority path [188 or 204]
	PL_LP:	packet length of low priority path [188 or 204]

2.2.4.4.3 Description of Menu Items for Non-Hierarchical Coding

INPUT SELECT

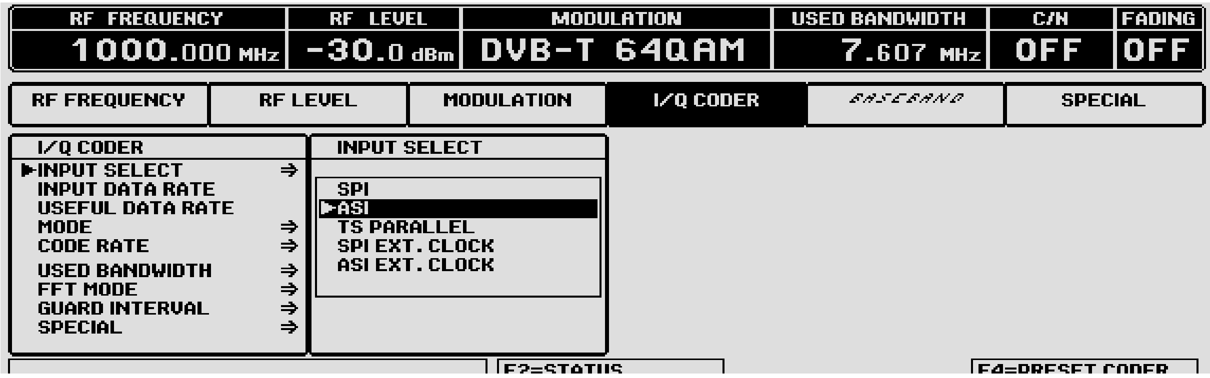


Fig.: 2.2.4-47 INPUT SELECT

The TS PARALLEL (SPI without stuffing) input can always be selected. If the input interface option is built in, ASI, SPI, ASI inputs can also be selected with external clock and SPI with external clock.

Clock coupling:

For the TS PARALLEL input the internal clock is coupled to the supplied clock. In the case of SPI EXT. CLOCK and ASI EXT. CLOCK, a clock must be supplied that may not deviate from the nominal value by more than +-50 ppm. The applied clock then acts as reference for the internal clock. The nominal clock is shown as the maximum useful data rate.

TS PARALLEL: synchronous parallel input in LVDS (low voltage differential signalling) format. This interface is defined in the DVB-PI-154 document. The associated 25-contact Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.
With this input selected the incoming data stream remains unchanged (no stuffing function).

SPI: synchronous parallel input in LVDS (low voltage differential signalling) format. This interface is defined in the DVB-PI-154 document. The associated 25-contact Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.
With this input selected the incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is also corrected.

ASI: asynchronous serial input. This BNC connector is located on the rear panel and labelled X40.3 (see also sticker on the rear).
With this input selected the incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is also corrected.

SPI EXT. CLOCK: synchronous parallel input in LVDS (low voltage differential signalling) format. This interface is defined in the DVB-PI-154 document. The associated 25-contact Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.
With this input selected data are read out with the external clock applied to the BNC connector X40.4 at the rear panel (see also sticker on the rear) and fed to the coder. The incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The applied clock may not deviate from the nominal value by more than +-50 ppm. The PCR (Program Clock Reference) value is corrected.

ASI EXT. CLOCK: asynchronous serial input. The BNC connector is located on the rear panel and labelled X40.3 (see also sticker on rear panel).
With this input selected data are read out with the external clock applied to the BNC connector X40.4 at the rear panel (see also sticker on the rear) and fed to the coder. The incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The applied clock may not deviate from the nominal value by more than +-50 ppm. The PCR (Program Clock Reference) value is corrected.

INPUT DATA RATE

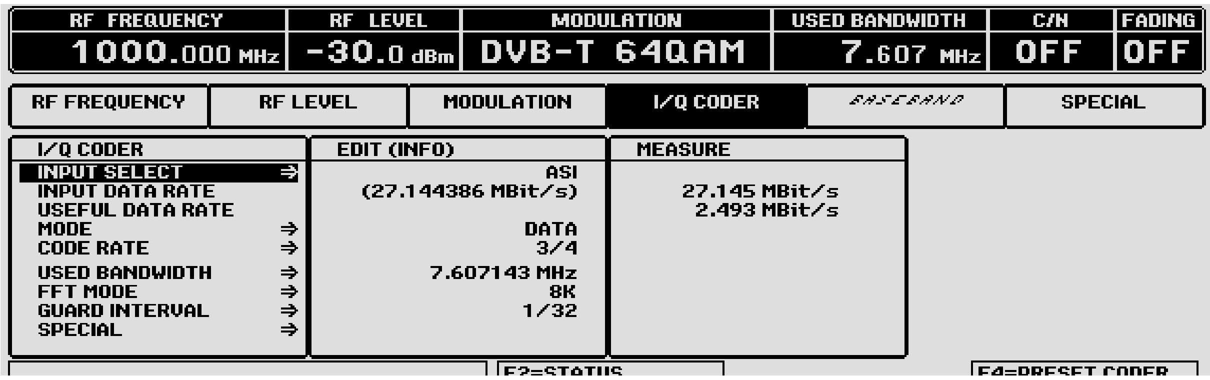


Fig.: 2.2.4-48 INPUT DATA RATE

For TS PARALLEL two values are shown in this line. The value on the left shows the calculated required input rate which must be supplied to comply with the set used bandwidth setting. The calculated value is given in [MBit/s].
The value shown on the right corresponds to the measured input data rate in [MBit/s].
The data rate applied via the parallel input must conform with the calculated data rate (+- 50 ppm).

If the SPI or ASI input is selected, the applied data rate is filled automatically to the required value (stuffing). This is possible only if the useful data rate is less than the calculated data rate.

Whereas the SFQ does not evaluate the DVALID signal in the TS PARALLEL mode, i.e. partial transport streams are not supported, only the data where DVALID = 1 are valid in the SPI mode. (see 2.2.4.5 Input Interface).

If SPI EXT. CLOCK or ASI EXT. CLOCK input is selected, the external clock must comply with the calculated input data rate to an accuracy of ± 50 ppm.

If the errors of the externally supplied data rate are too high, the VCO can no longer be tuned. The FIFO indicates an overflow (OVFLOW - overflow in FIFO of coder) or underflow (UNFLOW - underflow in FIFO of coder). If these messages occur they are displayed in the I/Q CODER of the menu bar.

USEFUL DATA RATE

If the input interface option is built in, the incoming useful data rate is measured. The useful data rate is the data rate without null packets. The measured incoming useful data rate is displayed in [MBit/s] on the right.

The useful data rate must be in any case less than the calculated maximum useful data rate which is displayed on the left.

If the incoming useful data rate is less than the calculated (required) input data rate, the data stream is filled up with null packets in the input interface option. The PCR (Program Clock Reference) values are corrected.

MODE:

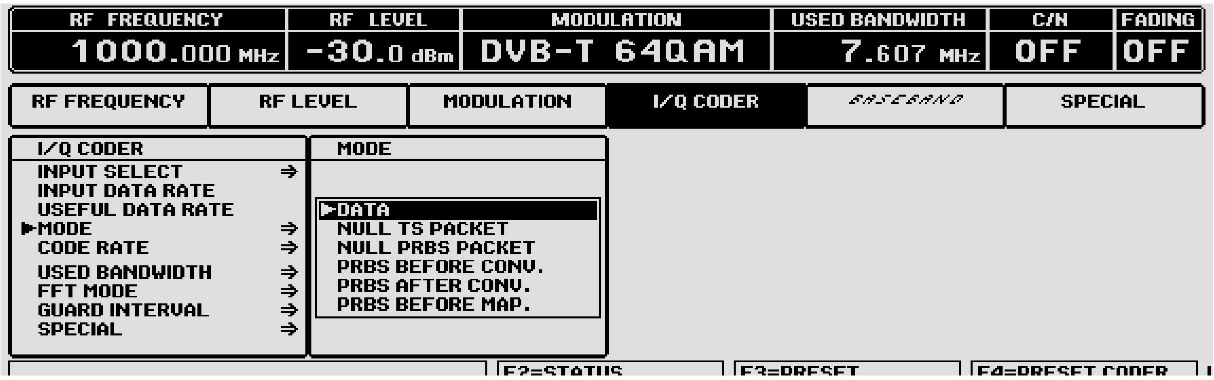


Fig.: 2.2.4-49 MODE

One of the following modes can be selected with this menu item:

DATA
PRBS BEFORE CONVOL.ENC.
PRBS AFTER CONVOL.ENC.
NULL TS PACKET
NULL PRBS PACKET

If DATA is selected, the data of the external MPEG2 transport stream are used for transmission. This mode is the normal mode.

If PRBS (Pseudo Random Bit Sequence) BEFORE CONVOL.ENC. is selected, a PRBS sequence is transmitted instead of data. This is a sequence (2^{23} – 1 or 2^{15} – 1 depending on the setting in the PRESET-PRBS SEQUENCE menu) which is described in CCITT Recommendations O.151. The PRBS sequence is generated before the convolutional encoder (following the convolutional interleaver).

If PRBS (Pseudo Random Bit Sequence) AFTER CONVOL.ENC. is selected, a PRBS sequence is transmitted instead of data. This is a sequence (2^{23} – 1 or 2^{15} – 1 depending on the setting in the PRESET-PRBS SEQUENCE menu) which is described in CCITT Recommendations O.151. The PRBS sequence is generated after the convolutional encoder (before the demux).

If NULL TS PACKET is selected, an internally generated test transport stream is transmitted. The test transport stream NULL TS PACKET is described in the DVB Measurement Guidelines (ETR 290) and is composed as follows:
47 (Hex) 1F (Hex) FF (Hex) 10 (Hex) – the remaining 184 bytes of the frame (=payload) are zeros (00 Hex).

If NULL PRBS PACKET is selected, an internally generated test transport stream is transmitted. The test transport stream NULL PRBS PACKET is composed as follows:

47 (Hex) 1F (Hex) FF (Hex) 10 (Hex) – in the remaining 184 bytes of the frames (as payload) a PRBS sequence (2^{23} – 1 or 2^{15} – 1 depending on the setting in the PRESET-PRBS SEQUENCE menu according to ITU-T Recommendations O.151) is continuously transmitted. The PRBS is transmitted byte by byte (MSB first).

If PRBS BEFORE MAP (pseudo random bit sequence) is selected, a random sequence is transmitted instead of the data. The PRBS is either 2^{23} – 1 or 2^{15}– 1 (depending on the setting in the PRESET-PRBS SEQUENCE menu) as described in ITU-T Recommendations O.151. The PRBS is generated by a mapper (after the symbol interleaver).

Note: *If TS PARALLEL is selected as input, the internal clock will be linked to the external clock. If mode PRBS, NULL TS PACKET or NULL PRBS PACKET is selected, an external clock is not required. If an external clock is available, it is used for coupling.*

CODE RATE:

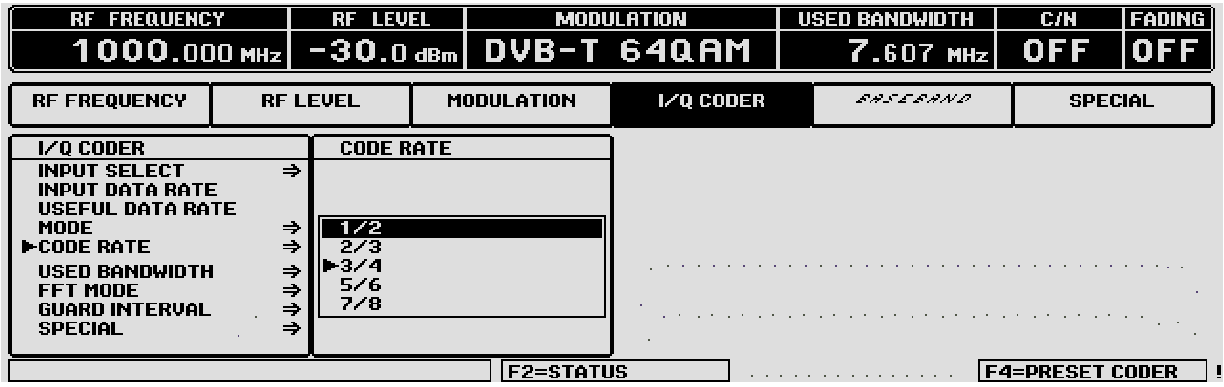


Fig.: 2.2.4-50 CODE RATE

The code rate of the convolutional encoder and puncturing can be selected under this menu item. The following code rates are possible: 1/2, 2/3, 3/4, 5/6, 7/8.
The convolutional encoder generates two output bits from an input bit. This doubling of the data rate within the convolutional encoder can partly be cancelled in the following puncturing. Code rate 1/2 signifies that no puncturing takes place.

USED BANDWIDTH

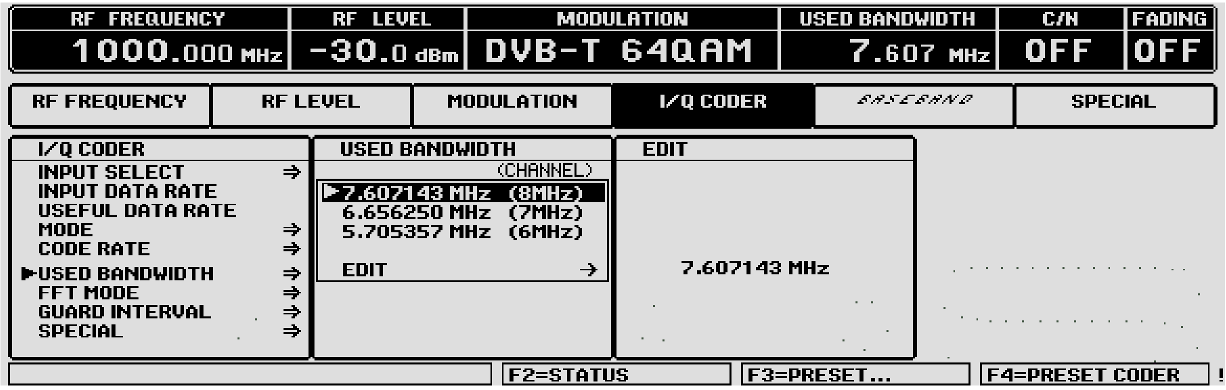


Fig.: 2.2.4-51 USED BANDWIDTH

The setting of the USED BANDWIDTH has an immediate effect on the required channel bandwidth. The DVB-T specification stipulates the values for the following channel bandwidths:

6 MHz channel bandwidth: 5.705357 MHz USED BANDWIDTH
7 MHz channel bandwidth: 6.656250 MHz USED BANDWIDTH
8 MHz channel bandwidth: 7.607143 MHz USED BANDWIDTH

These three values are stored and can be selected easily.
Moreover, USED BANDWIDTH can be set in the range from 5.163636 to 7.962617 MHz at a resolution of 1 Hz using the EDIT key.

The USED BANDWIDTH is calculated according to the following formula:

$$USED\_BANDWIDTH = (K-1)\bullet\frac{1}{T_U}$$

where K: number of carriers (6817 in 8 k FFT mode, 1705 in 2 k FFT mode)

$\frac{1}{T_U}$: spacing between two neighbouring carriers

FFT MODE

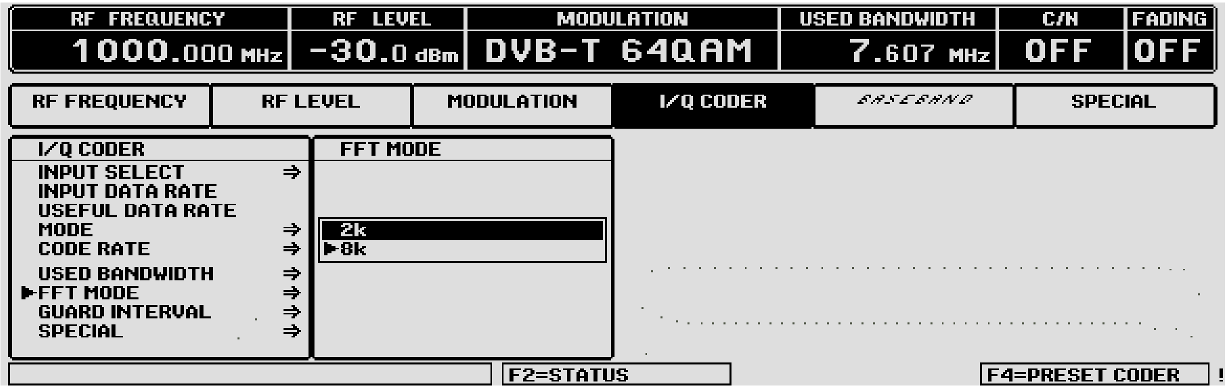


Fig.: 2.2.4-52 FFT MODE

An FFT mode of 2K or 8K can be set.
The 2K mode signifies that 1705 carriers are available. 2048 carriers are available all together but 343 are set to zero. The center carrier in the 2K mode has the number 852 if the first carrier transmitted has the number 0, or the number 1024 if all carriers are counted and the first carrier has the number 0.
6817 carriers are available in the 8K mode. 1375 of the 8192 available carriers are set to zero. The center carrier in the 8K mode has the number 3408 if the first carrier transmitted has the number 0, or the number 4096 if all carriers are counted and the first carrier has the number 0.

GUARD INTERVAL

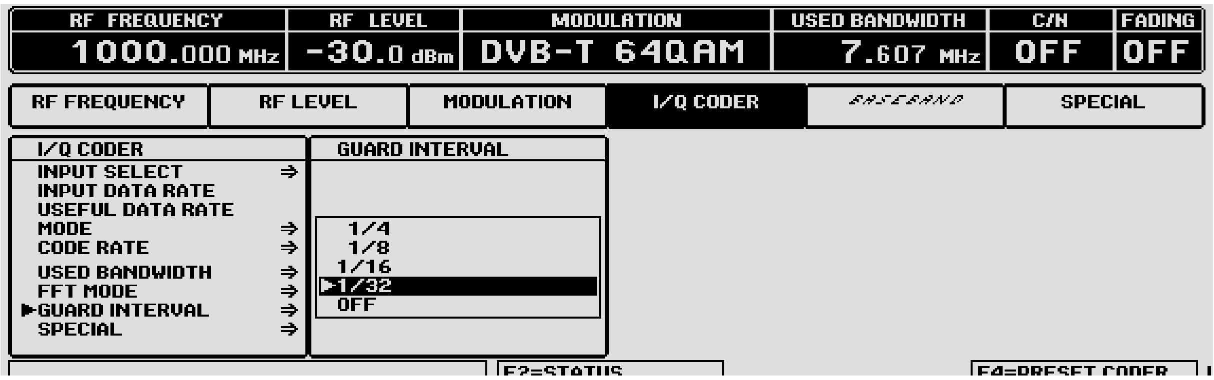


Fig.: 2.2.4-53 GUARD INTERVAL

The guard interval is sent prior to the useful part and is a cyclic continuation of the useful part. 1/4, 1/8, 1/16, 1/32 can be selected as guard interval. Under special circumstances, the guard interval can also be switched off, i.e. the cyclic continuation of the useful part is omitted – data will be transmitted continuously. If the guard interval is switched off, the MODIFY message will be displayed in the window of the I/Q CODER since this guard interval setting is not covered by the DVB specification. With the F4 - PRESET CODER key pressed, the guard interval is set to 1/32.

SPECIAL

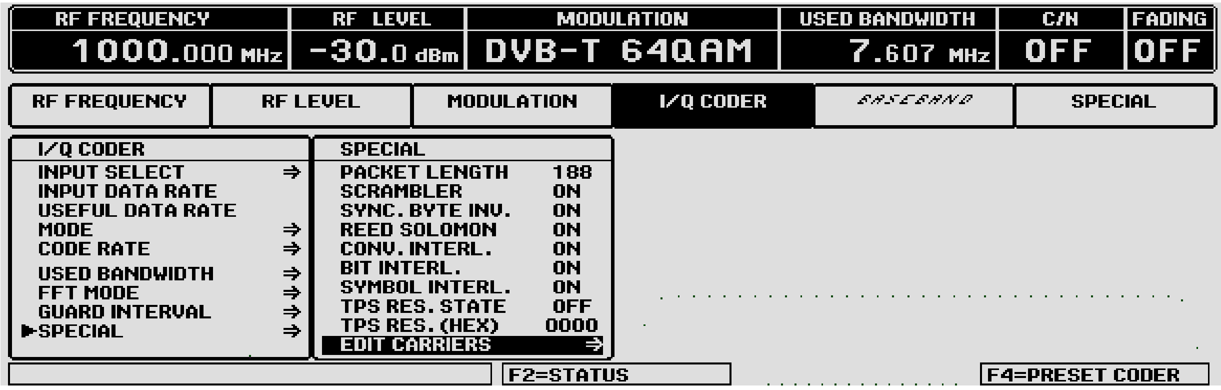


Fig.: 2.2.4-54 SPECIAL

All settings performed in the Special menu violate the normal operating state and therefore result in the message MODIFY which is displayed in the I/Q CODER window. All special settings can be cancelled by pressing the F4 - PRESET CODER key.

PACKET LENGTH

The frame length of the MPEG2 transport stream can be modified from 188 to 204 bytes.

Note:	*The DVALID signal at the TS PARALLEL and SPI input is not evaluated.*

SCRAMBLER

The energy dispersal (scrambler) can be switched off. The sync word inversion (47 (Hex) -> B8 (Hex) are retained for the first of every 8 MPEG2 transport stream frames.

SYNC BYTE INV

The sync word inversion (47 (Hex) -> B8 (Hex)), which is normally performed for each first of 8 MPEG2 frames, can be switched off.

REED-SOLOMON

The Reed-Solomon encoder can be switched off. This means that the first 188 bytes of the transport stream are transmitted in the same way as if the Reed-Solomon encoder were switched on. If a transport stream with a frame length of 188 bytes is supplied, 16 bytes will be added so that each frame consists of 204 bytes. With a packet length of 204 the frame length is 204 bytes. If the Reed-Solomon encoder is switched off, the bytes remain unchanged with a frame length of 204 bytes. With 188 bytes, undefined bytes are added.

If coded Reed-Solomon data streams are to be handled, such data streams must already be scrambled according to standard and sync word inversion must also be performed according to standard since the order is as follows: first scrambler, then sync word inversion and finally the Reed-Solomon encoder. The scrambler and sync word inversion then have to be switched off in the coder.

CONV. INTERL.

The convolutional interleaver can be switched off. Incoming data are transmitted unchanged.

BIT INTERL.

The bit interleaver can be switched off.

SYMBOL INTERL.

The symbol interleaver can be switched off.

TPS
Most TPS bits are indirectly influenced by the menu settings. The submenu described below here comprises the items which allow direct modification of the TPS information.

CELL ID(HEX)
The eight TPS bits s_{40} to s_{47} are used to transmit a cell identifier. The 16-bit cell identifier identifies the transmitter cell from which the signal originates. The most significant byte of the cell identifier (cell_id b_{15} to b_8) is transmitted in frames numbered 1 or 3. The least significant byte of the cell identifier (cell_id b_7 to b_0) is transmitted in frames numbered 2 or 4. The following table clarifies the interrelations.

TPS bit number	Frame number 1 or 3	Frame number 2 or 4
s_{40}	cell_id b_{15}	cell_id b_7
s_{41}	cell_id b_{14}	cell_id b_6
s_{42}	cell_id b_{13}	cell_id b_5
s_{43}	cell_id b_{12}	cell_id b_4
s_{44}	cell_id b_{11}	cell_id b_3
s_{45}	cell_id b_{10}	cell_id b_2
s_{46}	cell_id b_9	cell_id b_1
s_{47}	cell_id b_8	cell_id b_0

In compliance with the specification, the TPS bit length indicator is set to the value (011111) bin = (31) dec. When the reserved TPS bits are used, the length indicator is readjusted (see below).

TPS RES.STATE and TPS RES.(HEX)
The two menu items are used to influence the value of the reserved bits of the TPS information. In the ETSI EN 300 744 specification, the 68 TPS bits of a frame are referred to as s_0 to s_{67}. The bits s_{48} to s_{53} are reserved for future applications and must be set to 0. Their value can be modified for testing.
The modification is switched on and off with TPS RES.STATE. In the switched-off state, all reserved bits are set to 0 irrespective of TPS RES.(HEX), and the length indicator is set to the value (011111)bin = (31)dec. In the ON state, the reserved bits are transmitted according to TPS RES.(HEX); the length indicator is (100101)bin = (37)dec.

The value of reserved bits is entered in hexadecimal format with TPS RES.(HEX). The values range from (00) hex to (3F) hex. To do this, the numeric keypad or the cursor keys, especially for entering characters A to F, can be used. The following example shows the relation between entry value and TPS bits.

Entry value (hexadecimal)	2				1			
Entry value (binary)	x	x	1	0	0	0	0	1
TPS bit			s_{48}	s_{49}	s_{50}	s_{51}	s_{52}	s_{53}

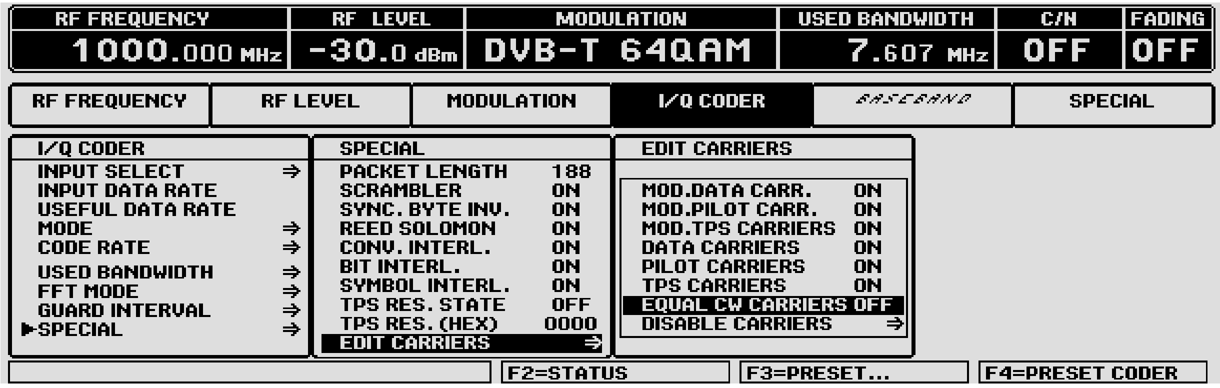


Fig.: 2.2.4-55 EDIT CARRIERS

EDIT CARRIERS

The modulation of carrier groups can be switched off under this menu item. Whole carrier groups or also individual carriers can be switched off.
Functions with reference to modifying carriers can be combined as required.

MOD.DATA CARR.

Deactivates modulation of data carriers.

Note: *The internal signal level is reduced by 24 dB. In this case the maximum output level of the SFQ is –17.5 dBm. Carrier suppression also deteriorates by 24 dB.*

MOD.PILOT CARR.

Deactivates modulation of pilots.

Note: *The internal signal level is reduced by 24 dB. In this case the maximum output level of the SFQ is –17.5 dBm. Carrier suppression also deteriorates by 24 dB.*

MOD.TPS CARR.

Deactivates modulation of TPS (Transmission Parameter Signalling) carriers.

Note: *The internal signal level is reduced by 24 dB. In this case the maximum output level of the SFQ is –17.5 dBm. Carrier suppression also deteriorates by 24 dB.*

DATA CARRIERS

Deactivates all data carriers.

PILOT CARRIERS

Deactivates all pilots.

TPS CARRIERS

Deactivates all TPS carriers.

EQUAL CW CARRIERS

In the normal state, EQUAL CW CARRIERS is set to "off". The carriers are modulated if the modulation has not been explicitly switched off. The carriers have standard-conformal levels. If no other special functions have been activated, the MODIFY message is not displayed in the I/Q CODER window.

The normal state can also be restored by pressing the F4=PRESET CODER key.

If EQUAL CW CARRIERS is set to "on", the modulation of the data, pilot and TPS carriers is disabled. All carriers are unmodulated and have an equal level (equal CW carriers). The MODIFY message is displayed in the I/Q CODER window.

If the guard interval is inserted, residual modulation of the carriers is visible. Switching off the guard interval (GUARD INTERVAL = OFF) yields pure CW carriers.

The spacing between two adjacent carriers is 1/TU – in the case of 8 MHz channel (USED BANDWIDTH = 7.607 MHz) and FFT MODE = 2K, the carrier offset is 1/(224 µs) = 4.464... kHz).

For carrier offset, see the channel bandwidth tables.

If all carriers have been enabled, the maximum output level is low, if only a few carriers have been enabled (DISABLE CARRIERS), the maximum output level is higher.

Example:

RF = 1000 MHz, RF LEVEL = -30 dBm, 8 MHz channel, FFT mode = 2K

GUARD INTERVAL = OFF

EQUAL CW CARRIERS = ON

DISABLE CARRIERS 10 to 1704,

i.e. only the carriers 0, 1, 2 to 9 have been enabled (10 CW carriers).

The maximum output level (sum level) is +5.1 dBm in this example.

The carrier offset is 4.464... kHz.

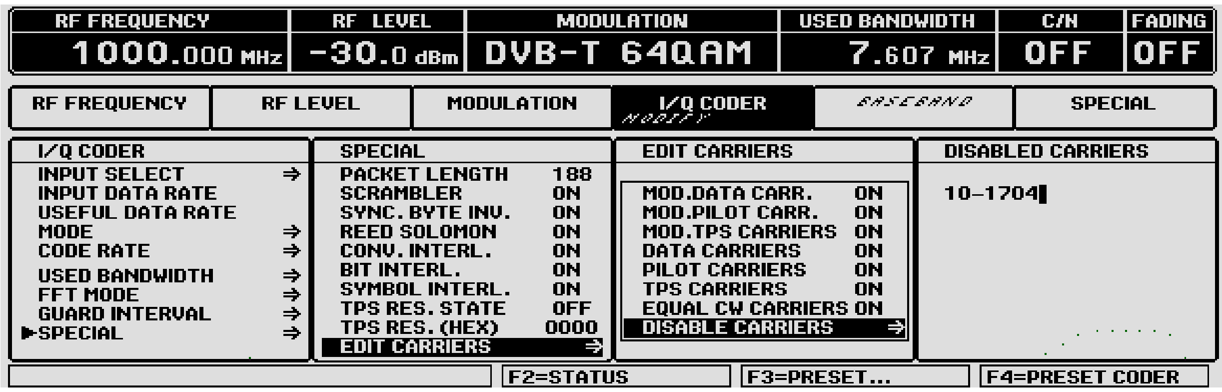


Fig.: 2.2.4-56 DISABLE CARRIERS

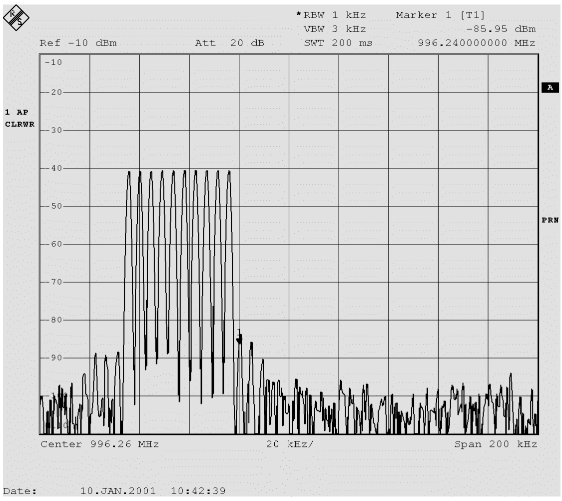


Fig.: 2.2.4-57 EQUAL CW CARRIERS

DISABLE CARRIERS

Any number of carriers can be switched off.
To switch off a carrier enter its carrier number. For 2K, counting is from 0 to 1704 and for 8K from 0 to 6816:

2K FFT mode:
Carrier 0 to 2047 with center carrier being 1024. Carriers 0 to 171 and 1877 to 2047 are always switched off, i.e. carrier 172 is the first carrier that is switched on and corresponds to the carrier 0 of counting from 0 to 1704.

Carriers set to zero	First carrier	Center carrier	Last carrier	Carriers set to zero
0 to 171	172	1024	1876	1877 to 2047
---	0	852	1704	---

8K FFT mode:
Carrier 0 to 8191 with the center carrier being 4096. Carriers 0 to 687 and 7505 to 8191 are always switched off, i.e. carrier 688 is the first carrier that is switched on and corresponds to the carrier 0 of counting from 0 to 6816.

Carriers set to zero	First carrier	Center carrier	Last carrier	Carriers set to zero
0 to 687	688	4096	7504	7505 to 8191
---	0	3408	6816	---

To switch off several consecutive carriers the first and the last carrier to be switched off has to be entered separately using a hyphen (minus sign).
Another group of carriers or an individual carrier is separated from the previous entry by a dot. Entry is made without any blanks. All combinations are possible.
The entry of carriers to be switched off is limited to 40 characters.
If a carrier which is not available is entered (e.g. carrier 2000 in FFT-MODE = 2K), the entry of the carrier is ignored.
If carrier ranges which are partly available are entered (e.g. carriers 1000-2000 in FFT-MODE = 2K), the entry of the non available carriers is ignored and 1000-1704 appears on the display instead.

All carriers are always activated on switching to the FFT mode.

Examples:

- Carrier 1024, carriers from 1026 to 1030, carriers form 1201 to 1030 and carrier 1444 are to be switched off:
  1024.1026-1030.1201-1300.1444
- Carrier 555, carrier 557, carrier 559 and carriers from 1024 to 2000 are to be switched off:
  555.557.559.1024-2000

Messages that may be displayed in the message window of the I/Q CODER menu (for non-hierarchical and hierarchical coding):

Message	Meaning	Reason	Remedy
MODIFY	Warning	Caused by a special setting which is not stipulated in the DVB-T standard.	After selection of the I/Q CODER field, the F4 PRESET CODER softkey is offered. On pressing the F4 - PRESET CODER key the MODIFY message should disappear.
UNLOCKED	Error	Oscillator not locked	With TS PARALLEL, check clock rate of MPEG2 transport stream.
WRONG INPUT CLOCK	Warning/error	Input clock: error >50 ppm	With TS PARALLEL, check clock rate of MPEG2 transport stream.
NO CLK	Error	No input clock available	Check whether an input data stream is applied.
NO DAT	Error	No input data available.	Check whether an input data stream is applied.
OVFLOW	Error	FIFO overflow in I/Q Coder	With TS PARALLEL, check clock rate of MPEG2 transport stream.
OVFLOW	Error	FIFO overflow in Input Interface	Check clock rate of MPEG2 transport stream or useful data rate.
UNFLOW	Error	FIFO underflow	With TS PARALLEL, check clock rate of MPEG2 transport stream.
FRMERR	Error	Frame error – no valid transport stream, the sync byte is not in the right place or is not available	The set packet length may be incorrect.

2.2.4.4.4 Description of Individual Menu Items with Hierarchical Coding

General:

If separate settings can be made for the Low and High Priority path, e.g. the code rate, two columns will be available: EDIT HIGH PRIO (High Priority path) and EDIT LOW PRIO (Low Priority path).

Settings made after the demultiplexer – after combining the two paths – are no longer separated by columns.

INPUT SELECT

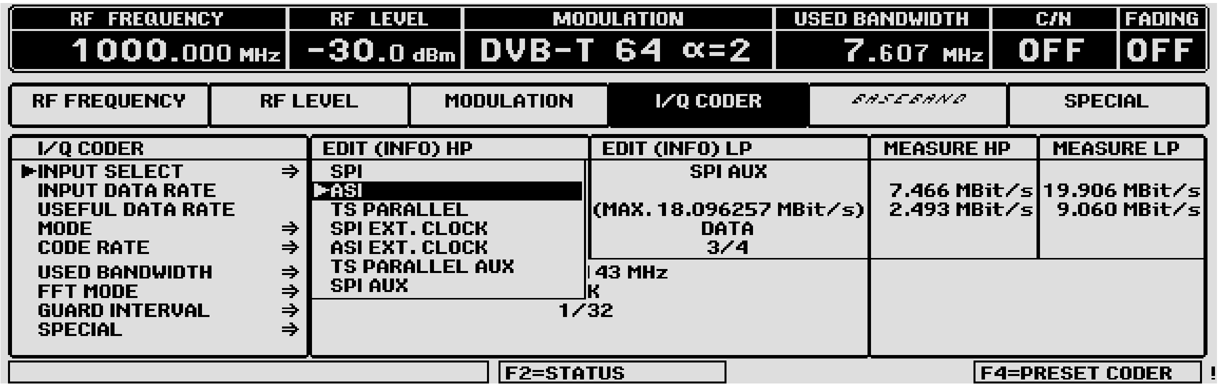


Fig.: 2.2.4-58 INPUT SELECT

The selectable inputs form 2 groups (MAIN and AUX). MAIN consists of TS PARALLEL, ASI, SPI, ASI with external clock and SPI with external clock (if option input interface is not provided, MAIN only consists of TS PARALLEL). The other group (AUX) consists of TS PARALLEL AUX and SPI AUX. (TS PARALLEL = SPI without stuffing).

For the High Priority path, for example, one input of group MAIN is selected. Group AUX is then automatically assigned to the Low Priority path.

If the selection is made for the Low Priority path, the other group is automatically assigned to the High Priority path. The setting made last applies.

Clock locking:
The input of the group MAIN is mainly for clock locking. With TS PARALLEL selected, the internal clock is directly locked to the supplied clock. With ASI and SPI selected, option INPUT INTERFACE determines the clock. With SPI EXT. CLOCK and ASI EXT. CLOCK selected, the user has to supply a clock which may not differ by more than ±50 ppm from the nominal clock. This supplied clock is the reference for the internal clock.

TS PARALLEL: synchronous parallel input in LVDS (Low Voltage Differential Signalling) format. For interface see document DVB-PI-154. The associated 25-pin Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.
When this input is selected the incoming data stream is not changed (no stuffing).

SPI: synchronous parallel input in LVDS (Low Voltage Differential Signalling) format. For interface see document DVB-PI-154. The associated 25-pin Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.
When this input is selected the incoming data stream is changed (stuffing and PCR correction). The useful data rate supplied is filled up with null packets to the required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is also corrected.

ASI: Asynchronous serial input. The BNC connector is located on the rear panel and labelled X40.3 (see also sticker at rear).
With this input selected the incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is also corrected.

SPI EXT. CLOCK: synchronous parallel input in LVDS (Low Voltage Differential Signalling) format. The interface is described in DVB-PI-154. The associated 25-pin Sub-D connector is located on the rear panel and is labelled X60 TS PARALLEL.
With this input selected the data are read out by means of the external clock applied to BNC connector X40.4 at the rear panel (see also sticker at rear) and are passed on to the coder. The incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled with null packets to the required data rate. The applied clock may not differ by more than ±50 ppm from the nominal value. The PCR (Program Clock Reference) value is corrected.

ASI EXT. CLOCK: asynchronous serial input. The BNC connector is located on the rear panel and is labelled X40.3 (see also sticker at rear).
With this input selected the data are read out by means of the external clock applied to BNC connector X40.4 at the rear panel (see also sticker at rear) and are passed on to the coder. The incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled with null packets to the required data rate. The applied clock may not differ by more than ±50 ppm from the nominal value. The PCR (Program Clock Reference) value is corrected.

TS PARALLEL AUX: additional synchronous parallel input in LVDS (Low Voltage Differential Signalling) format. For interface see document DVB-PI-154. The associated 25-pin Sub-D connector is provided at the rear panel and labelled X61 TS PARALLEL AUX.
With this input selected, the incoming data stream is not changed (no stuffing).

SPI AUX: additional synchronous parallel input in LVDS (Low Voltage Differential Signalling) format. For interface see document DVB-PI-154. The associated 25-pin Sub-D connector is provided at the rear panel and labelled X61 TS PARALLEL AUX.
With this input selected, the incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is corrected.

INPUT DATA RATE

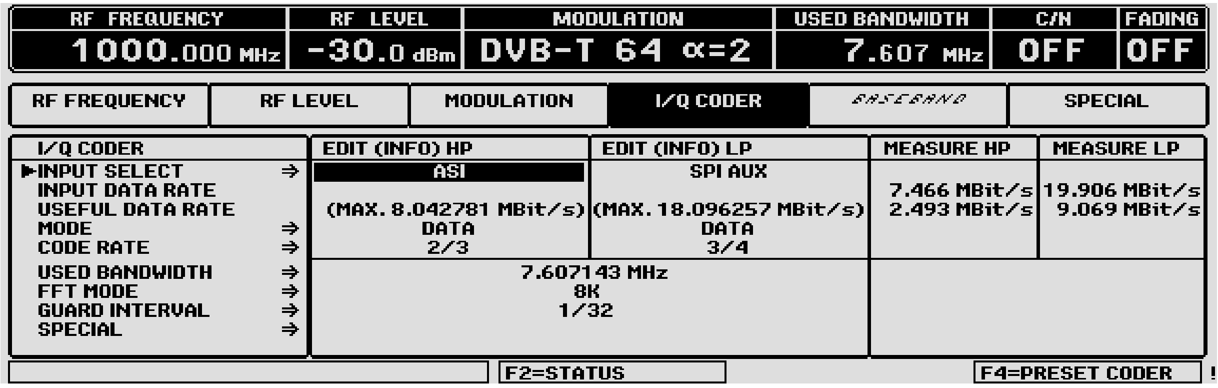


Fig.: 2.2.4-59 INPUT DATA RATE

In this line and with TS PARALLEL and TS PARALLEL AUX activated, the required (calculated) input data rates are displayed on the left both in the High and Low Priority path columns. The measured input data rates are displayed on the right in the corresponding column.

With TS PARALLEL selected as input, the data rate supplied externally via the parallel input must correspond to the calculated required data rate (±50 ppm).

With TS PARALLEL AUX selected as input, the data rate supplied externally via the parallel input must correspond to the calculated required data rate and must also be coupled with the data rate of the MAIN group. Otherwise, the FIFO may become full or empty.

Note: *If this clock of the AU input is not coupled to the clock of the MAIN group, select the SPI AUX input for the AUX group as this clock coupling is then ensured by stuffing.*

With SPI or ASI selected as input, the externally supplied data rate is automatically filled up to the required value (stuffing). This is only possible if the useful data rate is less than the calculated required data rate.

With SPI EXT. CLOCK or ASI EXT. CLOCK selected as input, the externally supplied clock has to correspond with the calculated input data rate with an accuracy of ± 50 ppm.

With SPI AUX selected as input, the externally supplied data rate has to be filled up automatically to the corresponding value (stuffing). This is only possible if the useful data rate is less than the calculated required data rate.

If the errors of the externally supplied data rate are too high, the VCXO can no longer be tuned. The FIFO indicates an overflow (OVFLOW - overflow in FIFO of coder) or underflow (UNFLOW - underflow in FIFO of coder). If these messages occur they are displayed in the I/Q CODER field of the menu bar.

USEFUL DATA RATE

If the input interface option is built in, the incoming useful data rate is measured for the input of the MAIN group. The useful data rate is the data rate without null packets. The incoming useful data rate is displayed in [MBit/s] in the corresponding column on the right.

In any case, the useful data rate must be less than the calculated maximum useful data rate which is displayed in the corresponding column on the left.

If the incoming useful data rate is less than the calculated (required) input data rate, the data stream is filled up with null packets in the input interface option. The PCR (Program Clock Reference) values are corrected.

MODE:

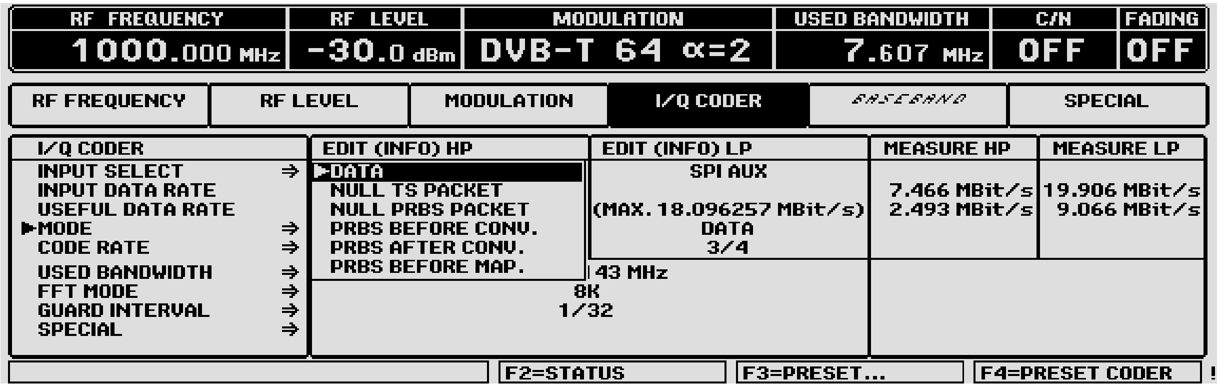


Fig.: 2.2.4-60 MODE

One of the following modes for the High Priority and the Low Priority path can be selected with this menu item:

DATA
PRBS BEFORE CONVOL.ENC.
PRBS AFTER CONVOL.ENC.
NULL TS PACKET
NULL PRBS PACKET
PRBS BEFORE MAP.

With DATA selected, the data of the externally supplied MPEG2 transport stream are used for transmission. This mode is the normal mode.

With PRBS (Pseudo Random Bit Sequence) BEFORE CONVOL.ENC. selected, a pseudo random bit sequence is transmitted instead of data. This is a 2^{23} –1 PRBS sequence which is described in CCITT Recommendations O.151. The PRBS sequence is generated before the convolutional encoder .

If PRBS (Pseudo Random Bit Sequence) AFTER CONVOL.ENC. is selected, a PRBS sequence is transmitted instead of data. This is a 2^{23} –1 PRBS sequence which is described in CCITT Recommendations O.151. The PRBS sequence is generated after the convolutional encoder.

If NULL TS PACKET is selected, an internally generated test transport stream is transmitted. The test transport stream NULL TS PACKET is described in the DVB Measurement Guidelines (ETR 290) and is composed as follows:

47 (Hex) 1F (Hex) FF (Hex) 10 (Hex) – the remaining 184 bytes of the frame (=payload) are zeros (00 Hex).

If NULL PRBS PACKET is selected, an internally generated test transport stream is transmitted. The test transport stream NULL PRBS PACKET is composed as follows:

47 (Hex) 1F (Hex) FF (Hex) 10 (Hex) – in the remaining 184 bytes of the frames (as payload) a PRBS sequence (2^23 - 1 according to CCITT Recommendations O.151) is continuously transmitted. The PRBS is transmitted byte by byte (MSB first).

If PRBS BEFORE MAP (pseudo random bit sequence) is selected, a random sequence is transmitted instead of the data. The PRBS is either 2^{23} – 1 or 2^{15}– 1 (depending on the setting in the PRESET-PRBS SEQUENCE menu) as described in ITU-T Recommendations O.151. The PRBS is generated by a mapper (after the symbol interleaver).

Note: *If PRBS BEFORE MAP. is selected, the MODE for the HP and LP section is set to PRBS BEFORE MAP. When the user then selects MODE = DATA for one of the sections, the other one is also set to MODE = DATA.*

Note: *If only an MPEG2 transport stream source is available, it can supply a path (Low or High Priority path) via an input of the MAIN group. This also ensures clock locking to the data source. The other path is automatically assigned to the input of the AUX group (TS PARALLEL AUX, SPI AUX). For this path, NULL PRBS PACKET can now for example be selected in the MODE menu. A valid transport stream is then transmitted in this path without a second MPEG2 transport stream source being required. NULL PRBS packets are generated with the suitable data rate.*

CODE RATE:

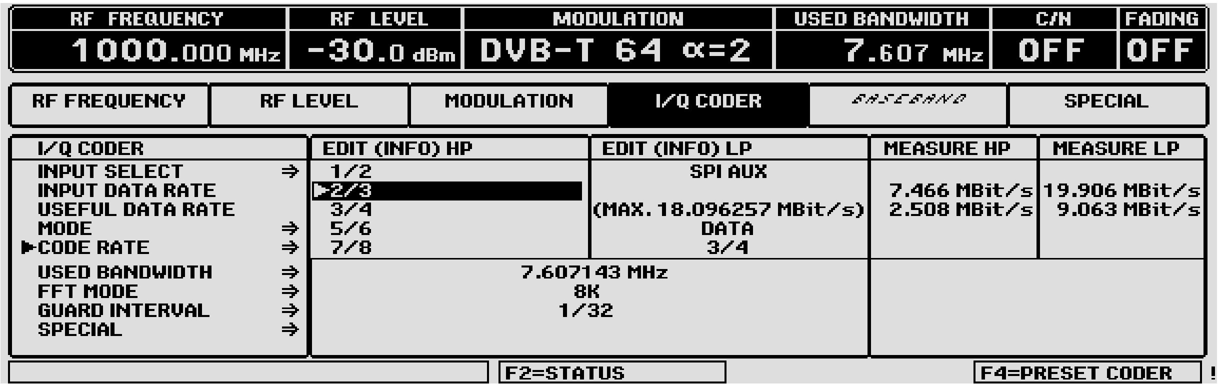


Fig.: 2.2.4-61 CODE RATE

The code rate of the convolutional encoder and puncturing for the High and Low Priority path can be selected under this menu item. The settings are independent of each other.

The following code rates are possible: 1/2, 2/3, 3/4, 5/6, 7/8.
The convolutional encoder generates two output bits from an input bit. This doubling of the data rate within the convolutional encoder can partly be cancelled in the following puncturing. Code rate 1/2 signifies that no puncturing takes place.

The following three menu items are identical to non-hierarchical coding:
USED BANDWIDTH
FFT MODE
GUARD INTERVAL

SPECIAL

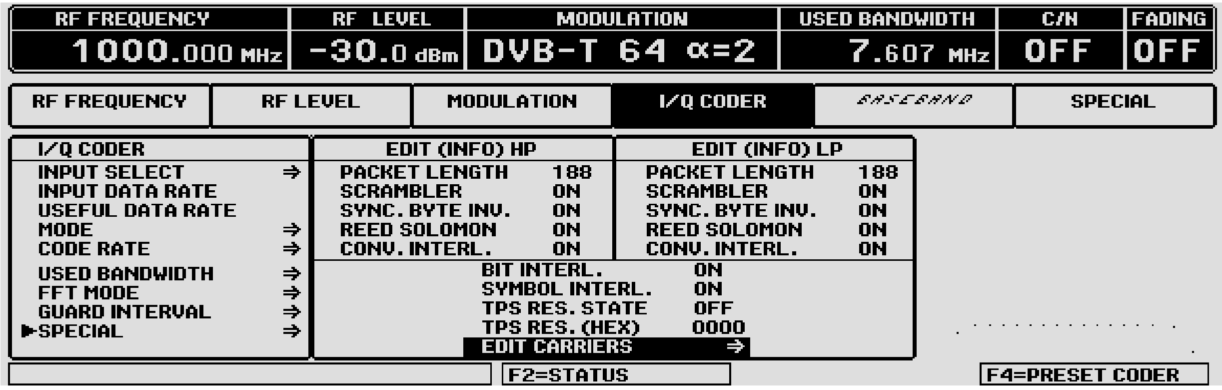


Fig.: 2.2.4-62 SPECIAL

All settings performed in the Special menu violate the normal operating state and therefore result in the message MODIFY which is displayed in the I/Q CODER window. All special settings can be cancelled by pressing the F4 - PRESET CODER key.

PACKET LENGTH

The frame length of the MPEG2 transport stream can be modified from 188 to 204 bytes.

Note:	*The DVALID signal at the TS PARALLEL and SPI input is not evaluated.*

SCRAMBLER

The energy dispersal (scrambler) can be switched off individually for the High and Low Priority paths. The sync word inversion (47 (Hex) -> B8 (Hex) are retained for the first of every 8 MPEG2 transport stream frames.

SYNC BYTE INV

The sync word inversion (47 (Hex) -> B8 (Hex)), which is normally performed for each first of 8 MPEG2 frames, can be switched off separately for the High and Low Priority paths.

REED-SOLOMON

The Reed-Solomon encoder can be switched off separately for the two paths. This means that the first 188 bytes of the transport stream are transmitted in the same way as if the Reed-Solomon encoder were switched on. If a transport stream with a frame length of 188 bytes is supplied, 16 bytes will be added so that each frame consists of 204 bytes. With a packet length of 204 the frame length is 204 bytes. If the Reed-Solomon encoder is switched off, the bytes remain unchanged with a frame length of 204 bytes. With 188 bytes, undefined bytes are added.

If Reed-Solomon-encoded data streams are to be handled, such data streams must already be scrambled according to standard and sync word inversion must also be performed according to standard since the order is as follows: first scrambler, then sync word inversion and finally the Reed-Solomon encoder. The scrambler and sync word inversion then have to be switched off in the coder.

CONV. INTERL.

The convolutional interleaver can be switched off separately for the High and Low Priority paths. Incoming data are transmitted unchanged.

The following items in the Special menu are identical to non-hierarchical coding:
BIT INTERL.

SYMBOL INTERL.

TPS

- **CELL ID(HEX)**
- **TPS RES.STATE**
- **TPS RES.(HEX)**

EDIT CARRIERS

- **MOD.DATA CARR.**
- **MOD.PILOT CARR.**
- **MOD.TPS CARR.**
- **DATA CARRIERS**
- **PILOT CARRIERS**
- **TPS CARRIERS**
- **DISABLE CARRIERS**

2.2.4.5 ITU-T J.83/B

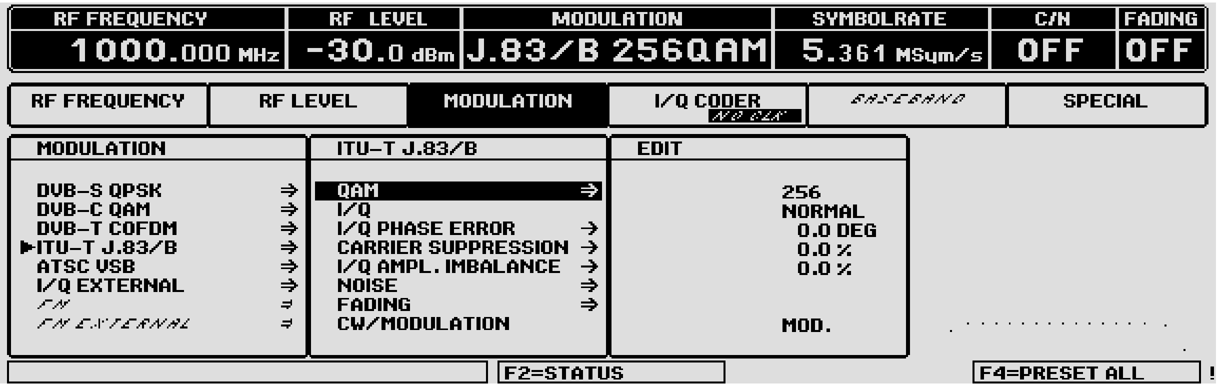


Fig.: 2.2.4-63 **ITU-T J.83/B**

After selecting ITU-T J.83/B in the modulation menu, the settings for the ITU-T J.83/B coder can be made in the I/Q CODER menu.

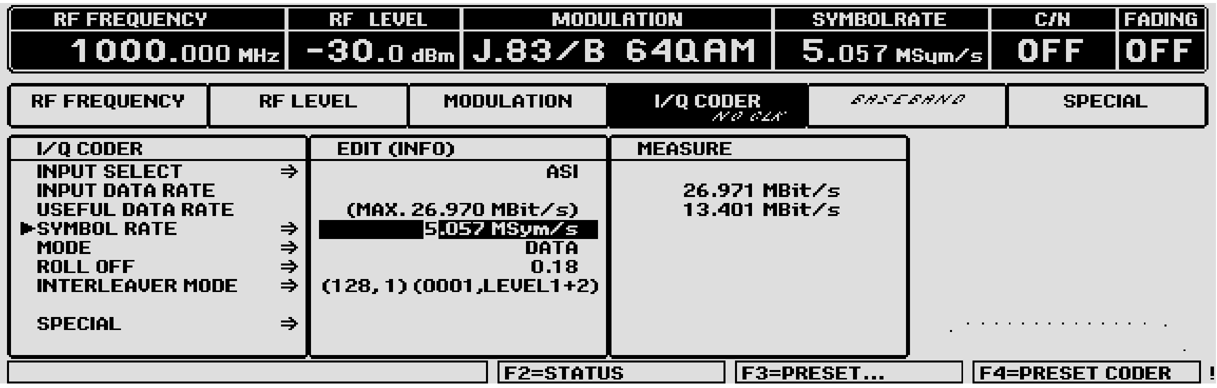


Fig.: 2.2.4-64 I/Q CODER menu

The settings for J.83/B modulation and those for the I/Q modulator have been made in the modulation menu (see 2.2.3.1.5).

2.2.4.5.1 Coding

Input:

The coder expects MPEG-2 transport stream packets as the input signal. The coder has a parallel MPEG-2 transport stream input in LVDS format. The signal packet sync has to be present if the coder is to synchronize to the input signal. The parallel input connector (25-contact SUB-D) is located at the rear of the test transmitter. It is labelled "X60 TS PARALLEL". The input data rate is fixed at 26.97035 Mbit/s. The coder will tolerate a deviation of ±10 % from this data rate.

Since the Input Interface option is always fitted for J.83/B, another MPEG2 transport stream input can be selected as well (ASI, SPI, ASI with external clock, SPI with external clock) The appropriate data rates are generated by the input interface - even if a lower or higher data rate is applied to the input.

If no data are applied to the input of the J.83/B coder, this is indicated NO DAT is displayed in the I/Q CODER field (the clock is always provided by the input interface).

Coding and error control meet the ITU-T J.83/B specification.

Synchronization to MPEG-2 transport stream

The data input signal is searched for the sync word 0 x 47. If it is found, a check is made to determine whether the packet sync appears again after 188 bytes. If this is the case without any interruptions for a specific number of times, the coder can synchronize to the input data.

Checksum generator:

The sync byte 47h ahead of the MPEG data stream is replaced by a checksum calculated from the preceding 187 bytes.

The data are then buffered in a RAM. Data are written into this RAM at the incoming byte clock of the transport stream of 3.371 MHz with 64 QAM or 4.851 MHz with 256 QAM. It is read at the J.83/B-specific clock of 3.792 MHz with 64 QAM or 5.361 MHz with 256 QAM. The higher clock frequency of the J.83/B coding for reading the RAMs is obtained by the Reed-Solomon encoder adding 6 symbols per FEC frame (forward error correction), by inserting 42 trailer bits with 64 QAM or 40 trailer bits with 256 QAM as well as by puncturing in the trellis coder.

Conversion of data from eight- to seven-bit width:

The J.83/B coder uses symbols that are seven bits wide (see QAM symbols 64 QAM with six bits and 256 QAM with eight bits). Conversion is performed after reading data from the RAM.

Reed-Solomon encoder:

A Reed-Solomon encoder (128, 122, t = 6) follows. Six parity symbols are inserted after every 122 symbols. These 128 symbols represent a Reed-Solomon block. This applies to 64 QAM as well as to 256 QAM. The first 122 symbols remain unchanged. The code redundancy allows correction of up to three errored symbols within a Reed-Solomon block.

Interleaver:

The ITU-T J.83/B specification stipulates twelve different possibilities for the interleaver. Interleaver depth I and base delay J are both varied.

The following interleaver modes can be set and are identified with the four-bit wide control word.

Control word	Interleaver depth I	Base delay J
0000 or 0001	128	1
0010	128	2
0011	64	2
0100	128	3
0101	32	4
0110	128	4
0111	16	8
1000	128	5
1001	8	16
1010	128	6
1100	128	7
1110	128	8

Interleaving thus provides a protection against interferers with a duration of up to 759 µs.

The trailer contains the information about the interleaver mode for the receiver.

Randomizer

The incoming data are scrambled in the randomizer. This means a uniform distribution of spectrum components within the 6 MHz channel. The randomizer XORs the data stream with a 3-bit PRBS sequence (**p**seudo **r**andom **b**inary **s**equence). The generator polynomial for this sequence is:

$f(x) = X^3 + X + \alpha^3$

where:

$\alpha^{7} + \alpha^3 + 1 = 0$

The randomizer is reinitialized after each FEC frame of 60 Reed-Solomon blocks with 64 QAM as well as 88 Reed-Solomon blocks with 256 QAM.

Trellis coder with 64 QAM

The input data stream of the trellis coder is divided into trellis groups of 28 bits each. A 6-bit wide QAM symbol is available at the coder output. Four of the six bits are directly taken from the input. The remaining two bits run through a differential precoder that determines the modifications of the quadrant. The two bits are then taken to the binary convolutional coder that contains puncturing. Four bits at the input yield five bits at the output. Thus, the whole trellis coder generates 30 output bits from 28 input bits with 64 QAM. The two puncturing bits appear in every fifth QAM symbol. The trailer at the end of each FEC frame is processed in the trellis coder like normal data symbols with 64 QAM.

Trellis coder with 256 QAM

The input data stream of the trellis coder for 256 QAM is divided into trellis groups of 38 bits each. An 8-bit wide QAM symbol is available at the coder output. Six of the eight bits are directly taken from the input. The remaining two bits run through a differential precoder that determines the modifications of the quadrant. The two bits are then taken to the binary convolutional coder that contains puncturing. Four bits at the input yield five bits at the output. Thus, the whole trellis coder generates 40 output bits from 38 input bits with 256 QAM. The two puncturing bits appear in every fifth QAM symbol.

In contrast to 64 QAM, the output symbols are divided into non-sync trellis groups and sync trellis groups. A FEC frame consists of 88 Reed-Solomon blocks with 128 symbols each. At its end there is a trailer with 40 bits in length. Puncturing produces 2076 trellis groups with 40 bits per FEC frame. The trailer is inserted in the last five trellis groups, i.e. eight bits per trellis group.

Mapper

The output symbols from the mapper represent the addressing for the look-up table. They generate a 6-bit constellation symbol with 64 QAM and an 8-bit one with 256 QAM. These symbols are applied to the modulator. The roll off is set to 0.18 with 64 QAM and to 0.12 with 256 QAM.

Note: *If a setting that differs from the standard coding procedure is made, the MODIFY warning is displayed in the I/Q coder field.*

By pressing the PRESET CODER (F4) key, any non-standard setting is replaced by the standard setting.

The user is warned in the same field if no input data are applied: NO DAT.

If no valid MPEG2 transport stream is applied, the following warning is displayed: FRMERR (frame error).

Overview of warnings in the I/Q CODER menu field:

NO DAT: No data stream is present

FRMERR: No valid transport stream or wrong packet length

UNLOCK: Error, PLL of oscillators not locked, data rate at coder input deviates by more than 10 %

MODIFY: A setting in the coder is non-standard

OVFLOW: The clock rate of the MPEG2 transport stream or the useful data rate is too high

The currently set status can be called by pressing the STATUS (F2) key. The status display is described after the menu items and their settings.

If modulation menu J.83/B is selected, the settings for the J.83/B coder can be set in the I/Q CODER menu.

The settings for the J.83/B modulation mode and for the I/Q modulator have already been made in the modulation menu (see 2.2.3.1.5).

2.2.4.5.2 Description of Menu Items

INPUT SELECT

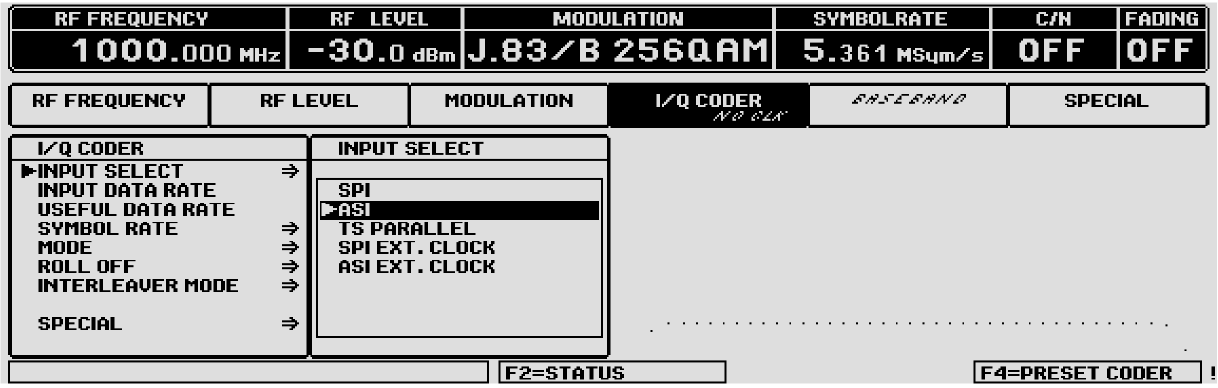


Fig.: 2.2.4-65 INPUT SELECT

For coding to J.83/B, TS PARALLEL ASI, SPI, ASI with external clock and SPI with external clock can be selected as data inputs.

For the TS-PARALLEL input, the data source has to be set to the required input data rate of the coder. A deviation of up to ±10 % is accepted but displayed on the coder by the message MODIFY.

Clocking:

With TS PARALLEL, the internal clock locks onto the supplied clock. The data rate may deviate by max. 10 % from the standard data rate of 26.97035 Mbit/s with 64 QAM and 38.81070 Mbit/s with 256 QAM.

If the ASI or SPI inputs are selected using the input interface, the input interface determines the clock.

With SPI EXT. CLOCK and ASI EXT. CLOCK, the clock has to be externally applied and may deviate by max. ±10 % from the nominal clock. The applied clock then represents the reference for the internal clock. The user can read the nominal clock rate from the USEFUL DATARATE display. The external clock is fed to connector X40.4 (labelled TS CLOCK EXT).

TS PARALLEL: Synchronous, parallel input in LVDS (low voltage differential signalling) format. The interface is described in document DVB-PI-154. The associated 25-contact trapezoidal connector is on the rear of the unit and labelled X60 TS PARALLEL.

On selecting this input, the incoming data stream is not modified (no stuffing).

SPI: Synchronous, parallel input in LVDS (low voltage differential signalling) format. The interface is described in document DVB-PI-154. The associated 25-contact trapezoidal connector is on the rear of the unit and labelled X60 TS PARALLEL.

On selecting this input, the incoming data stream is modified (stuffing and PCR correction). The applied useful data rate is filled with null packets up to the required data rate. The required value is automatically calculated and set. The PCR (program clock reference) value is also corrected.

ASI: Asynchronous, serial input. The BNC connector is on the rear of the unit and labelled X40.3 (see adhesive label on rear panel).

On selecting this input, the incoming data stream is modified (stuffing and PCR correction). The applied useful data rate is filled with null packets up to the required data rate. The required value is automatically calculated and set. The PCR (program clock reference) value is corrected.

SPI EXT. CLOC: Synchronous, parallel input in LVDS (low voltage differential signalling) format. The interface is described in document DVB-PI-154. The associated 25-contact trapezoidal connector is on the rear of the unit and labelled X60 TS PARALLEL.

On selecting this input, the data are read out with the external clock applied to rear-panel BNC connector X40.4 (see adhesive label on rear panel) and transferred to the coder. The incoming data stream is modified (stuffing and PCR correction). The applied useful data rate is filled with null packets up to the required data rate. The applied clock may deviate from the required value by max. ±10 %. The PCR PCR (program clock reference) value is corrected.

ASI EXT. CLOCK: Asynchronous, serial input. The BNC connector is on the rear of the unit and is labelled X40.3 (see adhesive label on rear panel).

On selecting this input, the data are read out with the external clock applied to rear-panel BNC connector X40.4 (see adhesive label on rear panel) and transferred to the coder. The incoming data stream is modified (stuffing and PCR correction). The applied useful data rate is filled with null packets up to the required data rate. The applied clock may deviate from the required value by max. ±10 %. The PCR (program clock reference) value is corrected.

INPUT DATA RATE

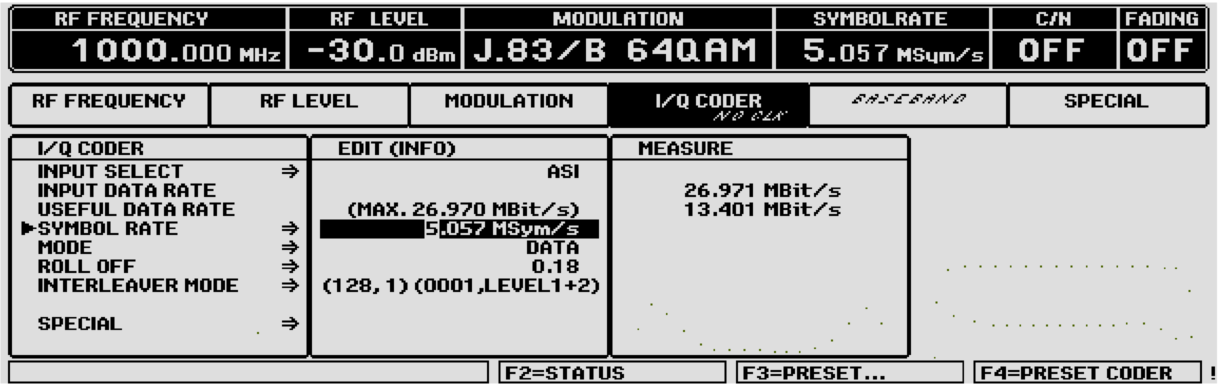


Fig.: 2.2.4-66 INPUT DATA RATE

With TS PARALLEL, two values are displayed in this line.

The left-hand value represents the required calculated input data rate, which has to be supplied to ensure that the nominal data rate is correct for current settings. The measured input data rate in [Mbit/s] is displayed on the right-hand side.

The data rate, which is externally applied via the parallel input, may deviate by max. ±10 % from the nominal data rate of 26.97037 Mbit/s with 64 QAM or 38.81070 Mbit/s with 256 QAM. A higher deviation produces the UNLOCKED message and indicates a problem with the internal PLL.

Whereas the SFQ does not evaluate the DVALID signal is not evaluated in the TS PARALLEL mode, i.e. partial transport streams are not supported, only the data where DVALID = 1 are valid in the SPI mode (see 2.2.4.5 Input Interface).

USEFUL DATA RATE

The payload of the data stream is measured, i.e. the null packets are ignored.

SYMBOL RATE

The symbol rate can be set to within ±10 % of the nominal symbol rate if the Input Interface option is fitted. The input interface inserts the required null packets.

The relationship between the symbol rate and the data rate is as follows for J.83/B:

In the case of 64 QAM, a FEC frame consists of 60 Reed-Solomon blocks of 122 symbols each and 6 Reed-Solomon parity symbol segments. A trailer of 42 bits in length is appended to each FEC frame.

In the case of 256 QAM, a FEC frame consists of 88 Reed-Solomon blocks of 122 symbols each and 6 Reed-Solomon parity symbol segments. A trailer of 40 bits in length is appended to each FEC frame.

The following symbol rate is therefore obtained for 64 QAM:

$$\text{Symbol rate}\left[\frac{\text{QAM\_symb}}{\text{s}}\right]=\text{TS\_DATA RATE}\left[\frac{\text{bit}}{\text{s}}\right]*$$

$$\left[\frac{(60\text{RS\_blocks/FEC}*128*7bit/RS\_block+42\,bit/FEC)}{(122*7bit/RS\_block*60RS\_blocks/FEC)}\right]*\frac{30}{28}*\frac{1}{6}*\frac{QAM\_symb}{bit}$$

The symbol rate for 256 QAM is calculated as follows:

$$\text{Symbol rate}\left[\frac{\text{QAM\_symb}}{\text{s}}\right]=\text{TS\_DATA RATE}\left[\frac{\text{bit}}{\text{s}}\right]*$$

$$\left[\frac{(88\text{RS\_blocks/FEC}*128*7bit/RS\_block+40\,bit/FEC)}{(122*7bit/RS\_block*88RS\_blocks/FEC)}\right]*\frac{40}{38}*\frac{1}{8}*\frac{QAM\_symb}{bit}$$

This results in a QAM symbol rate of 5.056941 Msymb/s with 64 QAM and of 5.360537 Msymb/s with 256 QAM.

MODE

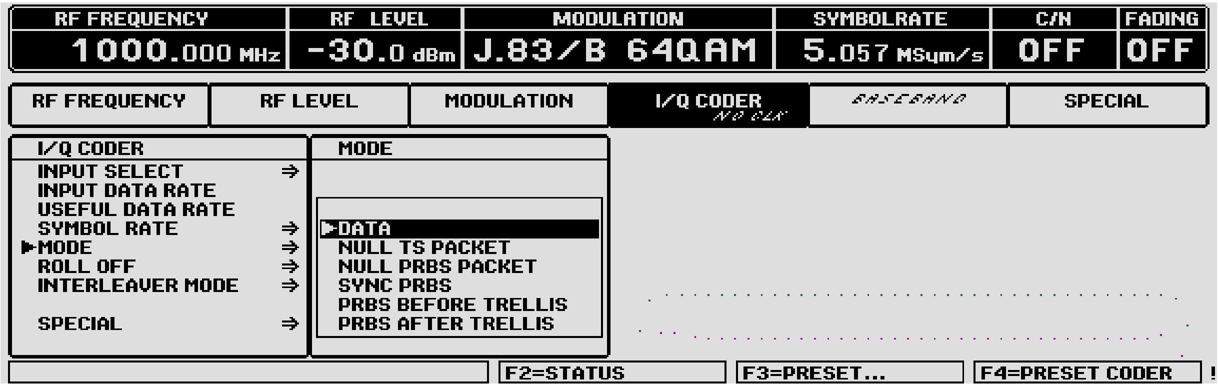


Fig.: 2.2.4-67 MODE

64QAM, 256 QAM:

With this menu item, six different possibilities can be selected. These are:

DATA
NULL TS PACKET
NULL PRBS PACKET
SYNC PRBS
PRBS BEFORE TRELLIS
PRBS AFTER TRELLIS

DATA: If DATA is selected, the data of the external MPEG2 transport stream are used for transmission. This is the normal mode.

NULL TS PACKETS: An internally generated test transport stream with the following structure is transmitted:

47 (HEX), 1F (HEX), FF (HEX), 10 (HEX) – the remaining 184 bytes of the frame (= payload) are nulls (00 HEX).

NULL PRBS PACKET: An internally generated test transport stream is transmitted. The test transport stream has the following structure:

47 (HEX) 1F (HEX), FF (HEX), 10 (HEX) – in the remaining 184 bytes of the frame (= payload) a PRBS sequence (2^{23}–1 or 2^{15}–1, depending on the setting in the PRESET PRBS SEQUENCE menu, in line with ITU-T Recommendations O.151, pseudo random binary sequence) is continuously transmitted. The PRBS is transmitted byte by byte (MSB first).

SYNC PRBS: An internally generated test transport stream is transmitted. The test transport stream has the following structure:

47 (HEX) – in the remaining 187 bytes of the frame (= payload) a PRBS sequence (2^{23}–1 or 2^{15}–1, depending on the setting in the PRESET PRBS SEQUENCE menu, in line with ITU-T Recommendations O.151, pseudo random binary sequence) is continuously transmitted. The PRBS is transmitted byte by byte (MSB first).

PRBS BEFORE TRELLIS: A PRBS sequence (2^{23} –1 or 2^{15}–1, depending on the setting in the PRESET PRBS SEQUENCE menu, in line with ITU-T Recommendations O.151, pseudo random binary sequence) which ignores any headers is transmitted. It is fed in ahead of the trellis coder.

PRBS AFTER TRELLIS: A PRBS sequence (2^{23} –1 or 2^{15}–1, depending on the setting in the PRESET PRBS SEQUENCE menu, in line with ITU-T Recommendations O.151, pseudo random binary sequence) which ignores any headers is transmitted. The PRBS sequence is fed in after the trellis coder at the QAM symbol clock.

Note:	*If TS PARALLEL is selected as the input, the externally applied clock is transferred to the coder. If the NULL TS PACKET, NULL PRBS PACKET, SYNC PRBS, PRBS BEFORE TRELLIS or PRBS AFTER TRELLIS mode is selected, the clock input interface is used.*

ROLL OFF

The roll-off factor cannot be set by the user and is internally set in accordance with the selected mode.

The roll-off factor is 0.18 with 64 QAM and 0.12 with 256 QAM.

INTERLEAVER MODE

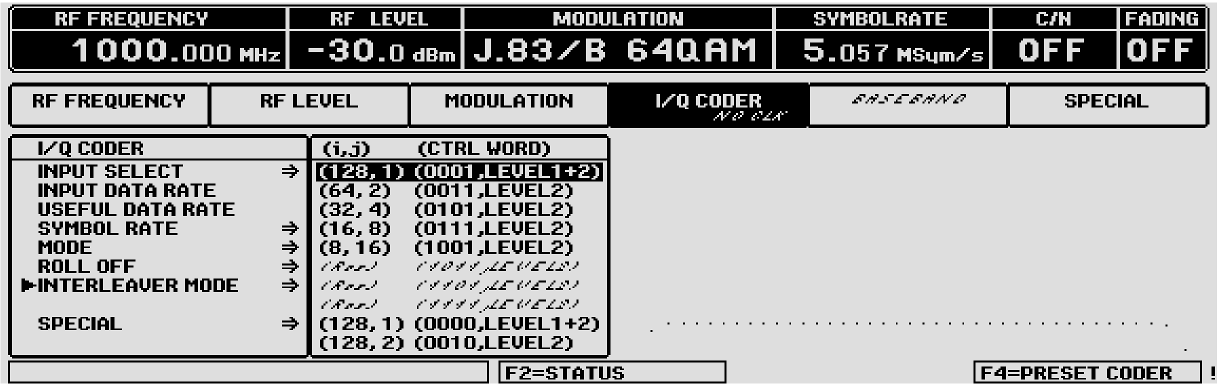


Fig.: 2.2.4-68 Interleaver mode

With J.83/B, 13 different interleaver modes can be set, which are displayed under INTERLEAVER MODE. Mode 128,1 is displayed twice with CRTL WORD 0000 and 001 in line with specification ITU-T J.83/B. The selected CTRL WORD is transferred to the receiver in the trailer.

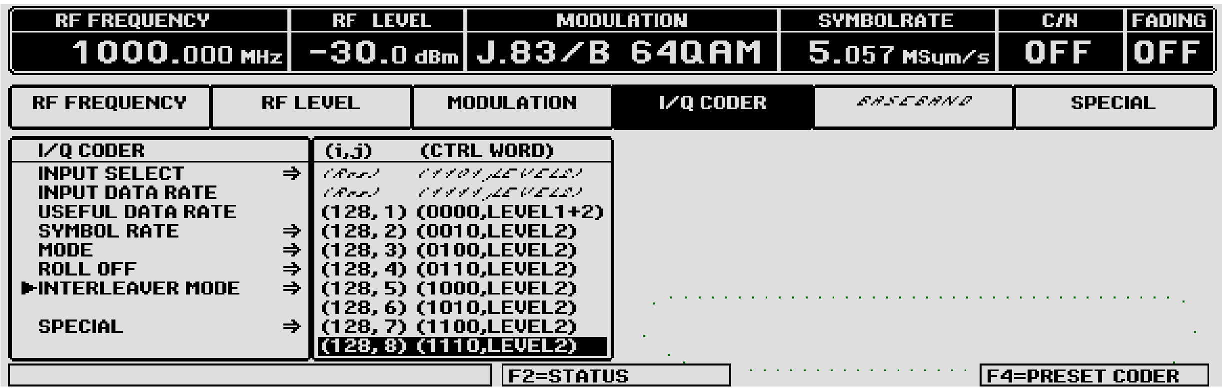


Fig.: 2.2.4-69 Mode 128,1

The following interleaver modes can be set:

CTRL WORD (4 Bit)	Interleaver depth I (number of tabs)	Base delay J	Level
0001	128	1	1 and 2
0011	64	2	2
0101	32	4	2
0111	16	8	2
1001	8	16	2
1011	Reserved (cannot be set)		
1101	Reserved (cannot be set)		
1111	Reserved (cannot be set)		
0000	128	1	1 and 2
0010	128	2	2
0100	128	3	2
0110	128	4	2
1000	128	5	2
1010	128	6	2
1100	128	7	2
1110	128	8	2

SPECIAL

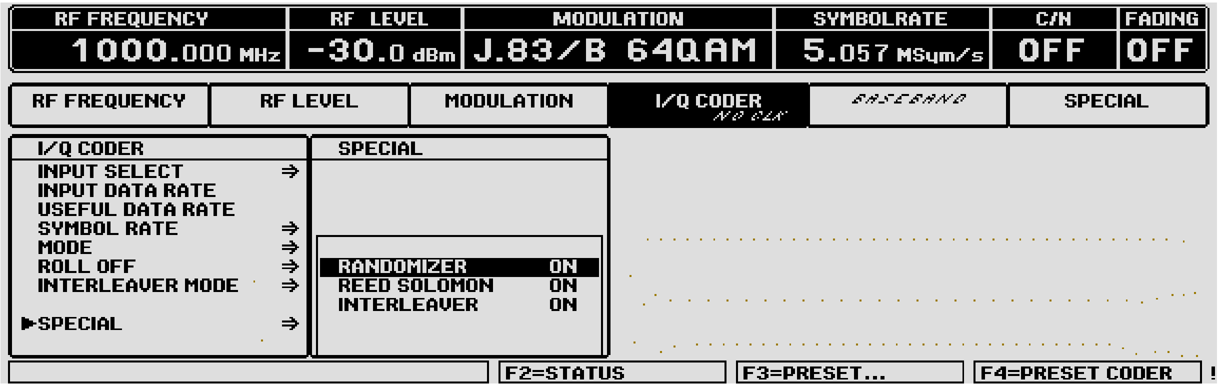


Fig.: 2.2.4-70 SPECIAL

All settings in the Special menu violate the normal operating mode and therefore cause the MODIFY message to be displayed in the I/Q CODER window. All special settings can be cancelled by pressing the F4-PRESET CODER key.

RANDOMIZER

Scrambling for energy dispersal can be switched off. Data go through the randomizer and are passed on unaltered to the trellis coder.

REED SOLOMON

The Reed-Solomon encoder can be switched off. Nulls are inserted instead of the six correction symbols.

INTERLEAVER

The interleaver can be switched off. The incoming data are passed on unaltered to the randomizer.

2.2.4.6 ATSC 8VSB

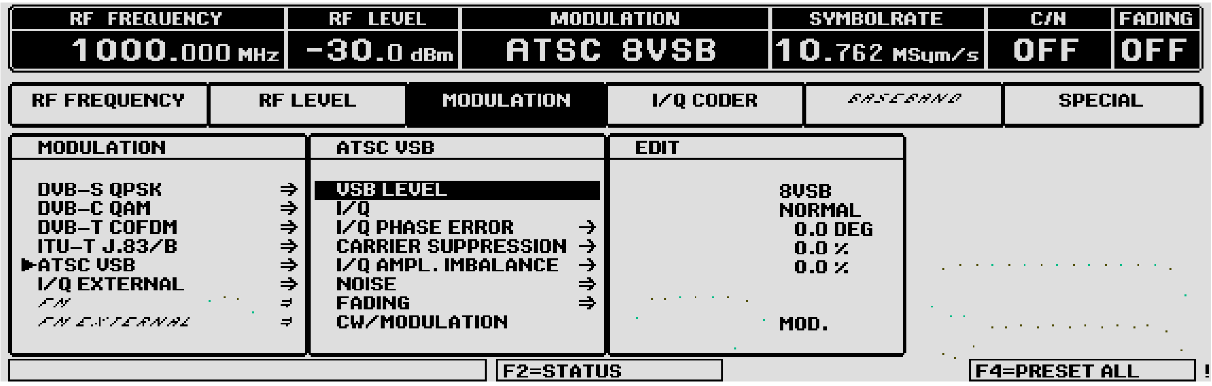


Fig.: 2.2.4-71 ATSC 8VSB

If ATSC VSB is selected in the modulation menu, the settings for the ATSC 8VSB coder can be set in the I/Q CODER menu.

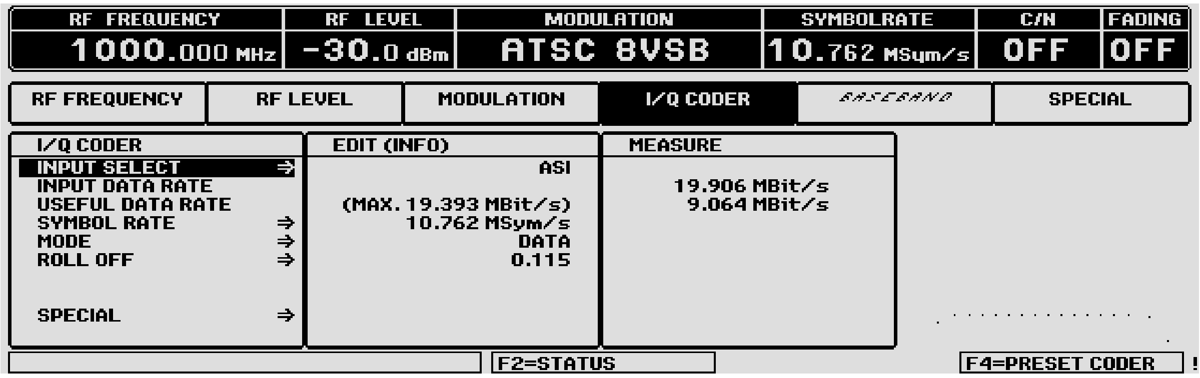


Fig.: 2.2.4-72 I/Q CODER menu

The settings for the modulation mode 8VSB and the settings for the I/Q modulator have already been made in the modulation menu (see 2.2.3.1.4).

2.2.4.6.1 Coding

Input:

The coder is expecting MPEG2 transport stream packets as the input signal. The coder has a parallel MPEG2 transport stream input in LVDS format. The signal packet sync has to be present, if the coder is to synchronize onto the input signal. The connector for the parallel input (25-pole SUB-D) is located at the rear of the test transmitter. It is labelled “X60 TS PARALLEL”. The input data rate is fixed at 19.392658 Mbit/. The coder will tolerate a variation of ±10 % in this data rate.

If the Input Interface option is fitted, another MPEG2 transport stream input can be selected (ASI, SPI, SMPTE, ASI with external clock, SPI with external clock, SMPTE with external clock). The corresponding data rates are generated by the input interface - even if a lower or higher data rate is applied to the input.

If no data are applied to the input of the VSB coder, this is indicated in the I/Q CODER field with NO DAT or NO CLK.

Coding and error control meet the specification Doc. A/53.

Synchronization to the MPEG2 transport stream

The data input signal is searched for sync word 0 x 47. If it is found, a check is made to determine whether the packet sync appears again after 188 bytes. If this occurs at a certain repetition rate without any interruptions, the coder can synchronize onto the input data.

The data are then buffered in a RAM. The incoming byte clock of the transport stream with a rate of 2.424 MHz is written to this RAM. The data are read with the VSB-specific clock with a rate of 2.696 MHz. The clock frequency for VSB coding is higher because the Reed-Solomon encoder adds 20 bytes and 208 field sync bytes are inserted every 313 segments.

Randomizer

The incoming data are scrambled in the randomizer. The randomizer XORs the data stream with a 16-bit PRBS sequence (**P**seudo **R**andom **B**inary **S**equence). The generating polynomial for this sequence is:

$G(16) = X^{16} + X^{13} + X^{12} + X^{11} + X^{7} + X^{6} + X^{3} + X + 1$

The each register is reinitialized with 0x180 after each field sync.
This corresponds to the registers X^{16}, X^{15}, X^{14}, X^{13}, X^{9} and X^{8} . The sync word 0x47, the 208 bytes of the field sync and the 20 zeros for the Reed-Solomon bytes that follow are not involved. The randomizer, therefore, provides a balanced, flat spectrum for even long data sequences.

Reed-Solomon encoder

A Reed-Solomon encoder (207, 187, t = 20) follows. The zeros added beforehand are replaced by 20 Reed-Solomon bytes. The first 188 bytes remain unchanged. The code redundancy allows correction of up to 10 errored bytes within a frame (segment).

Convolutional interleaver

The convolutional interleaver with an interleaver depth of I=52 and a basic delay of M=4, delays the incoming data by different values. The sync bytes are always transferred in the "0" branch, i.e. without any delay. The positions of the sync segment and the 208 bytes of the field sync are not changed. The advantage of this is that longer transmission errors are distributed among many minor errors and so can be corrected by the Reed-Solomon decoder.

Trellis coder and mapper

The transition from bytes to symbols takes place in the trellis coder. Four symbols are assigned per byte. Each symbol comprises 3 bits, i.e. a further bit is added to each dibit.

A cascade of twelve, identical trellis coders are under multiplexer and demultiplexer control, this again corresponding to an interleaver function.

The symbol rate is then defined as 10.7622 Msymbols/s for the two operating modes. This corresponds to the quadruple 8VSB byte clock.

In the mapper, the corresponding amplitude stages are assigned to the various bit combinations.

Addition of Segment Sync and Field Sync

The packet syncs at the beginning of each segment are replaced by 4 symbols which represent the data segment sync.

Every 312 segments are followed by the 208 bytes of the segment sync. The segment sync comprises training sequences for the receiver, the VSB mode information as well as the last symbols of the last segment.

Pulse filtering for VSB is permanently set to a roll-off of R=0.1152.

Note:	*If the selected setting deviates from the standard coding procedure, in the field I/Q CODER the warning MODIFY appears in the menu.*

If a setting that differs from the standard coding procedure is made, the MODIFY warning is displayed in the menu bar for the I/Q coder field. By pressing the PRESET CODER (F4) key, any non-standard setting is replaced by the standard setting.

The user is warned in the same field if no input data are applied: NO DAT or if the input clock is missing: NO CLK.

If no valid MPEG2 transport stream is applied, the following warning is displayed: FRMERR (frame error).

Overview of warnings in the I/Q CODER field of the menu bar:

NO CLK: no clock
NO DAT: no data stream
FRMERR: no valid transport stream available or the packet length is incorrect
UNLOCK: error, PLL of oscillators not locked, data rate deviation of more than 10 % at coder input
MODIFY: a coder setting is non-standard
OVFLOW: the clock rate of the MPEG2 transport or the useful data rate is too high

The currently set status can be called by pressing the STATUS (F2) key. Status display information is described after the submenu items and their settings.

If ATSC VSB is selected in the MODULATION menu, the settings for the ATSC VSB coder can be made in the I/Q CODER.

The settings concerning the modulation mode 8VSB as well as the settings of the I/Q modulator have already been made in the MODULATION menu (see 2.2.3.2).

2.2.4.6.2 Description of Menu Items

INPUT SELECT

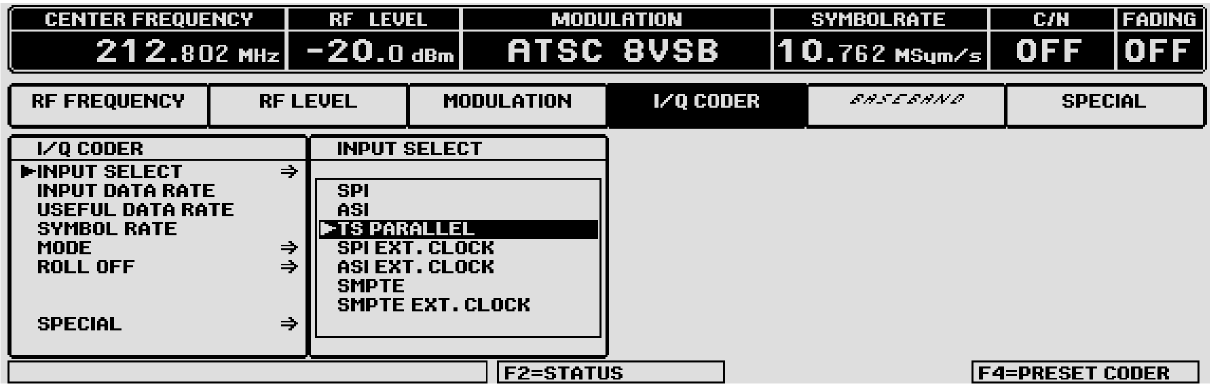


Fig.: 2.2.4-73 INPUT SELECT

Depending on whether the Input Interface option is fitted, either only TS PARALLEL (no input interface) or the ASI, SPI, ASI inputs with external clock and SPI with external clock can be selected.

Clock locking:

With TS PARALLEL, the internal clock locks directly onto the supplied clock. The data rate may deviate by max. 10% from the nominal data rate of 19.392658 Mbit/s.

If the ASI or SPI inputs are selected with the input interface fitted, the input interface determines the clock.

With the SPI EXT. CLOCK, ASI EXT. CLOCK and SMPTE EXT. CLOCK, the clock has to be externally applied and may deviate by max. ±10% from the nominal clock. The applied clock then represents the reference for the internal clock. The user can read off the nominal clock rate from USEFUL DATA RATE. The external clock is fed in at connector X40.4 (labelled TS CLOCK EXT).

TS PARALLEL: synchronous parallel input in LVDS (low voltage differential signalling) format. This interface is defined in the DVB-PI-154 document. The associated 25-contact Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.

With this input selected the incoming data stream remains unchanged (no stuffing function).

SPI: synchronous parallel input in LVDS (low voltage differential signalling) format. This interface is defined in the DVB-PI-154 document. The associated 25-contact Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.

With this input selected the incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is also corrected.

ASI: asynchronous serial input. This BNC connector is located on the rear panel and labelled X40.3 (see also sticker on the rear).

With this input selected the incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The required value is calculated and set automatically. The PCR (Program Clock Reference) value is also corrected.

SPI EXT. CLOCK: synchronous parallel input in LVDS (low voltage differential signalling) format. This interface is defined in the DVB-PI-154 document. The associated 25-contact Sub-D connector is located on the rear panel and labelled X60 TS PARALLEL.

With this input selected, data are read out with the external clock applied to the BNC connector X40.4 at the rear panel (see also sticker on the rear) and fed to the coder. The incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The applied clock may not deviate by more than ±10% from the nominal value. The PCR (Program Clock Reference) value is corrected.

ASI EXT. CLOCK: asynchronous serial input. The BNC connector is located on the rear panel and labelled X40.3 (see also sticker on rear panel).

With this input selected, data are read out with the external clock applied to the BNC connector X40.4 at the rear panel (see also sticker on the rear) and fed to the coder. The incoming data stream is changed (stuffing and PCR correction). The supplied useful data rate is filled up with null packets to the required data rate. The applied clock may not deviate by more than ±10% from the nominal value. The PCR (Program Clock Reference) value is corrected.

SMPTE: Asynchronous serial input in SMPTE 310M format (Society of Motion Picture & Television Engineers). The feed connector is BNC connector X40.3 which is also used for the ASI data input. The data rate at the input connector should be 19.392658 Mbit/s. The content of the incoming data stream is not changed (no stuffing, no PCR correction). The symbol rate cannot be edited when SMPTE input is selected.

SMPTE EXT. CLOCK: Asynchronous serial input in SMPTE 310M format (Society of Motion Picture & Television Engineers). The feed connector is BNC connector X40.3which is also used for the ASI data input. The incoming data stream (data rate at the input only 19.392658 Mbit/s) is changed (stuffing and PCR correction). The supplied useful data rate is filled with null packets to obtain the required data rate that is determined by the external clock. The applied clock may not deviate by more than ±10% from the standard data rate. The PCR value (PCR Program Clock Reference) is corrected.

Note:	*The SMPTE and SMPTE EXT. CLOCK menu items are only available if model 03 of option SFQ-B6 (2072.7679.03) is installed.*

INPUT DATA RATE

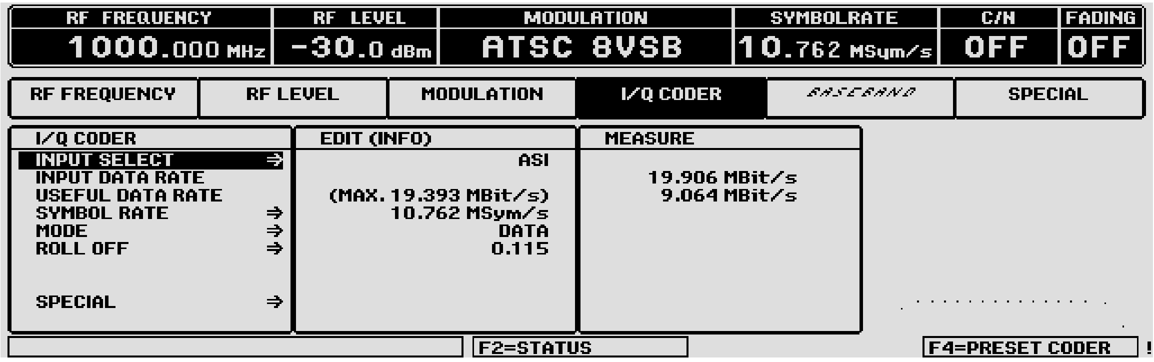


Fig.: 2.2.4-74 INPUT DATA RATE

With TS PARALLEL, two values are displayed in this line.

The left-hand value represents the required calculated input data rate which has to be supplied so that the nominal data rate is correct for current settings. The measured input data rate in [Mbit/s] is displayed on the right-hand side.

The data rate which is externally applied via the parallel input may deviate by max. ±10% from the nominal data rate of 19.392658 Mbit/s. A higher deviation elicits the UNLOCKED message and indicates a problem with the internal PLL.

Whereas the DVALID signal is not evaluated in the TS PARALLEL mode on SFQ, i.e. partial transport streams are not supported, only the data with DVALID = 1 are valid in the SPI mode. (see 2.2.4.5 Input Interface)

USEFUL DATA RATE

The payload of the data stream is measured, i.e. the null packets are ignored.

SYMBOL RATE

The symbol rate can – if the Input Interface option is fitted – be set to within ±10% of the nominal symbol rate. The input interface inserts the required null packets.

The relationship between the symbol rate and the data rate for 8VSB is as follows:

A field comprises of 313 segments, 312 data segments and a field sync, each of 208 bytes. The incoming data stream supplies 188 bytes per data segment.

A symbol comprises two data bits.

The following symbol rate is, therefore, obtained:

$$\text{Symbol rate}\left[\frac{\text{Symbols}}{\text{s}}\right] = \text{TS\_DATA.RATE}\left[\frac{\text{Bit}}{\text{s}}\right] * \left[\frac{(208\,\text{Bytes/Segments} * 313\,Segments/Field)}{(188\,Bytes/Packet * 312\,Packets/Field)}\right] * 0{,}5\,\frac{Symbols}{Bit}$$

MODE

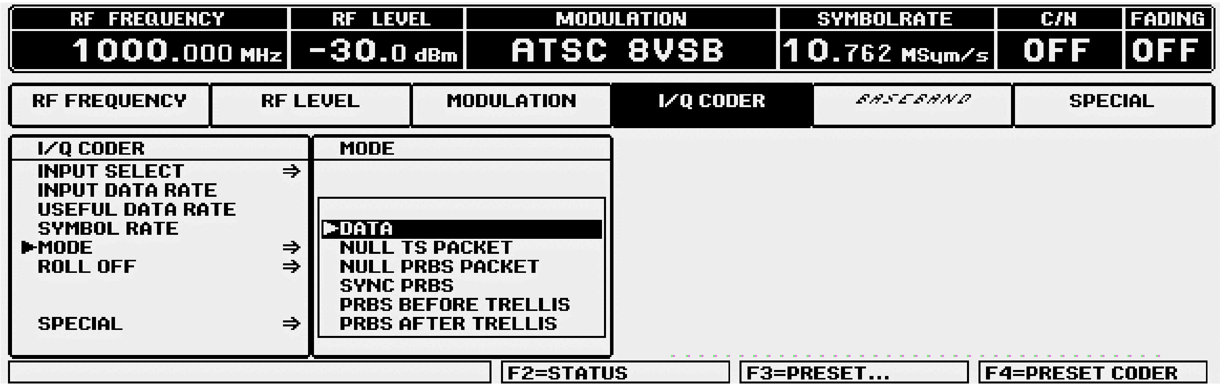


Fig.: 2.2.4-75 MODE

8VSB This menu item is for selecting the following items:

DATA
NULL TS PACKET
NULL PRBS PACKET
SYNC PRBS
PRBS BEFORE TRELLIS
PRBS AFTER TRELLIS

PRBS: A PRBS sequence (2^{23} –1 or 2^{15}–1, depending on the setting in the PRESET PRBS SEQUENCE menu, in line with ITU-T Recommendations O.151, pseudo random binary sequence) which ignores any headers is transmitted. The PRBS sequence is fed before the mapper with the VSB byte clock.

DATA: If DATA is selected, the data of the external MPEG2 transport stream are used for transmission. This mode is the normal mode.

NULL TS PACKETS: An internally generated test transport stream with the following structure is transmitted:
47 (HEX), 1F (HEX), FF (HEX), 10 (HEX) – the remaining 184 bytes of the frame (=payload) are zeros (00 HEX).

NULL PRBS PACKET: An internally generated test transport stream is transmitted. The test transport stream has the following structure:
47 (HEX), 1F (HEX), FF (HEX), 10 (HEX) – in the remaining 184 bytes of the frame (=payload) a PRBS sequence (2^{23} –1, to ITU-T Recommendation O.151, pseudor andom binary sequence) is continuously transmitted. The PRBS is transmitted byte-by-byte (MSB first).

SYNC PRBS: An internally generated test transport stream is transmitted. The test transport stream has the following structure:
47 (HEX) – in the remaining 187 bytes of the frame (= payload) a PRBS sequence (223–1 or 215–1, depending on the setting in the PRESET – PRBS SEQUENCE menu, in line with ITU-T Recommendations O.151, pseudo random binary sequence) is continuously transmitted. The PRBS is transmitted byte by byte (MSB first).

PRBS BEFORE TRELLIS: A PRBS sequence (2^{23} – 1 or 2^{15} – 1 depending on the setting in the PRESET-PRBS SEQUENCE menu), to ITU-T Recommendation O.151, pseudo random binary sequence which ignores headers is transmitted. With 8VSB, the PRBS sequence is fed in before the trellis coder with the VSB byte clock.

PRBS AFTER TRELLIS: A PRBS sequence (2^{23} –1, to ITU-T Recommendation O.151, pseudo random binary sequence) which ignores any headers is transmitted. The PRBS sequence is fed in after the trellis coder with the VSB symbol clock.

Note:	*If TS PARALLEL is selected as the input, the internal clock will be locked to the external clock.* *If the NULL TS PACKET, NULL PRBS PACKET, SYNC PRBS, PRBS BEFORE TRELLIS or PRBS AFTER TRELLIS mode is selected, an external clock is not required. If an external clock is available, it is used for locking.*

SPECIAL

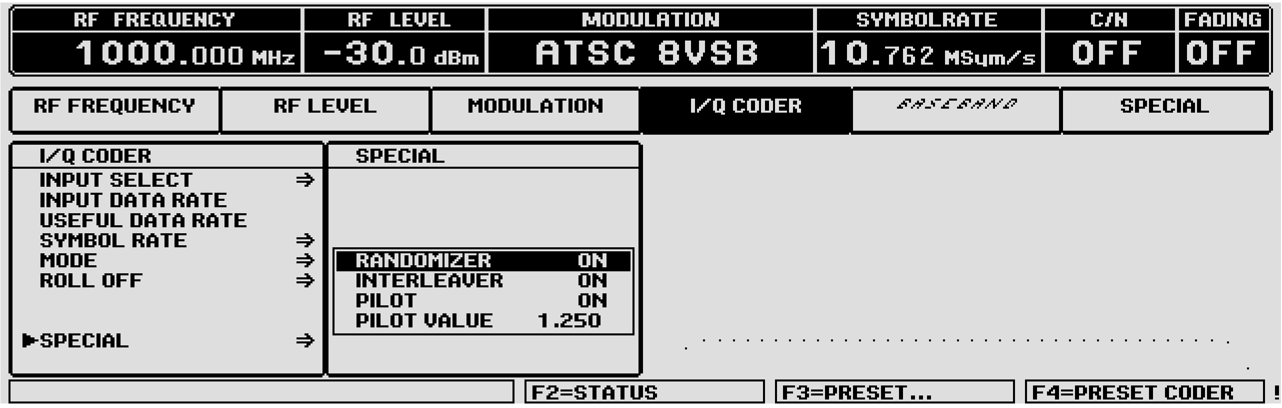


Fig.: 2.2.4-76 SPECIAL

All settings in the Special menu violate the normal operating mode and therefore elicit the MODIFY message which is displayed in the I/Q CODER window. All special settings can be cancelled by pressing the F4-PRESET CODER key.

RANDOMIZER

Scrambling for energy dispersal can be switched off. Data go through the randomizer and are passed on unaltered to the Reed-Solomon encoder.

REED-SOLOMON

The Reed-Solomon encoder can be switched off in this case. Nulls are inserted instead of the 20 correction bytes.

INTERLEAVER

The convolutional interleaver can be switched off. The incoming data are passed on unaltered to the trellis coder.

PILOT

The pilot, which is important for the synchronization in the receiver, can be switched off.

PILOT VALUE

The pilot value can be changed. The pilot setting range is 0 to 5 with a step width of 0.125. PILOT has to be set to ON.

2.2.4.7 ISDB-T

2.2.4.7.1 Overview

In the 90s the Japanese Association of Radio Industries and Business (ARIB) developed a transmission standard for digital terrestrial broadcasting. Unlike the transmission standards already in use in the other parts of the world, the television, radio and data services are to be covered by one standard. The Japanese broadcasting standard ISDB-T (Terrestrial Integrated Services Digital Broadcasting) was established, in which these services can be transmitted separately in a large number of combinations.

Comprehensive test trials proved the system performance. The characteristics of the transmission system were verified in these field trials. The following capabilities should be particularly mentioned: SFN (single frequency network), the positive characteristics in mobile reception and narrowband reception where only a part of the transmitted data is evaluated (*Partial Reception*).

2.2.4.7.2 Characteristics of ISDB-T

For both ISDB-T and the other comparable standards, the MPEG-2 method was chosen as source coding of the digital signals to be transmitted. Hierarchical transmission allows adaptation to the different receive conditions. The signal in the transmission channel consists of 13 OFDM segments (Orthogonal Frequency Division Multiplex) whose parameters can be selected independently of each other.

The MPEG-2 transport stream is channel-coded and then embedded in the OFDM segments for transmission. Pilot carriers predefine the OFDM frame structure.

2.2.4.7.2.1 Hierarchical Transmission

With ISDB-T, the transmission parameters of the OFDM carriers, the code rates of the *inner coder* and the length of *time interleaving* can be set separately for each data segment. Hierarchical transmission is only possible with ISDB-T if groups of OFDM segments have different transmission parameters. Up to three *layers*, i.e. segment groups, can be simultaneously transmitted in one channel.

Narrowband reception with a special receiver (*Partial Reception*) is to be considered an independent hierarchical *layer*.

2.2.4.7.2.2 Partial Reception

If the influence range of *frequency interleaving* is limited to one OFDM segment, this segment can be considered independently of the other 12 segments. A narrowband receiver that only evaluates this OFDM segment thus receives a complete receive signal.

2.2.4.7.3 Transmission Parameters

The OFDM spectrum comprises 13 segments that have a bandwidth of approx. 429 kHz. A transmission bandwidth of approx. 5.6 MHz is thus obtained and the signal is suitable for transmission in a 6 MHz channel.
Three transmission modes with four *guard intervals* each are available. The various combinations are represented in simplified form in the table below.

Mode	Mode 1	Mode 2	Mode 3
Number of segments	13		
Bandwidth	5.575 to MHz	5.573 to MHz	5.572 to MHz
Carrier offset	3.968 to kHz	1.984 to kHz	0.992 to kHz
Number of carriers	1405	2809	5617
Carrier modulation	QPSK, 16QAM, 64QAM, DQPSK		
Symbols per frame	204		
Symbol duration (rms)	252 µs	504 µs	1008 µs
Guard interval	1/4, 1/8, 1/16, 1/32		
IFFT length	2K	4K	8K
Inner code	Convolutional code (1/2, 2/3, 3/4, 5/6, 7/8)		
Outer code	Reed Solomon RS (204,188)		

Table 2.2.4-1 Transmission parameters for ISDB-T (6 MHz channel)

2.2.4.7.4 Terminology

Some terms used in the ISDB-T standard are explained below.

AC	Auxiliary channel for the transmission of additional data
Coherent Modulation Portion	A group of data segments for which the following types of modulation are used: QPSK, 16QAM and 64QAM
Continual Pilot	Pilot carrier in fixed position in the OFDM signal used for framing, and allows channel estimation in the receiver.
Differential Modulation Portion	A group of data segments that are only DQPSK-modulated.
OFDM Frame	Transmission frame comprising 204 OFDM symbols.
Partial Reception	Reception of the central OFDM segment with a special narrowband receiver.
Scattered Pilot	Pilot carrier in changing position in the OFDM signal used for framing, and allows channel estimation in the receiver.
TMCC	Transmission and Multiplex Configuration Control Pilot. Information is transmitted for signal structure.

2.2.4.7.5 Channel Coding

The block diagram below shows the functional design of channel coding with ISDB-T. Three identical paths are available, corresponding to the three hierarchical layers.

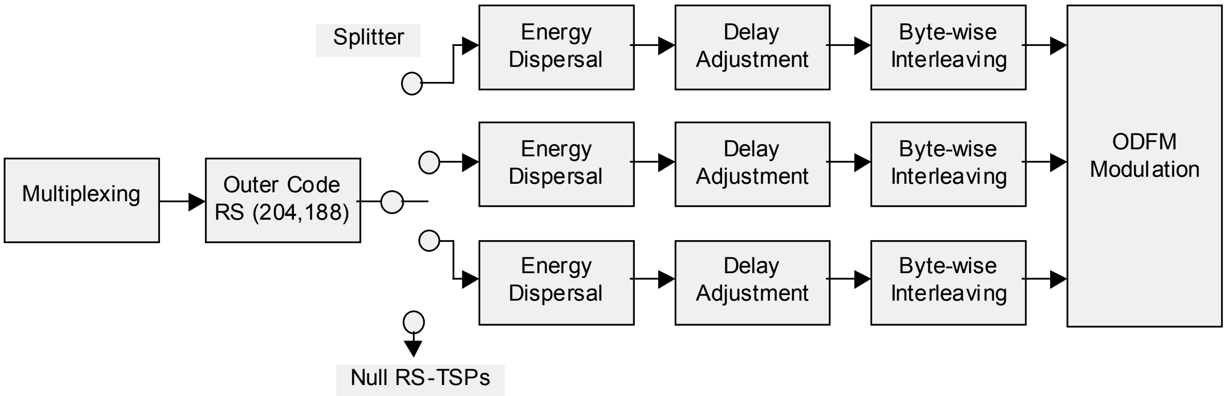


Fig. 2.2.4-77 Channel coding block diagram

First the transport stream passes through the **outer coder**. The Reed-Solomon RS (204, 188) shortened code is applied to each transport stream packet. 16 parity bytes are added to the 188-byte packets so that 204-byte packets are obtained. With this Reed-Solomon code up to eight erroneous bytes can be detected in a transport stream packet and corrected.

The error-protected data stream passes through one **splitter** in which the transport stream packets are divided into up to three hierarchical layers. The control information necessary for this is generated in a data stream multiplexer.

The following module **energy dispersal** adds a pseudo random binary sequence (PRBS) to the data stream in order to obtain a quasi-random bit sequence that has a positive effect on the transmitted RF spectrum (lower VSWR).

Depending on the transmission parameters modulation and code rate, a varying delay of the data stream in the three paths is obtained through the byte-wise interleaving in the transmitter and de-interleaving in the receiver. A **delay adjustment** is performed in the coder to minimize the expenditure in the receiver. In this module, the three data streams are delayed so that subsequent delay differences can be compensated for beforehand.

The following **byte-wise interleaver** separates bytes that were initially adjacent. Burst errors in the transmission channel interfere with the adjacent bytes, which, however, are again separated in the de-interleaver of the receiver. Thus, burst errors are sorted out as individual errors. Individual errors can be corrected by the Reed-Solomon decoder.

Finally, the **convolutional coder** adds further redundancy to the data stream to permit error correction in the receiver. The integrated puncturer removes bits from the redundant data stream. Puncturing slightly impair the characteristics of the code. The code rates that can be set are 1/2, 2/3, 3/4, 5/6 and 7/8. The code rate can be selected according to the required transmission characteristics of the system.

2.2.4.7.6 Modulation

The block diagram below shows the functional design of the OFDM modulation block with ISDB-T.

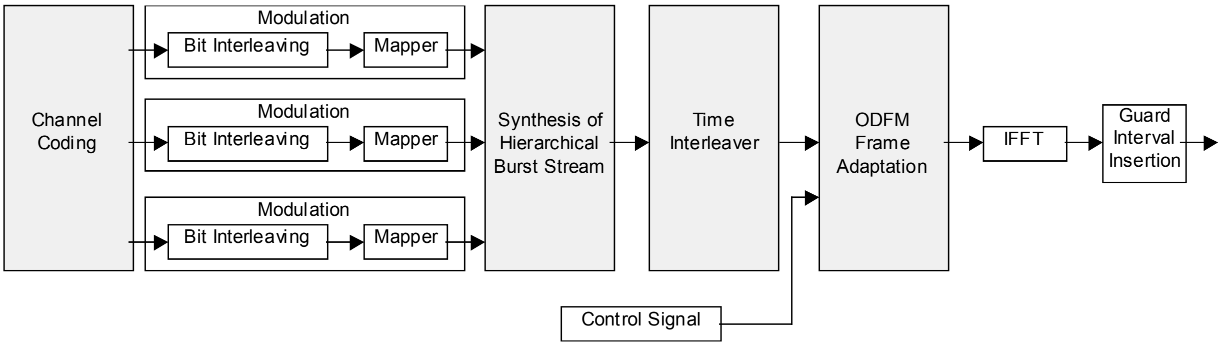


Fig. 2.2.4-78 Modulation block diagram

Modulation is performed in the first block. Modulation includes bit interleaving with delay compensation and mapping to the modulation constellation diagram. The possible constellations with ISDB-T are DQPSK, QSPK, 16QAM and 64QAM. The constellation can be selected according to the required transmission characteristics of the system. Suitable bit interleaving and delay compensation are automatically selected.

The **synthesis** of the hierarchical data stream is now performed. For this purpose, the complex mapped data from each of the three paths is added together to form a serial data stream.

Symbol-by-symbol **time interleaving** follows synthesis. This is an intra-segment time interleaver whose depth can be set separately for each layer. Delay compensation is also assigned to the time interleaver in order to compensate for different delays in the paths.

The following **frequency interleaving** scrambles the data in an OFDM symbol, i.e. in the frequency domain. First an inter-segment interleaver is applied between the OFDM segments that have the same modulation, followed by an intra-segment interleaver that rotates the data in a segment. The data pass through an intra-segment randomizer that shifts the data in a segment to quasi-random positions.

The next step is **OFDM framing**. Frames are formed from 204 OFDM symbols by adding pilot carriers. Depending on the mode and the selected modulation pilot carriers are inserted into the data stream at different positions. TMCC carriers (Transmission and Multiplexing Configuration Control) and AC carriers (Auxiliary Channel) are added.

The data handled in this way undergo inverse Fourier transform **IFFT** so that it is transferred from the frequency domain to the time domain as usual with OFDM modulation. The length of IFFT depends on the selected ISDB-T mode and can be 2K, 4K or 8K.

IFFT is followed by the insertion of the **guard interval**. This guard interval extends the OFDM symbols by a specific factor (1/4, 1/8, 1/16 or 1/32). This measure has a positive effect on the receiving characteristics with multipath propagation.

2.2.4.7.7 Description of Menu Items

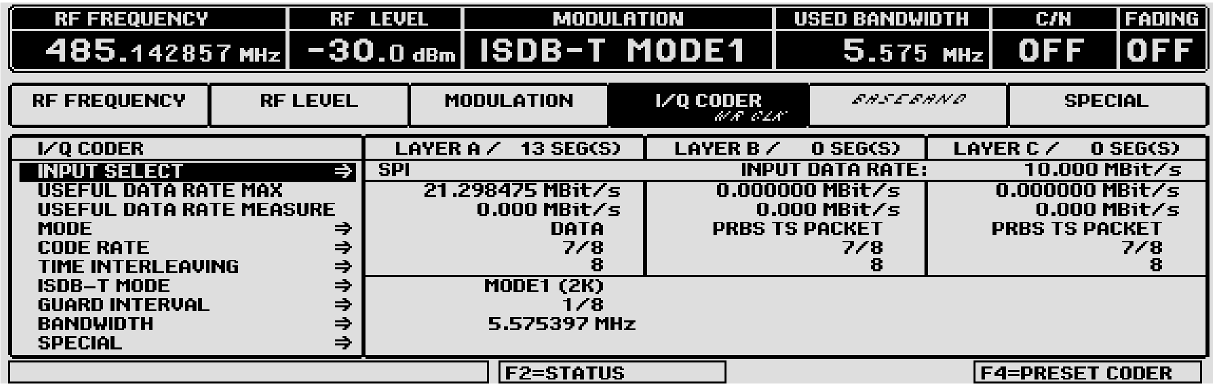


Fig. 2.2.4-79 I/Q coder menu

The I/Q coder menu contains important information on the ISDB-T coder and can be used to change the parameters.

The **title line** specifies the number of segments assigned to the different layers. This assignment is performed in the modulation menu. If zero segments are assigned this means that the layer is activated.

INPUT SELECT

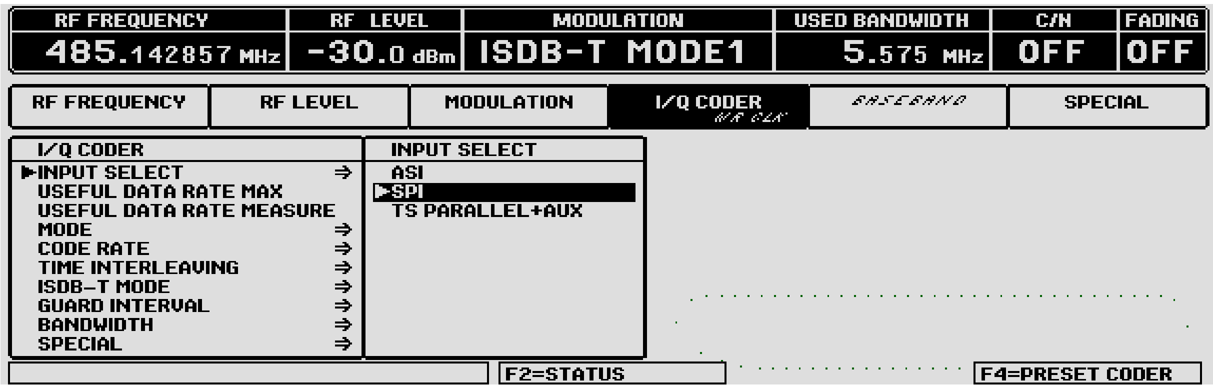


Fig. 2.2.4-80 INPUT SELECT

The transport stream input can be selected with this menu item. The following inputs are available:

ASI: Asynchronous Serial Interface. This input is available only with the option input interface (SFQ-B6). The data rate of the incoming data stream is converted to a defined data rate in the input interface (32.507936 Mbit/s). The new data stream thus obtained is transferred to the ISDB-T coder in which it is converted to a valid ISDB-T data stream.

SPI: Synchronous Parallel Interface. This input is available either with and without the option input interface (SFQ-B6). The option input interface does not modify the data stream. A valid data stream is only generated in the ISDB-T coder.

TS PARALLEL+AUX: The TS PARALLEL input and also the TS PARALLEL AUX input are used here. The actual data stream comes from a transport stream multiplexer and is already in line with the ISDB-T standard. The data rate is 32.507936 Mbit/s. The actual useful data are supplied via the TS PARALLEL input and the associated control information is fed to the TS PARALLEL AUX input.

Caution: *When the input is switched, the MODE is switched if required. For details refer to menu item MODE.*

INPUT DATA RATE

The measured data rate is displayed in this field in the INPUT SELECT line. This is the gross data rate at the instrument input. The measured values are displayed with three decimal places.

USEFUL DATA RATE MAX. / USEFUL DATA RATE MEASURE

The maximum useful data rate in the corresponding layer is displayed here (USEFUL DATA RATE MAX.). This data rate depends on various parameters, e.g. on the selected constellation carrier, the guard interval and the code rate of the convolutional coder.

The data rate measured in the layers is displayed in the next line (USEFUL DATA RATE MEASURE). If the measured data rate is greater than the maximum data rate an overflow message is output.

MODE

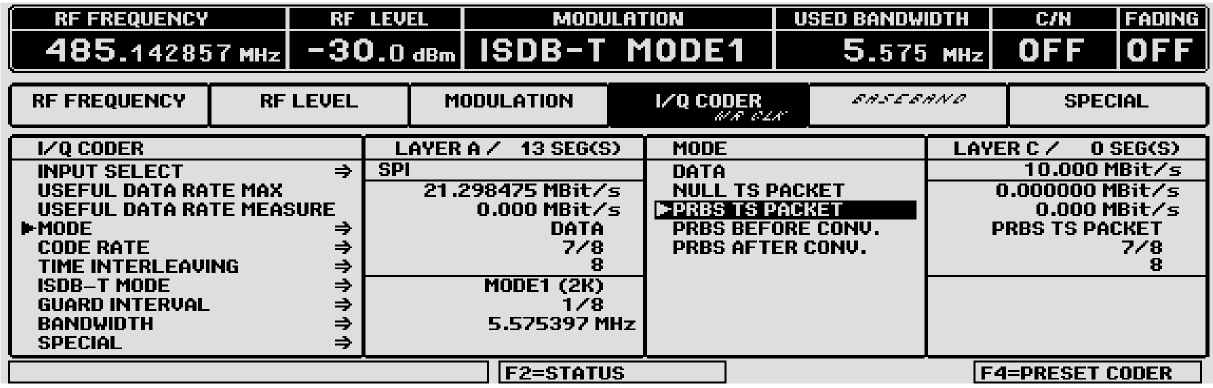


Fig. 2.2.4-81 MODE

In this menu, the type of the data to be transmitted can be selected for each layer. Distinction is made between the data supplied via the transport stream input and various test data. The table below describes the terms used.

DATA	The data supplied via the transport stream input are transmitted.
NULL TS PACKET	Exclusively *Null packets* are transmitted, i.e. transport stream packets with the PID 1FFFhex. The *payload* of these packets consists of bytes with the value 00hex.
PRBS TS PACKET	Exclusively transport stream packets are transmitted; their PID can be selected in the SPECIAL menu. A *pseudo random binary sequence* (PRBS) is inserted into the p*ayload* of these packets (MSB first). The degree of the PRBS can be selected as 2^{15}-1 or 2^{23}-1 in the PRESET - PRBS SEQUENCE menu (according to ITU-T O.151).
PRBS BEFORE CONV.	A PRBS can be inserted before the convolutional coder. The degree of the PRBS can be selected as 2^{15}-1 or 2^{23}-1 in the PRESET - PRBS SEQUENCE menu (according to ITU-T O.151).
PRBS AFTER CONV.	A PRBS is inserted after the convolutional coder. The degree of the PRBS can be selected as 2^{15}-1 or 2^{23}-1 in the PRESET - PRBS SEQUENCE menu (according to ITU-T O.151).

Table 2.2.4-2 Values for mode

If the **TS PARALLEL+AUX** input is selected the mode can be set separately for each layer. However, as soon as test data is transmitted in at least one layer, the warning MODIFY is displayed provided the TS PARALLEL+AUX input is selected.

If the input **ASI** or **SPI** is selected data can be transmitted in maximally one layer. The table below shows the possible combinations. NULL/PRBS identifies test data, i.e. either NULL TS PACKET, PRBS TS PACKET, PRBS BEFORE CONV. or PRBS AFTER CONV.

Layer	Pattern 1	Pattern 2	Pattern 3	Pattern 4
A	NULL / PRBS	DATA	NULL / PRBS	NULL / PRBS
B	NULL / PRBS	NULL / PRBS	DATA	NULL / PRBS
C	NULL / PRBS	NULL / PRBS	NULL / PRBS	DATA

Table 2.2.4-3 Permissible settings with ASI or SPI

If, for example, pattern 2 is set and layer B is to be set to DATA (pattern 3), the setting of layer B is first transferred to layer A and then layer B is set to DATA.

Caution: *Switching the input from TS PARALLEL+AUX to ASI or SPI in the INPUT SELECT menu may cause the MODE menu to be automatically switched when two or three layers were set to DATA. In this case, pattern 2 is automatically set.*

CODE RATE

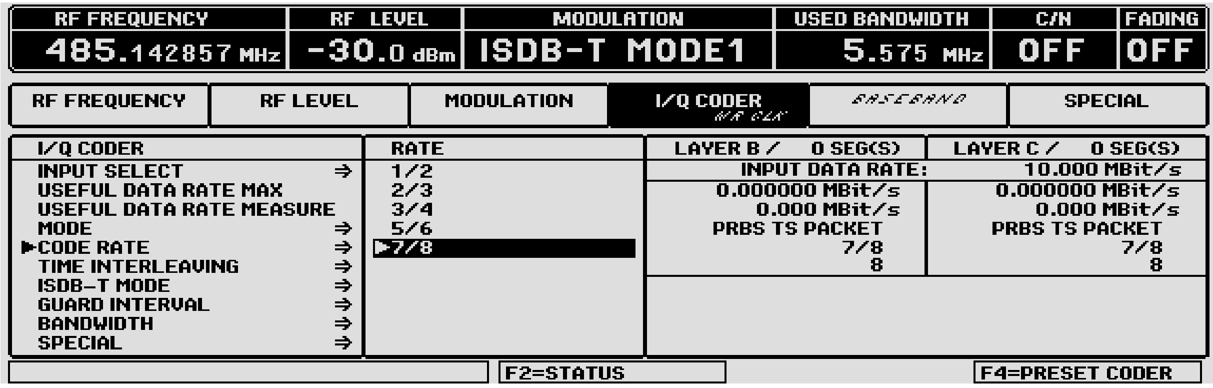


Fig. 2.2.4-82 CODE RATE

The convolutional coder code rate of each layer can be separately set in this menu. The code rates that can be set are 1/2, 2/3, 3/4, 5/6 and 7/8. This setting influences the maximum data rate to be transmitted on the layer concerned. If more useful data is transmitted (i.e. less redundancy) error correction is less possible to be performed. If less useful data is transmitted transmission reliability is higher.

The convolutional coder first adds the same quantity of redundancy bits to the data stream. Bits are removed during subsequent puncturing. The code rate specifies the ratio of input to output bits. With code rate ½ two output bits correspond to one input bit (maximum error protection). With code rate 7/8 seven input bits correspond to eight output bits, i.e. the puncturer again removes a large number of redundancy bits (minimum error protection).

TIME INTERLEAVING

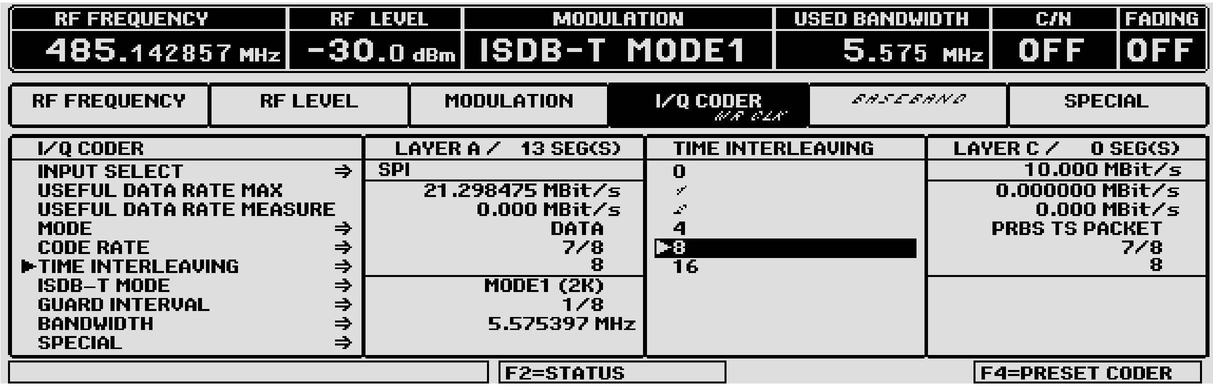


Fig. 2.2.4-83 TIME INTERLEAVING

The time interleaving length of each layer can be separately set in this menu. The possible lengths depend on the selected ISDB-T mode as shown in the table below. The parameter I defines the time interleaving length as described in the ISDB-T specification.

ISDB-T mode	Parameter I of the time interleaver
MODE 1	0 4 8*) 16
MODE 2	0 2 4*) 8
MODE 3	0 1 2*) 4

*) **Caution:** *When the ISDB-T mode is switched the parameter I of the time interleaver is switched, if required, provided the currently set value is not available in the mode selected last. The value marked with an * is then set.*

Table 2.2.4-4 Parameter I of the time interleaver

ISDB-T MODE

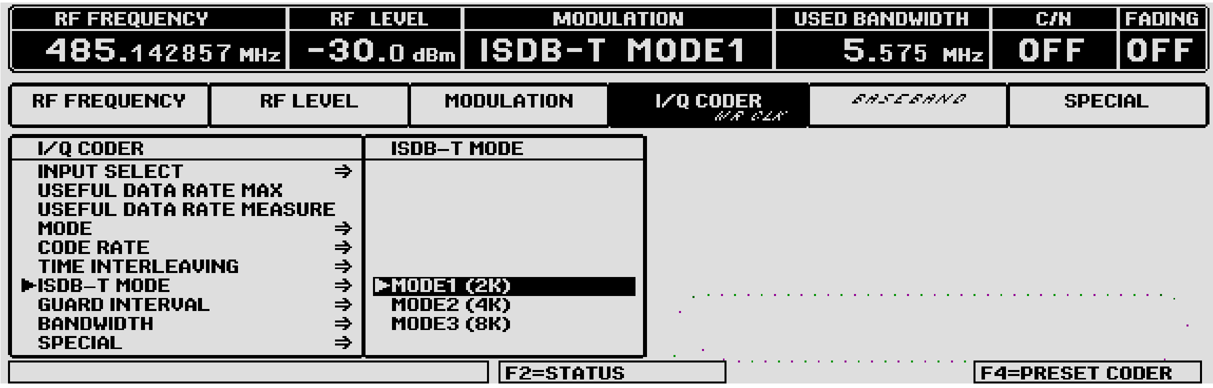


Fig. 2.2.4-84 ISDB-T MODE

The ISDB-T mode can be selected in this menu. This setting is not specific to individual layers but refers to the entire transmission.

Possible values are 2K, 4K and 8K.

This mode is primarily used to select the length of the IFFT (Inverse Fast Fourier Transform) which has an effect on the OFDM symbol duration. Information on this is contained in section "Transmission Parameters". This causes the RF spectrum width to be slightly modified depending on the mode (BANDWIDTH menu). In addition, the settings of the time interleaver are influenced (see above).

GUARD INTERVAL

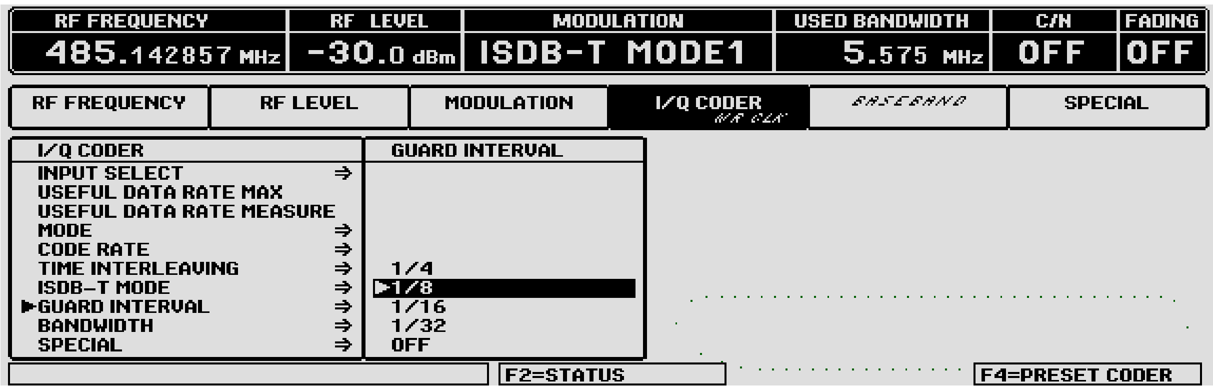


Fig. 2.2.4-85 GUARD INTERVAL

The transmission guard interval can be selected in this menu. The guard interval is a cyclic extension of the OFDM symbol by a specific factor. Possible values are 1/4, 1/8, 1/16 and 1/32. The guard interval can be deactivated as a special setting so that only the useful component of OFDM symbols can be transmitted continuously. In this case, the warning MODIFY is displayed.

When the guard interval is selected the receiving characteristic is influenced with multipath propagation. With a large guard interval, long echo delays can be eliminated. With a small guard interval, the echoes of an OFDM symbol can emit in the following OFDM symbol.

BANDWIDTH

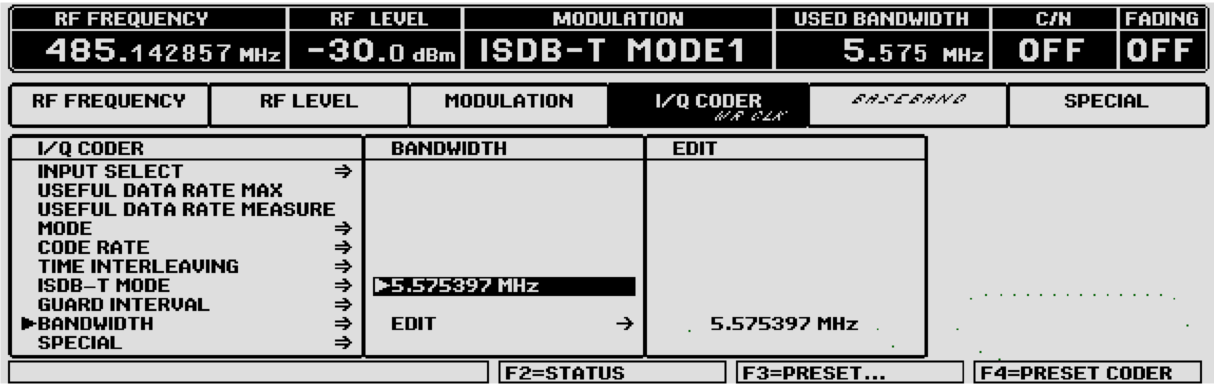


Fig. 2.2.4-86 BANDWIDTH

The bandwidth of the ISDB-T spectrum can be varied in this menu. On the one hand, the nominal bandwidth of the current ISDB-T mode can be directly set. On the other hand, the bandwidth can be varied by ±1 % in the lower editing field. A bandwidth other than the nominal one generates a MODIFY warning.

Caution: *When the ISDB-T mode is switched the nominal bandwidth of the new ISDB-T mode is always selected automatically.*

The table below shows the nominal bandwidth depending on the ISDB-T mode.

ISDB-T mode	Nominal bandwidth
MODE 1	(39000 / 7 + 250 / 63) kHz ˜ 5.575397 MHz
MODE 2	(39000 / 7 + 125 / 63) kHz ˜ 5.573413 MHz
MODE 3	(39000 / 7 + 125 / 126) kHz ˜ 5.572421 MHz

Table 2.2.4-5 Nominal bandwidth depending on the ISDB-T mode

SPECIAL

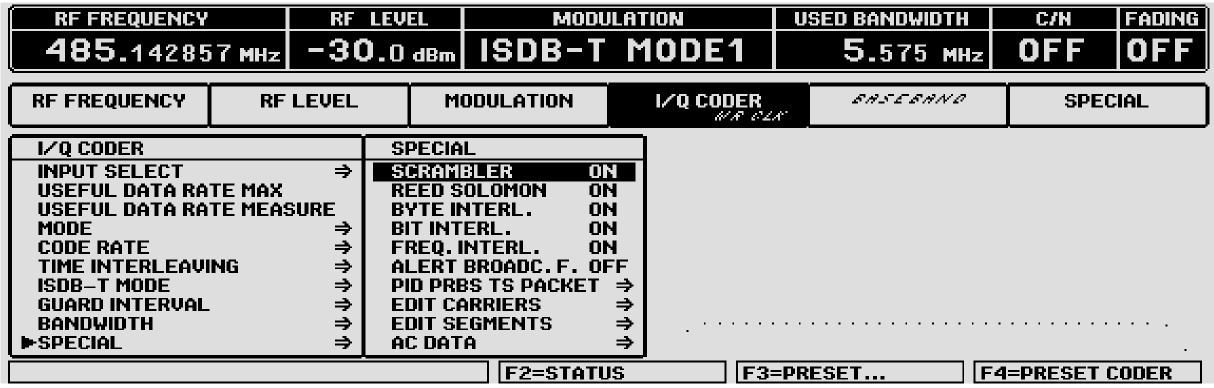


Fig. 2.2.4-87 SPECIAL

This menu contains various special settings. The table below describes the different menu items.

Menu item	Description
SCRAMBLER	This menu item refers to the energy dispersal in channel coding. Each of the three hierarchical paths has an energy dispersal block that can be activated or deactivated in common.
REED SOLOMON	The Reed-Solomon coder can be switched on or off in this menu. With the Reed-Solomon coder switched off, 16 bytes with the value 0 are added to the 188-byte transport stream packets. With the Reed-Solomon coder switched on, the 16 parity bytes are added.
BYTE INTERLEAVER	The byte interleavers can be switched on or off in the three hierarchical paths in this menu. With the byte interleavers switched off, the transport stream packets are transferred unchanged.
BIT INTERLEAVER	The bit interleavers can be switched on or off in the three hierarchical paths in this menu. With the bit interleavers switched off, the channel-coded data are transferred unchanged to the corresponding mapper.
FREQ. INTERLEAVER	The frequency interleaver can be switched on or off in this menu.
ALERT BROADC. FLAG	The alert broadcasting flag can be switched on or off in the TMCC data.
PID PRBS TS PACKET	see below
EDIT CARRIERS	see below
EDIT SEGMENTS	see below
AC DATA	see below

Table 2.2.4-6 SPECIAL menu items

PID PRBS TS PACKET

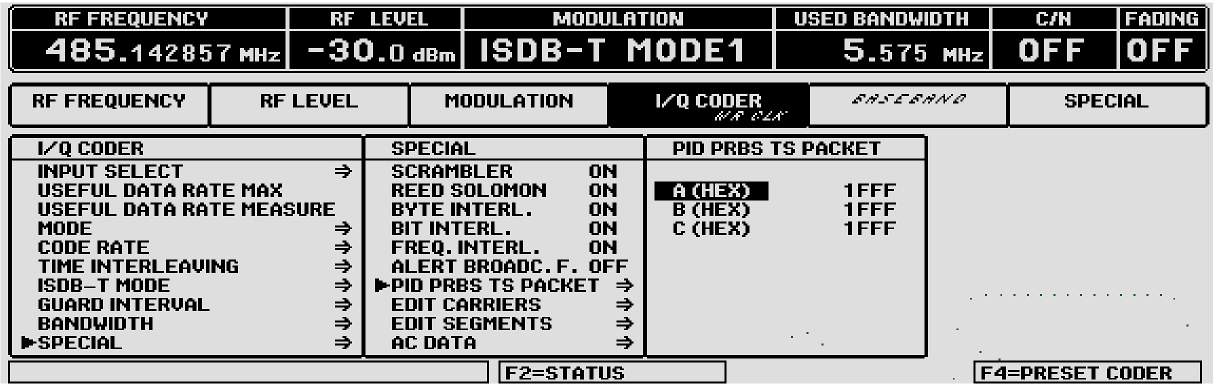


Fig. 2.2.4-88 PID PRBS TS PACKET

PRBS TS PACKET can be selected as test data in the MODE menu. The PID of these transport stream packets can be selected separately for each of the three hierarchical layers. The entry is hexadecimal. Since the PID of the transport stream packets is 13 bits long, PIDs can be entered in the range 0000hex to 1FFFhex.

SPECIAL - EDIT CARRIERS

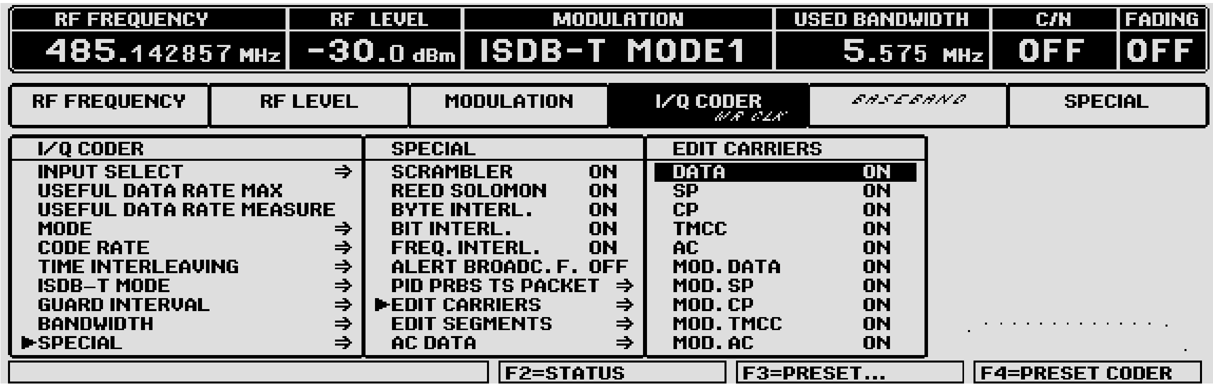


Fig. 2.2.4-89 SPECIAL - EDIT CARRIERS

Groups of carriers can be handled in this submenu. The table below describes the menu items.

Menu item	Description
DATA	All data carriers are switched on/off (I = 0, Q = 0).
SP	All *scattered pilots* are switched on/off (I = 0, Q = 0).
CP	All *continual pilots* are switched on/off (I = 0, Q = 0).
TMCC	All TMCC carriers are switched on/off (I = 0, Q = 0).
AC	All *auxiliary channel* carriers are switched on/off (I = 0, Q = 0).
MOD. DATA	The modulation of all data carriers is switched on/off.
MOD. SP	The modulation of all s*cattered pilots* is switched on/off.
MOD. CP	The modulation of all *continual pilots* is switched on/off.
MOD. TMCC	The modulation of all TMCC carriers is switched on/off.
MOD. AC	The modulation of all *auxiliary channel* carriers is switched on/off.

Table 2.2.4-7 EDIT CARRIERS menu items

With a carrier switched off, the I and Q values are set to zero in the constellation diagram; they thus specify the origin of the constellation diagram (I = 0, Q = 0).

If the modulation of a carrier is switched off, the pointer points to a fixed constellation point in the diagram. This pointer position remains constant through the OFDM symbols. A PRBS sequence defines the constellation point of each deactivated carrier. This is to ensure that not all carriers point to the same point.

SPECIAL - EDIT SEGMENTS

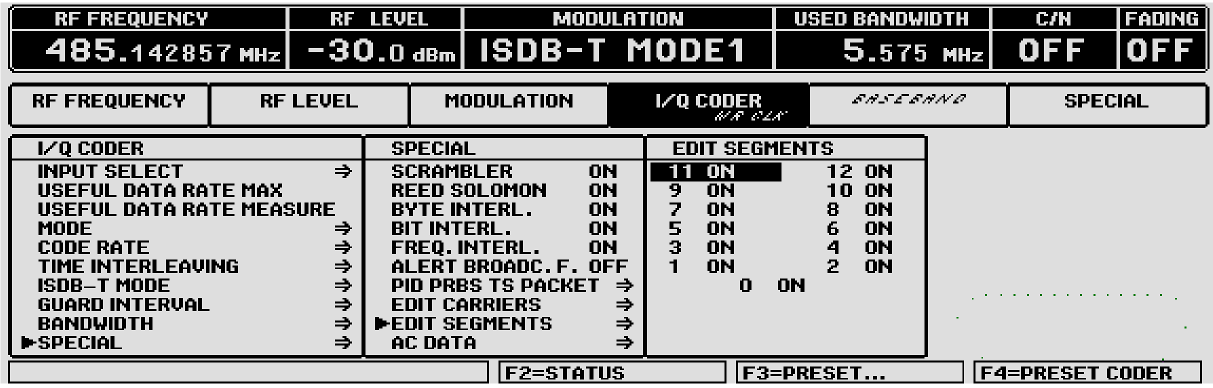


Fig. 2.2.4-90 SPECIAL - EDIT SEGMENTS

OFDM segments can be deactivated in this menu. The table shows the numbers of the 13 segments (from low to high frequencies).

11	9	7	5	3	1	0	2	4	6	8	10	12
low frequencies										high frequencies		

Table 2.2.4-8 Sequence of OFDM segments in the ISDB-T spectrum

SPECIAL - AC DATA

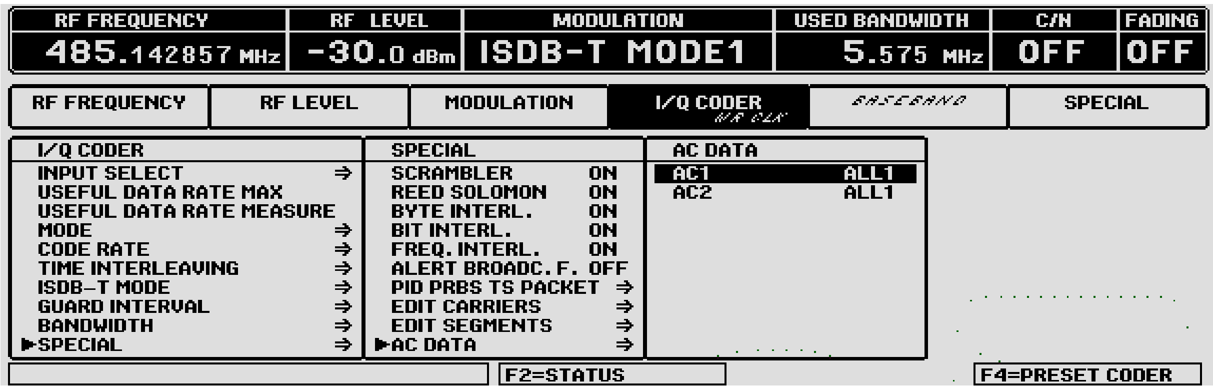


Fig. 2.2.4-91 SPECIAL - AC DATA

The data contents of the auxiliary transmission channels AC can be selected in this menu.
ALL1 inserts ones exclusively (*all ones*).
PRBS inserts a pseudo random binary sequence into the AC channel.

Error messages and warnings

Error messages and warnings can be displayed in the I/Q CODER field of the main menu bar. The following table provides an overview of the possible errors and warnings.

Message	Meaning	Cause	Remedy
ERROR	An error has occurred.	One of the cyclically monitored voltage test points on the ISDB-T coder is out of tolerance.	The cause of the error can be determined in the SETUP/INFO-HARDWARE-EQUIPMENT menu.
UNLOCK	The processing clock of the ISDB-T coder has not locked to the input clock.	The selected input is TS PARALLEL+AUX. The clock supplied to this input differs considerably from the nominal value so that the PLL of the ISDB-T coder can no longer lock to it.	Set the nominal value (32.507937 MHz with nominal bandwidth).
NO CLK	No clock signal is available at the instrument input.	No transport stream is applied to the input.	Check cables or switch on or start generator.
NO DAT	No data signal applied to the instrument input.	No transport stream is applied to the input.	Check cables or switch on or start generator.
OVFLOW	Too much data was supplied, thus causing an overflow.	The useful data rate of the transport stream used is too high for these ISDB-T settings.	Select another transport stream with a lower useful data rate.
UNFLOW	Not enough data is supplied, causing a FIFO buffer to become empty.	The selected input is TS PARALLEL+AUX. The transport stream supplied to this input does not have enough data.	Select a valid ISDB-T data stream.
WR CLK	The clock supplied differs from the required clock by more than ±50 ppm.	The selected input is TS PARALLEL+AUX. The clock supplied to this input slightly differs from the nominal value. The PLL of the ISDB-T coder can still lock to the clock.	Adapt either the bandwidth of the ISDB-T spectrum to the input clock or the input clock to the bandwidth.
FRMERR	The frame structure of the supplied transport stream does not correspond to the MPEG-2 structure.	The packet length of the generator is probably not set to 188 bytes per packet.	Select 188 bytes per packet on the generator.
MODIFY	At least one setting does not comply with the ISDB-T standard.	This setting might be intentional.	Correct the non-standard setting. The **F4=PRESET CODER** key resets the complete coder to defined initial values.

Table 2.2.4-9 Error messages and warnings

2.2.4.8 Input Interface

The INPUT INTERFACE option SFQ-B6 provides up to three transport stream inputs in addition to the TS PARALLEL input integrated in the basic unit, depending on the selected type of modulation.

- Asynchronous serial interface (**ASI**)
- Synchronous parallel interface (**SPI**)
- Synchronous serial interface (**SMPTE**)

Each of these three inputs is also available with an external clock input:

- Asynchronous serial interface with external clock input (**ASI EXT. CLOCK**)
- Synchronous parallel interface with external clock input (**SPI EXT. CLOCK**)
- Synchronous serial interface with external clock input (**SMPTE EXT. CLOCK**)

The ASI and SPI inputs (each with external clock input) can be selected with every type of modulation, but the SMPTE input can only be selected with ATSC 8VSB.

In the following sections, first the structure of an MPEG2 transport stream is explained in brief, then the method of operation of the input interface and the characteristics of the transport stream inputs are described. Finally, the characteristics of a partial transport stream are shown.

2.2.4.8.1 Structure of the MPEG-2 Transport Stream

An MPEG-2 transport stream is a data stream with packet-oriented structure used to transmit digital video, audio and data signals. It consists of data packets with a constant length of 188 bytes. Each data packet comprises a 4-byte start sequence (*header*) and 184 bytes of useful information (*payload*).

The *header* is made up of a constant sync word, a packet type number (PID) and various control bits.

The *payload* contains the information to be transmitted. This information may be part of a video stream, audio stream or table, which contains information on the program to be transmitted.

The packets are assigned to a definite program using the PID and by evaluating the tables.

Null packets are inserted to adapt the data rate of a transport stream to the data rate required by the transmission channel. Null packets are identified by their special PID and can include any information in their *payload*.

204-byte packets are described in DVB DOCUMENT A010. The *payload* is extended by 16 bytes, the structure being otherwise maintained. These 16 bytes are used to transmit the checksum bytes of a Reed-Solomon coding.

2.2.4.8.2 Method of Operation of the Input Interface

As reagards the TS PARALLEL and the SMPTE input (without external clock), the MPEG data stream is transmitted unchanged to the corresponding I/Q coder, thus determining the symbol rate or bandwidth of the I/Q coder. However, inputs ASI, SPI and SMPTE (with external clock) allow adjustment of the symbol rate irrespective of the input data rate.

This function requires a data rate conversion of the input transport stream. For this purpose, all null packets that may be present in the data stream are removed so that the data stream only contains useful packets.

The data rate obtained in this way is the minimum output data rate of the module and is displayed on the front panel of SFQ as **Useful Datarate**. To ensure correct operation of SFQ, this data rate should be smaller than the maximum possible data rate of the selected type of modulation. The maximum possible data rate is displayed on the front panel of SFQ in the **EDIT (INFO)** field in the line **Useful Datarate**.

In the second step of data rate conversion, the data stream without null packets is filled with null packets until the required output data rate is obtained. During this procedure called *stuffing*, the useful packets are distributed in the new data stream as evenly as possible.

The *payload* of the newly added null packets contains a standardized PRBS (pseudo random binary sequence), which allows bit error measurement of the transmission link during operation. The PRBS complies with ITU-T Recommendation O.151. In menu item **PRESET PRBS SEQUENCE**, either the sequence 2^{15}-1 or the sequence 2^{23}-1 can be selected.

A synthesizer that can be set over a wide range generates the data clock of the output data stream of the module. For synchronization with other units, an external clock can be fed instead of the internal clock for ASI, SPI and SMPTE.

If a transport stream is modified by removing and adding null packets as described before, the relative position of the useful packets is changed since they are now at other positions in the transport stream. This means, however, that the PCR (program clock reference) values available in the transport stream are no longer correct. (The PCR values indicate the program time at which the transport packets leave a processing unit).

To correct the PCR values, the dwell time of the packet in the input interface is added to the original value. To avoid too a large deviation from the original values, a constant time value is then subtracted from the corrected PCR value. This constant time value corresponds to the minimum possible dwell time of a packet in the input interface.

The jitter added to the PCR values by their correction remains clearly below the limit value stipulated by the DVB specification.

2.2.4.8.3 MPEG-2 Transport Stream Inputs

DVB DOCUMENT A010 describes the physical characteristics of an asynchronous, serial interface (ASI) and a synchronous, parallel interface (SPI). SMPTE standard 310M describes the characteristics of a synchronous, serial interface. These standards are used to transmit an MPEG-2 transport stream and form the basis for the MPEG-2 transport stream inputs described in the following.

ASI input

The asynchronous, serial transport stream interface (DVB DOCUMENT A010) has a constant data rate of 270 Mbit/s. Data bytes (8 bits) are transmitted via this interface at a rate of max. 27 Mbyte/s, which corresponds to a maximum useful data rate of 216 Mbit/s. The 8-bit data bytes are extended to 10 bits according to a mapping prescription. This recoding eliminates the electrical DC component of the serial transmit signal. In addition, error detection can be performed at the receiver end.

If the required useful data rate is smaller than 216 Mbit/s, so-called *comma characters* are inserted to obtain the constant data rate.

If the ASI input of SFQ is selected, *stuffing* is always activated, i.e. the data rate of the input transport stream is adapted to the requirements inside the unit.

The BNC connector of the ASI input is on the rear of the unit. The input impedance is 75 Ω. The level of a standard signal is 800 mV pp ±10 %. The input is operational down to 200 mV pp.

SPI input and TS PARALLEL input

The synchronous, parallel transport stream interface (DVB DOCUMENT A010) uses different data rates. Data transmission is synchronized to the byte clock of the data stream. The data are in NRZ format (non return to zero).

The transmitted transport stream packets can have a length of 188 or 204 bytes. With 204-byte packets, a DVALID signal is used to declare the last 16 bytes of a packet valid or invalid. This DVALID signal also identifies invalid data of a partial transport stream. The interrelation is illustrated in a diagram in the corresponding section further below.

A PSYNC signal identifies the beginning of each transport stream packet.

If the SPI input of SFQ is selected, *stuffing* is always activated, i.e. the data rate of the input transport stream is adapted to the requirements inside the unit. If the *stuffing* function is not desired, it can be de-activated by selecting the TS PARALLEL input, i.e. the only difference between the SPI and the TS PARALLEL input is that the *stuffing* function is activated or de-activated.

The SPI input of SFQ is on the rear of the unit. The following table shows the pin assignment of the 25-contact trapezoidal connector:

Pin	Signal	Pin	Signal
1	Clock +	14	Clock -
2	System ground	15	System ground
3	Data 7 + (MSB)	16	Data 7 - (MSB)
4	Data 6 +	17	Data 6 -
5	Data 5 +	18	Data 5 -
6	Data 4 +	19	Data 4 -
7	Data 3 +	20	Data 3 -
8	Data 2 +	21	Data 2 -
9	Data 1 +	22	Data 1 -
10	Data 0 + (LSB)	23	Data 0 - (LSB)
11	DVALID +	23	DVALID -
12	PSYNC +	25	PSYNC -
13	Cable shield		

All signals are differentially transmitted in LVDS format. Therefore, the signals appear in pairs with the indication + or -.

The input impedance of the input pins is 100 Ω. The input signal level must lie between 0.1 V pp and 2.0 V pp.

SMPTE 310M input

The synchronous, serial transport stream interface (SMPTE 310M) uses a constant data rate of 19.392658 Mbit/s and can only be selected with ATSC 8VSB.

Biphase mark coding is used for transmission. This data coding method offers the advantage that the clock information is included in the data signal and that the electrical DC component is eliminated. The biphase mark coding operates as follows:

- The binary output signal changes its state at the beginning of each bit.
- If a logic 1 is transmitted, there is a further change of the output signal in the middle of the bit.
- If a logic 0 is transmitted, there is no further change of the output signal.

The BNC connector of the SMPTE input is on the rear of the unit and is identical with the ASI input. The input impedance is 75 Ω. The level of a standard signal is 800 mV pp ±10 %. The input is operational down to 400 mV pp.

2.2.4.8.4 Input for External Clock

The output clock of the input interface is generated by a synthesizer in the modes described so far, which use *stuffing* (ASI and SPI). Without *stuffing*, the output clock of the input interface is identical with the input clock (TS PARALLEL and SMPTE). For synchronization to other units, the input interface may also work with an external clock. Inputs ASI, SPI and SMPTE are therefore available with an external clock.

With an external clock, the *stuffing* function is always activated since the output clock of the input interface does not depend on the input clock.

The following table shows the characteristics of inputs with internal or external clock:

	Asynchronous, serial interface	**Synchronous, parallel interface**	**Synchronous, serial interface**
with *stuffing*	**ASI / ASI EXT. CLOCK**	**SPI / SPI EXT: CLOCK**	**SMPTE EXT. CLOCK**
without *stuffing*	(not available)	**TS PARALLEL**	**SMPTE**

The BNC input connector for the external clock is on the rear of the unit. It is a high-impedance digital input.

2.2.4.8.5 Partial Transport Streams

DVB DOCUMENT A010 specifies three transmission formats for the synchronous, parallel interface in (see Fig.: 2.2.4-92, Fig.: 2.2.4-93 and Fig.: 2.2.4-94). The DVALID signal controls the validity of data in the presence of a continuous clock signal.

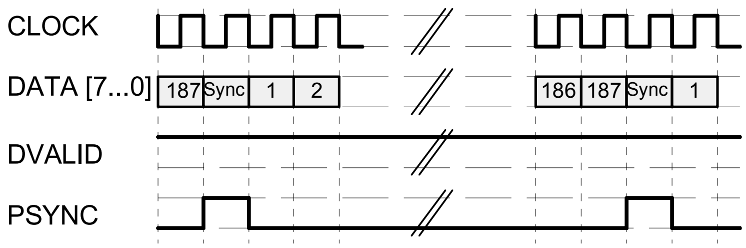


Fig.: 2.2.4-92 Transmission format with packets of 188 bytes

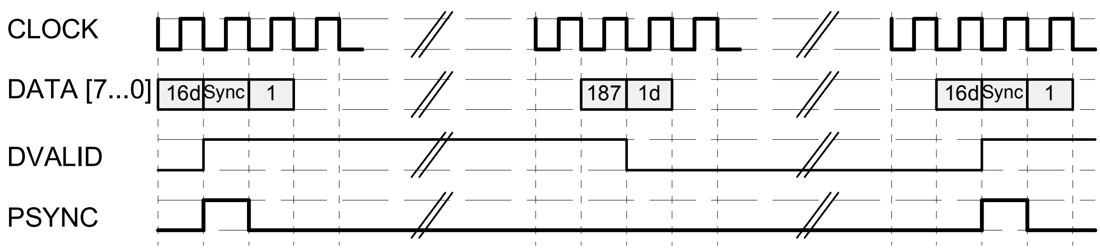


Fig.: 2.2.4-93 Transmission format with packets of 204 bytes (188 bytes of payload and 16 dummy bytes)

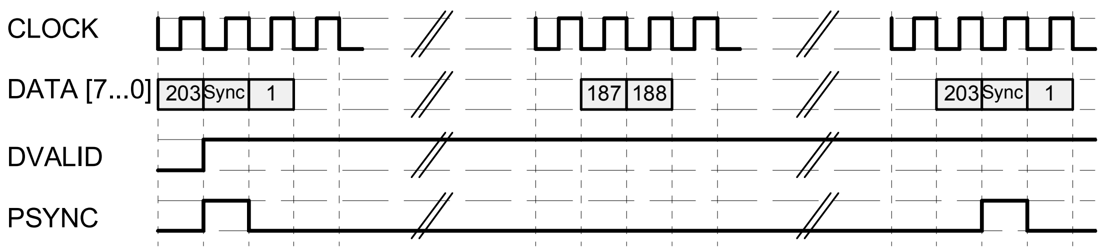


Fig.: 2.2.4-94 Transmission format with packets of 204 bytes (188 bytes of payload and 16 additional bytes)

The three formats are supported for partial transport streams (ETR 154). A partial transport stream is characterized by the fact that any number of data bytes are declared as invalid by DVALID = 0 after a transport packet.

Whereas the SFQ does not evaluate the DVALID signal in the TS PARALLEL mode, i.e. partial transport streams are not supported, only the data where DVALID = 1 are valid in the SPI mode. Fig.: 2.2.4-95 and Fig.: 2.2.4-96 show examples of partial transport streams.

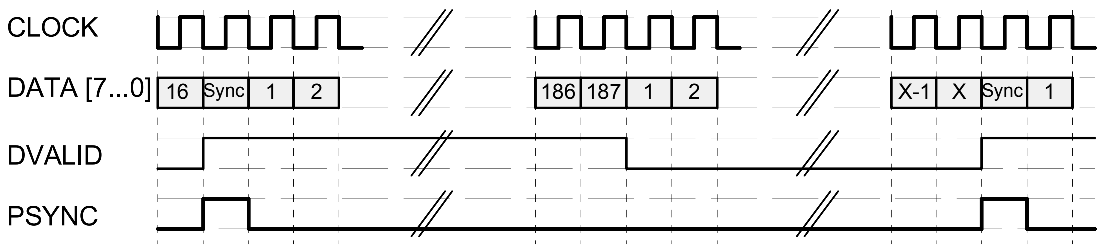


Fig.: 2.2.4-95 Partial TS with a packet length of 188 bytes and x dummy bytes between TS packets

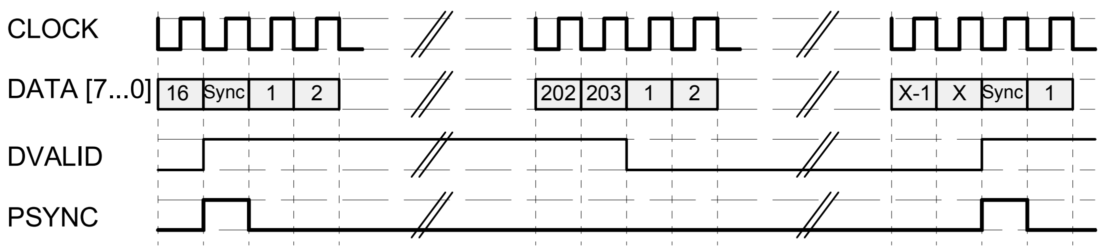


Fig.: 2.2.4-96 Partial TS with a packet length of 204 bytes and x dummy bytes between TS packets

Definition of signals:

Data [7...0]: TS data word (8 bits: Data 7 to Data 0). Data 7 is the most significant bit.

DVALID: High active, indicates valid data. This signal is constantly high in the 188 byte mode. In the 204 byte mode as well as with partial TS, the signal indicates invalid data if its level is 0.

PSYNC: High active, indicates the beginning of a TS packet.

2.2.5 BASEBAND Menu

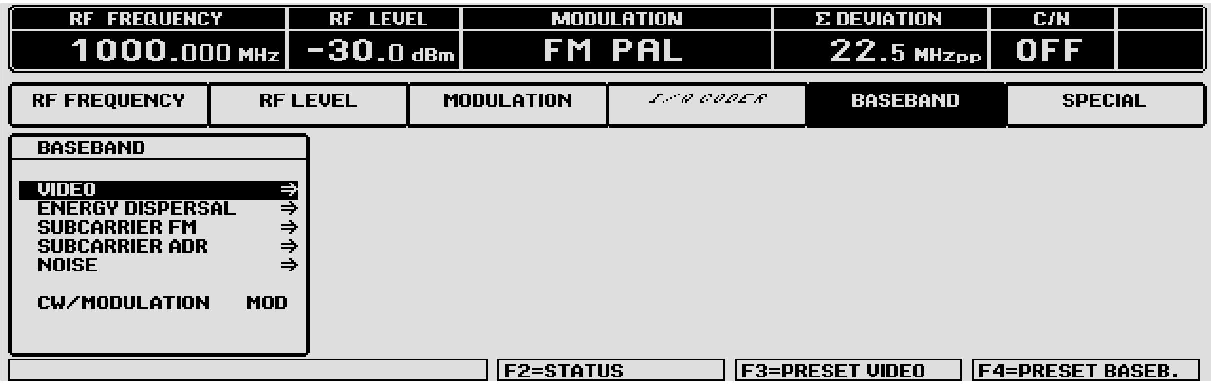


Fig.: 2.2.5-1 BASEBAND menu

The whole modulation signal is processed in the baseband.

It consists of: **VIDEO** (external source)**,**
ENERGY DISPERSAL,
SUBCARRIER FM,
SUBCARRIER ADR and **NOISE.**

The menu item:

CW / MODULATION allows a switchover between modulated and unmodulated RF carriers.

CW: The complete baseband signal is switched off; video and all subcarriers.

MODULATION: The RF carrier is modulated with the baseband.

Note: *With the MOD OFF hardkey actuated in the* **MODULATION FM** *menu, the video and the modulation of the subcarrier is switched off. The RF carrier is then further modulated with the unmodulated sound subcarriers. This is an advantage since the sound subcarriers can be checked for intermodulation products after demodulation in the receiver.*

2.2.5.1 VIDEO

Menu items:
VIDEO →

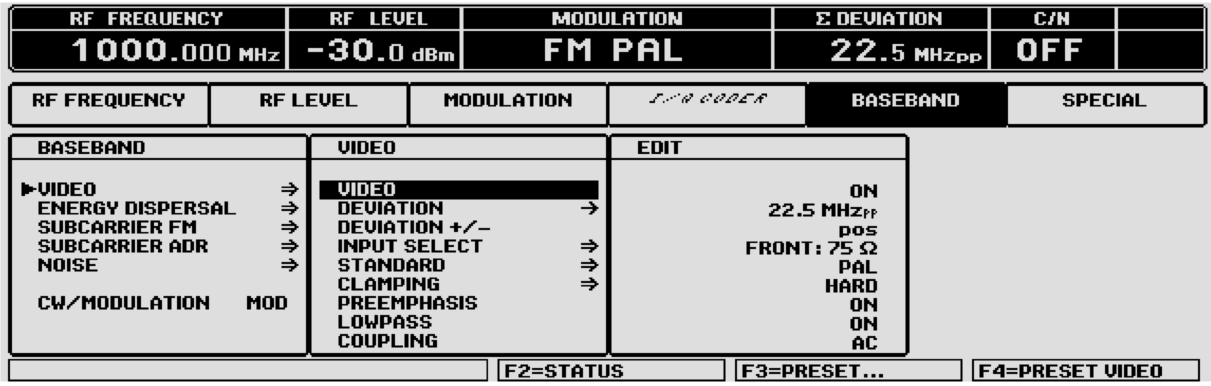


Fig.: 2.2.5-2 VIDEO

VIDEO ON/OFF The applied video can be switched ON/OFF. This is valid for all standards provided that appropriate inputs are used for PAL, SECAM and NTSC.

DEVIATION → Input value for video deviation; 10 to 40 MHz_{pp}.

DEVIATION +/- The sign of the deviation can be changed. This is required if a signal is applied at the IF for SAT receivers.

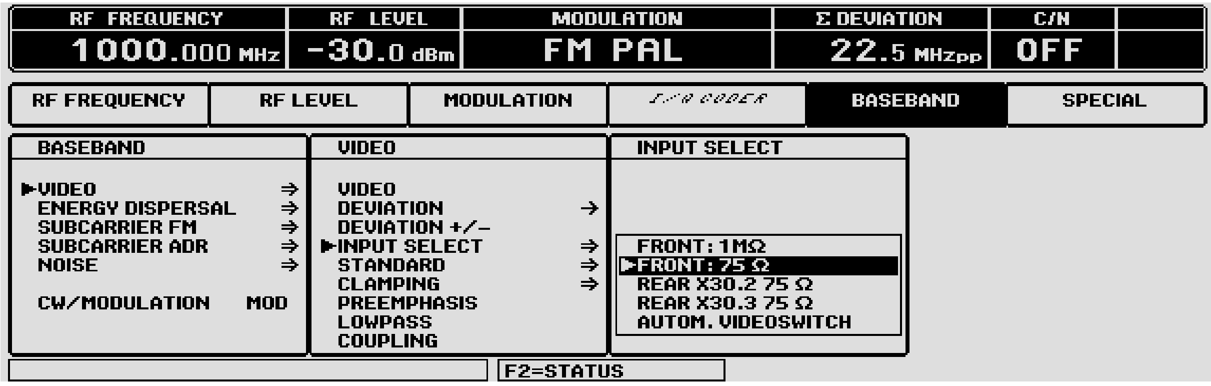


Fig.: 2.2.5-3 INPUT SELECT

INPUT SELECT This menu item allows to select the input connectors for the external video signals.

FRONT 1: 1 MΩ
FRONT 1: 75 Ω is a video input with loop-through filter which can be operated as input or output.
Under menu item **FRONT 1: 1 MΩ** the output of the loop-through filter has to be terminated into 75 Ω.
Under menu item **FRONT 1: 75 Ω** the loop-through filter is internally terminated into 75 Ω which is indicated by the front-panel LED. An external 75 Ω termination must not be connected.

REAR X 30.2 75 Ω
REAR X 30.3 75 Ω
After selection of one of the two BNC inputs the video signal can be applied via the rear of SFQ.

AUTOM. VIDEOSWITCH
Under this menu item the video input connectors are assigned to a standard. Automatic switchover of the input cable is effected with the selection of the standard.

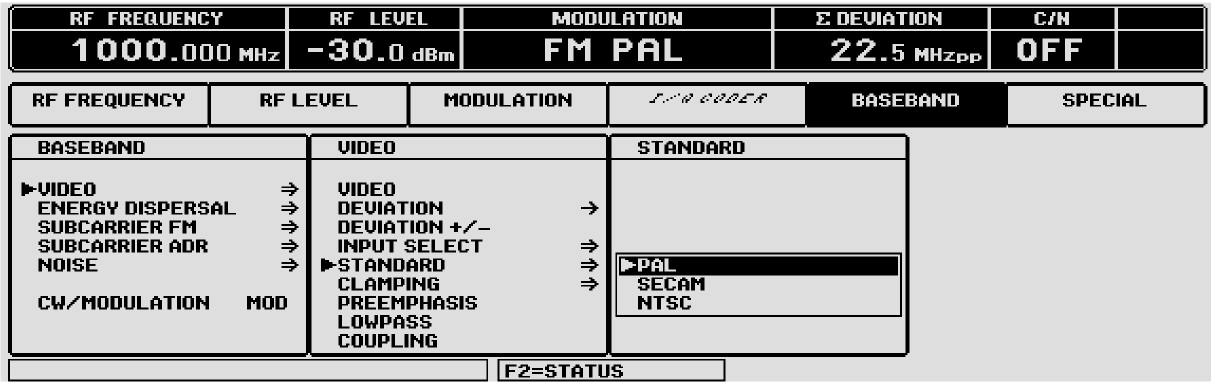


Fig.: 2.2.5-4 STANDARD

STANDARD This menu item allows to select STANDARD **PAL, SECAM** or **NTSC**. The external video generators are connected via BNC connectors (see **INPUT SELECT**)

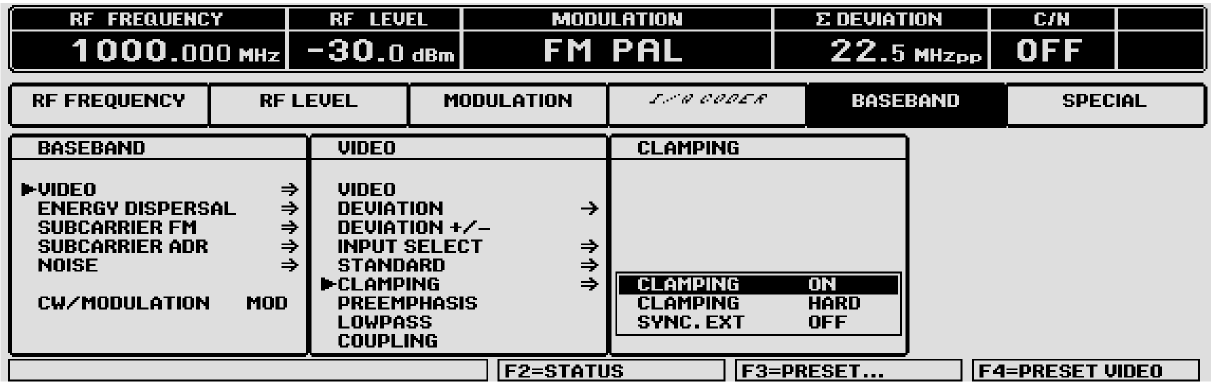


Fig.: 2.2.5-5 CLAMPING

CLAMPING **ON /OFF** Clamping can be switched on or off. For all standards clamping is effected on the back porch.

HARD Under this menu item a hum superimposed upon the video signal is suppressed by >50 dB.

SOFT Hum is not clamped. Clamping circuits in receivers can thus be tested.

SYNC. EXT An external sync pulse can be applied via the rear X..... Level: -2 to -4 V. External synchronization is necessary for scrambled video signals. The sync separator in SFQ cannot process scrambled video signals.

PREEMPHASIS **ON / OFF** The preemphasis for the video signal can be switched on or off under this menu item.

The preemphasis is CCVS (625) for standards PAL and SECAM and FCC (525) for standard NTSC.

LOWPASS **ON /OFF** The group-delay-corrected lowpass with its limit frequency of 4.8 MHz can be switched on or off under this menu item.

2.2.5.2 ENERGY DISPERSAL

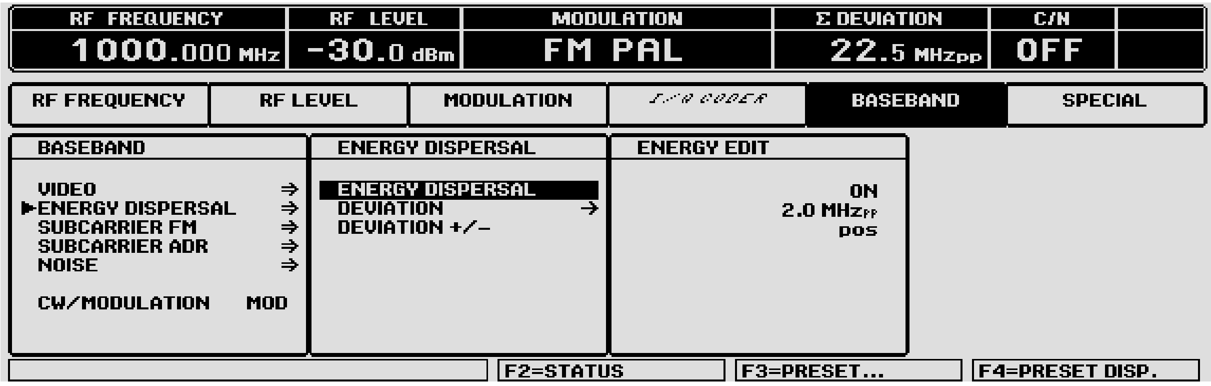


Fig.: 2.2.5-6 ENERGY DISPERSAL

ON /OFF The energy dispersal signal can be switched on and off.

DEVIATION Input value for the energy dispersal deviation; 0 to 4 MHz_{pp}. The nominal level with video modulation is 2 MHz_{pp}. The energy dispersal deviation is doubled if the video is switched off.

DEVIATION + / - The sign of the deviation can be changed.

2.2.5.3 BASEBAND - SUBCARRIER FM

List of FM subcarriers

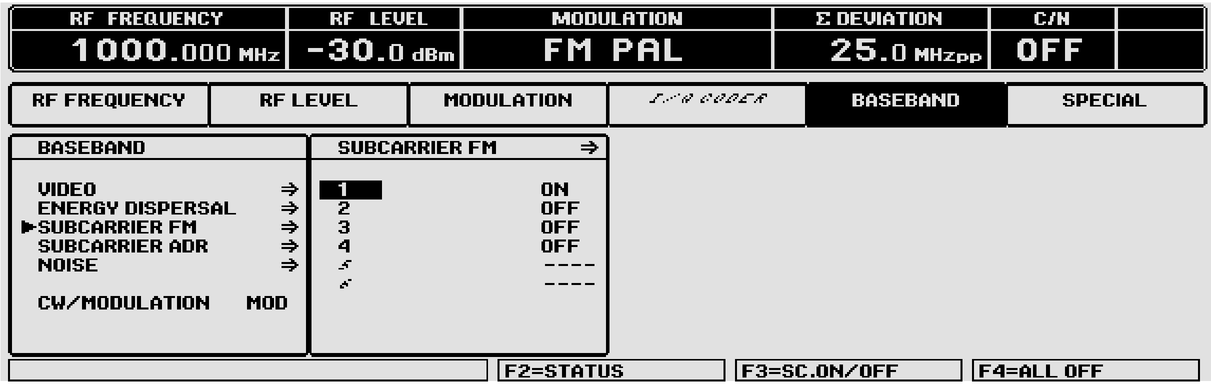


Fig.: 2.2.5-7 BASEBAND - SUBCARRIER FM

With line SUBCARRIER FM selected in the BASEBAND menu all available FM subcarriers are listed. The individual subcarriers can be switched on/off with the F3 (ON/OFF) key. The F4 (ALL OFF) key allows to switch off all FM subcarriers at the same time. Switch on/off of FM subcarriers influences the sum frequency deviation which is displayed at the top right in the status bar. FM subcarriers that are not available are displayed in italics.

The required subcarrier can be selected in the list of FM subcarriers by using the cursor and pressing the ENTER key. The associated submenu will then be opened.

Subcarrier ON/OFF

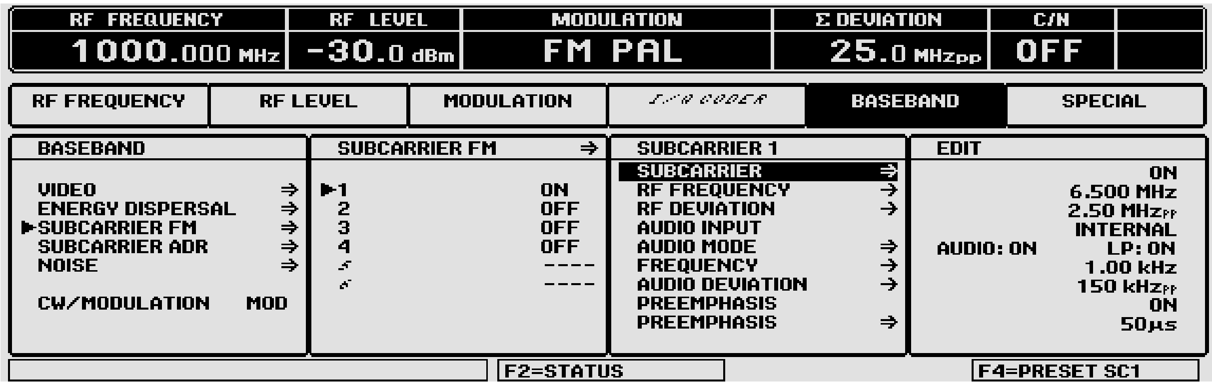


Fig.: 2.2.5-8 Subcarrier ON/OFF

The subcarrier selected in the SUBCARRIER FM column (arrow) can be switched on and off (toggle function) under menu item SUBCARRIER. This corresponds to the function of the F3 (ON/OFF) key described above (one menu higher).

RF frequency of subcarrier

The RF frequency (RF FREQUENCY) of the FM subcarrier can be set from 5.000 to 9.000 MHz. The resolution is 1 kHz.

RF frequency deviation of FM subcarrier

The RF frequency deviation of the FM subcarrier (RF DEVIATION) can be set from 1.00 to 4.00 MHz_{pp} (peak to peak) with a resolution of 10 kHz.

Audio input of FM subcarrier

The audio input (AUDIO INPUT) of the FM subcarrier can be toggled between internal and external sources. The external audio input is a differential input with an input resistance >5 kΩ. The nominal input level is +9 dBm (600 Ω). The set and displayed audio frequency deviation (AUDIO DEVIATION) is valid for this nominal input level. A Lemo Triax connector for FM subcarriers 1 and 2 is provided on the front panel, that for subcarriers 3, 4, 5 and 6 on the rear panel. The internal audio signal is generated by a DSP.

Audio mode

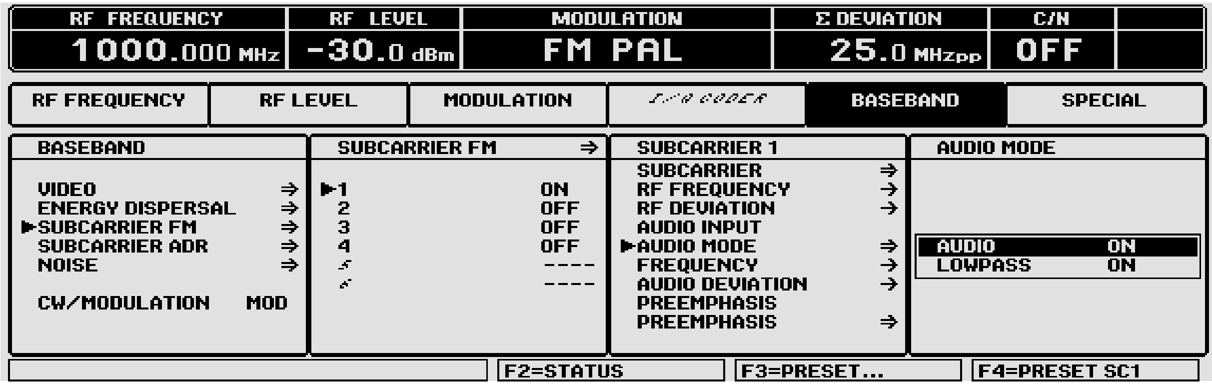


Fig.: 2.2.5-9 Audio Mode

Menu item AUDIO MODE allows the switch on/off of the audio signal (unmodulated FM subcarrier if Audio = OFF) and the switch on/off of an AF lowpass filter with a limit frequency of 15 kHz.

Audio frequency

The audio frequency (FREQUENCY) of the internal AF generator (DSP) can be set from 0.02 to 15.00 kHz. The resolution is 10 Hz.

Audio frequency deviation

The audio frequency deviation (AUDIO DEVIATION) can be set from 0 to 600 kHz_{pp} (peak to peak) with a resolution of 1 kHz. The set audio deviation corresponds to the actual audio deviation if the internal audio source is selected (AUDIO INPUT: INTERNAL). A set preemphasis is taken into account. For an external audio source the set and displayed audio frequency deviation are valid for low frequencies (20 Hz) and only for a nominal input level of +9 dBm (600 Ω).

Switch-on of preemphasis for FM subcarrier

The preemphasis can be switched on/off by pressing the ENTER key (toggle function) if the cursor is set to menu item PREEMPHASIS (not marked by an arrow pointing to the right). With the internal audio source selected, the audio frequency deviation is recalculated according to the set audio frequency and is displayed. With "external audio source" set, the displayed audio deviation changes only slightly, since the frequency deviation display is valid for low frequencies (20 Hz) and the preemphasis is only of minor importance.

Selection of preemphasis

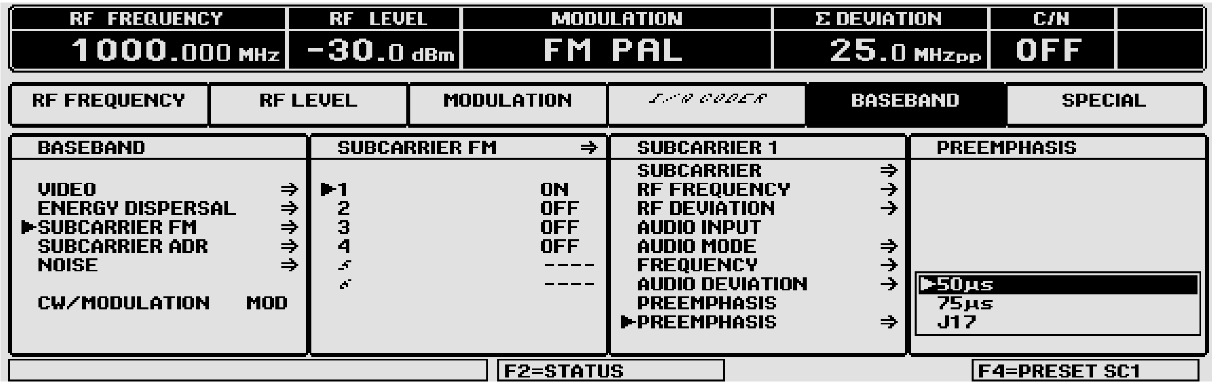


Fig.: 2.2.5-10 Selection of preemphasis

50 µs, 75 µs or J17 can be selected as audio preemphasis. The preemphases have a different characteristic which is reflected by the following expression.

50 µs, 75 µs

$$\Omega(f) = \Omega_0 \bullet \sqrt{1+(2\pi f\tau)^2}$$

where τ = 50 µs or 75 µs

Frequency deviation at preemphasis off: Ω_0
Frequency deviation: Ω
Frequency: f [MHz]
Time constant: τ [µs]

J17

According to ITU-R Recommendation J.17; neutral frequency f = 1.42 kHz.

$$\Omega(f) = \Omega_0 \bullet \sqrt{\frac{1+\left|\frac{2\pi f}{3000}\right|^2}{75+\left(\frac{2\pi f}{3000}\right)^2}} \bullet 2{,}918$$

2.2.5.4 BASEBAND - SUBCARRIER ADR

List of ADR subcarriers

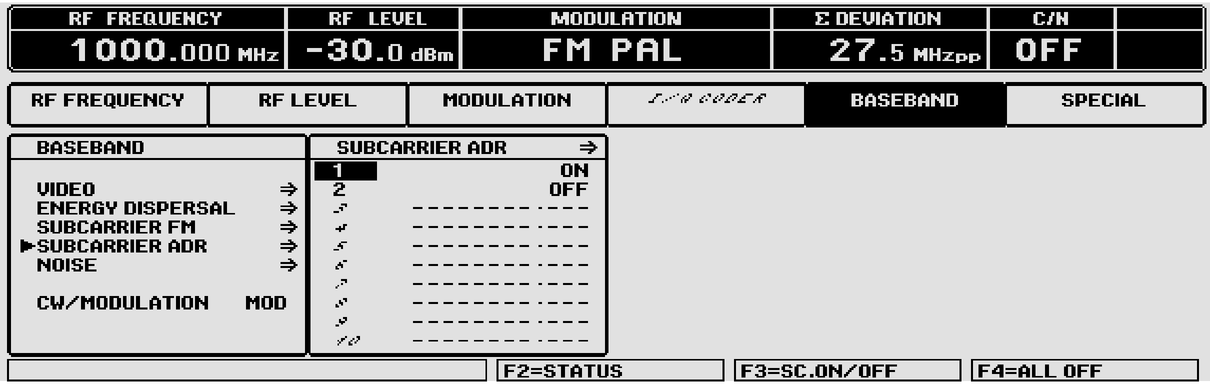


Fig.: 2.2.5-11 List of ADR subcarriers

With line SUBCARRIER ADR selected in the BASEBAND menu all available ADR subcarriers are listed. The individual subcarriers can be switched on/off with the F3 (ON/OFF) key. The F4 (ALL OFF) key allows to switch off all ADR subcarriers at the same time. Switch on/off of ADR subcarriers influences the sum frequency deviation which is displayed at the top right in the status bar. ADR subcarriers that are not available are displayed in italics.

The required subcarrier can be selected in the list of ADR subcarriers by using the cursor and pressing the ENTER key. The associated submenu will then be opened.

Subcarrier ON/OFF

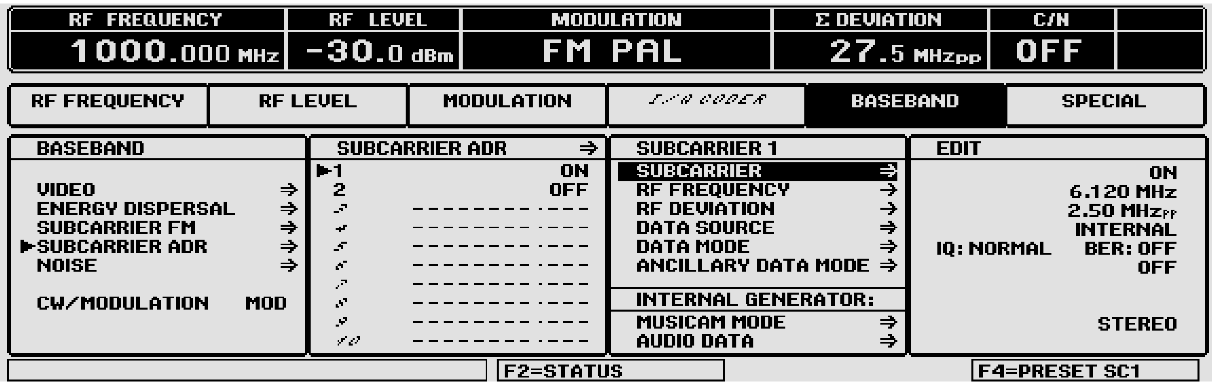


Fig.: 2.2.5-12 Subcarrier ON/OFF

The subcarrier selected in the SUBCARRIER ADR column (arrow) can be switched on and off (toggle function) under menu item SUBCARRIER. This corresponds to the function of the F3 (ON/OFF) key described above (one menu higher).

RF frequency of the subcarrier

The RF frequency (RF FREQUENCY) of the ADR subcarrier can be set from 0.100 to 9.000 MHz. The resolution is 1 kHz.

RF frequency deviation of ADR subcarrier

The RF frequency deviation of the ADR subcarrier (RF DEVIATION) can be set from 1.00 to 4.00 MHz_{pp} (peak to peak) with a resolution of 10 kHz.

Data source of ADR subcarrier

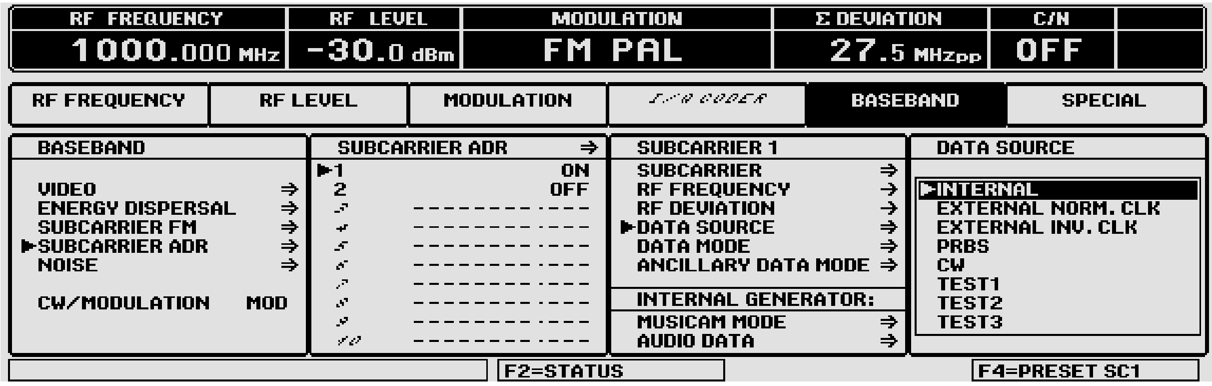


Fig.: 2.2.5-13 Data source of ADR subcarrier

Menu item DATA SOURCE of the ADR subcarrier allows to select one of several data sources:

INTERNAL

With the internal data source selected a MUSICAM data stream is generated by a DSP.

EXTERNAL NORM. CLK

External data source with normal clock.

EXTERNAL INV. CLK

External data source with inverted clock.

PRBS

A PRBS sequence is used as data source instead of the MUSICAM data stream.

CW

The ADR carrier is unmodulated (continuous wave).

TEST 1

Test sequence at modulator.

TEST 2

Test sequence at modulator.

TEST 3

Test sequence at modulator.

The possibility to switch to an external data source is only provided for one ADR subcarrier per module (1 module = 2 ADR subcarriers). If, for example, four ADR subcarriers are available in a unit (ADR 1 to 4), the odd ADR subcarriers - i.e. ADR 1 and 3 - can be switched to an external data source.

If an external data source is to be used, a MUSICAM data stream (192 kbit/s) and the corresponding clock (192 kHz) have to be applied (level: RS422).

A Lemo Triax connector is provided on the rear panel. The signal is a differential signal with shielding, positive pole in the middle and negative pole between positive pole and the shielding.

Data mode

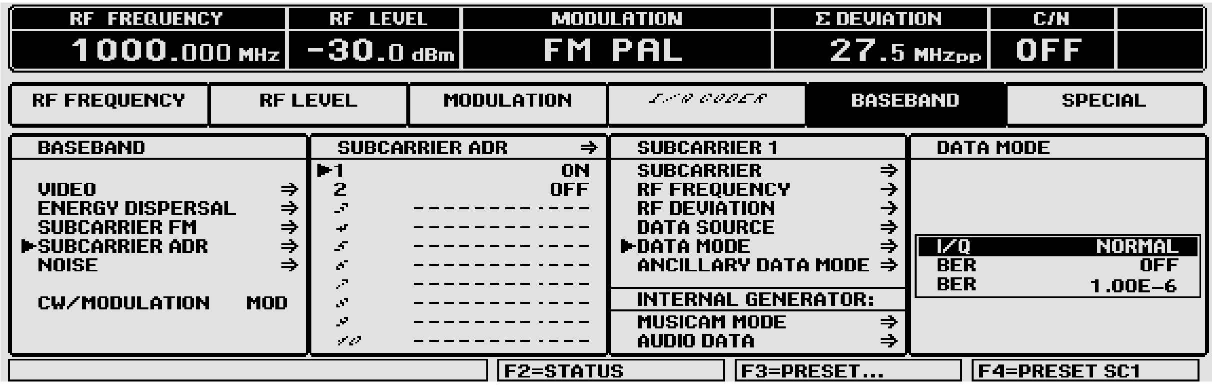


Fig.: 2.2.5-14 Data mode

Under menu item DATA MODE, the I path can be exchanged with the Q path before the modulator (I/Q NORMAL / I/Q CHANGED toggle function). An artificial bit error rate can be switched off and on (BER ON/OFF toggle function).

The bit error rate can be set from 1.00E^{-2} to 1.00E^{-6}. The bit errors are generated before the modulator and thus relate to the gross data rate.

Ancillary data

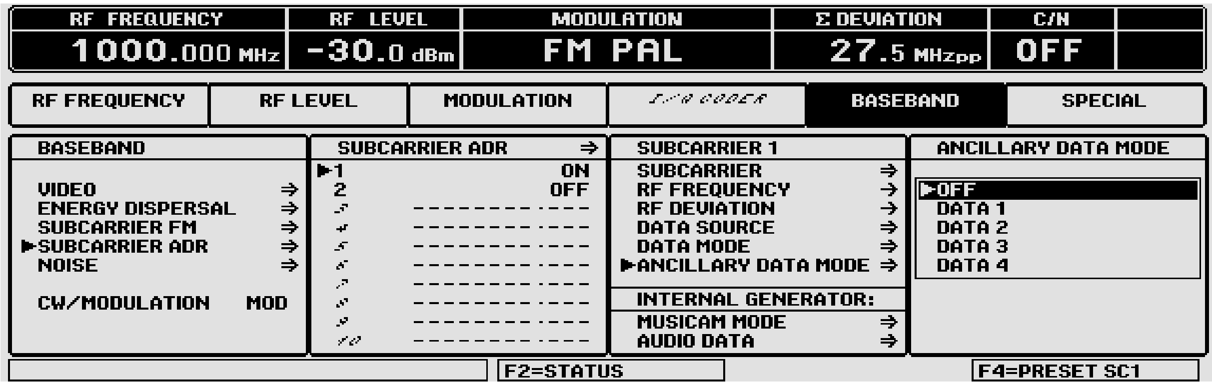


Fig.: 2.2.5-15 Ancillary data

Under menu item ANCILLARY DATA MODE, the ancillary data can be switched off (ancillary data bits are filled with zeros) or a data set can be selected among four possible data sets (DATA 1 to DATA 4).

(DATA 1 to DATA 4 is not yet implemented).

Internal MUSICAM generator

The following menu items are only effective with the internal data source selected. The MUSICAM data stream is coded according to ISO/IEC 11172-3.

MUSICAM mode

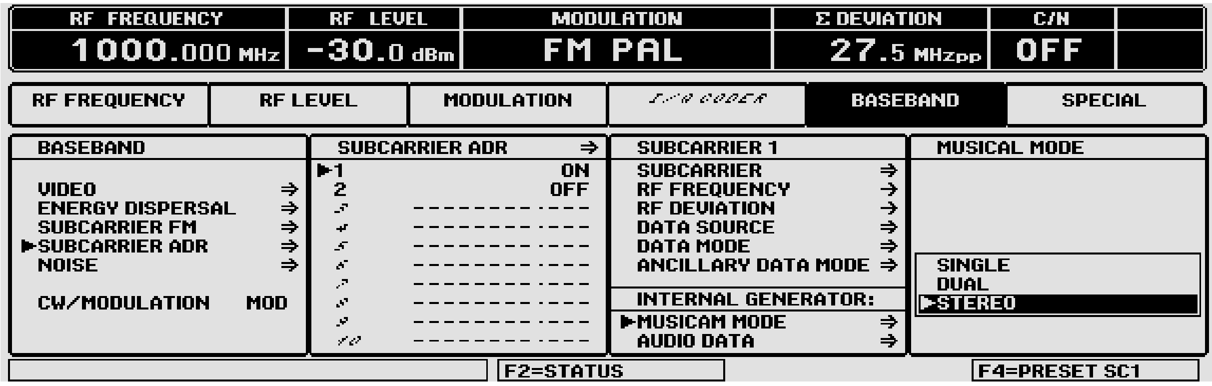


Fig.: 2.2.5-16 MUSICAM mode

SINGLE, DUAL or STEREO mode can be selected under menu item MUSICAM MODE.

Audio data

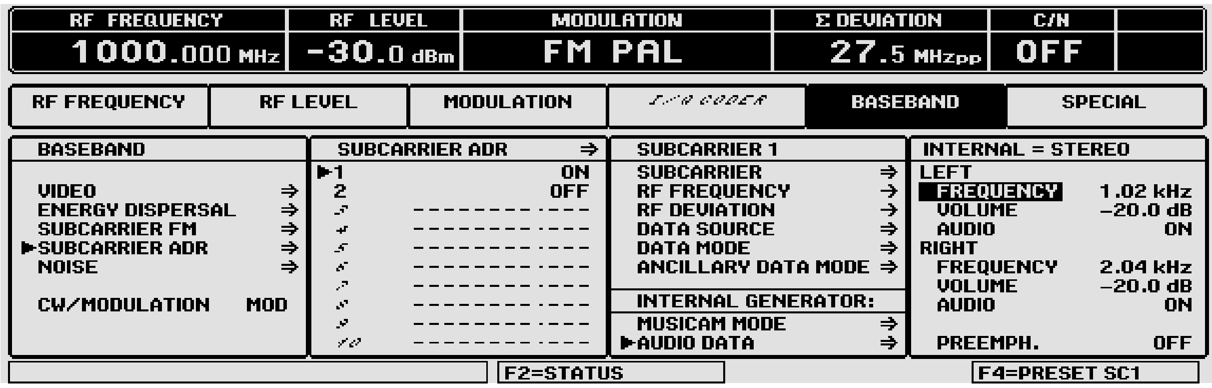


Fig.: 2.2.5-17 AUDIO DATA

Under menu item AUDIO DATA the audio frequencies and the volume for the left and right channel can be set independently of each other. Moreover, the audio for each channel can be switched on/off separately.

Audio frequency

The audio frequency (FREQUENCY) can be set from 0.01 to 19.87 kHz with a resolution of 10 Hz.

Volume

The volume can be set from -100.0 to 0.0 dB.

Switching audio on/off

The audio can be switched on/off separately for the left and right channel (AUDIO ON/OFF toggle function)

Preemphasis

The preemphasis can be switched on/off for the two audio channels together (PREEMPH. ON/OFF toggle function). Preemphasis 50/15 µs is implemented according to ITU-R Recommendation 651.

2.2.6 SPECIAL Menu

When the sweep function is activated, the modulation is not switched off.

Note:	*In the ATSC modulation mode, START FREQUENCY/STOP FREQUENCY and CENTER FREQUENCY/SPAN always refers to the pilot frequency in the ATSC spectrum, i.e. the pilot frequency is varied within the limits of the sweep range.*

If a sweep is to be performed in the CW mode, the I/Q modulation can be switched off by means of the MOD OFF hardkey (modulation switched off).

In the SWEEP START/STOP and the SWEEP CENTER/SPAN modes the sweep is started and stopped with key F4 (toggle function).

2.2.6.1 SWEEP START/STOP Submenu

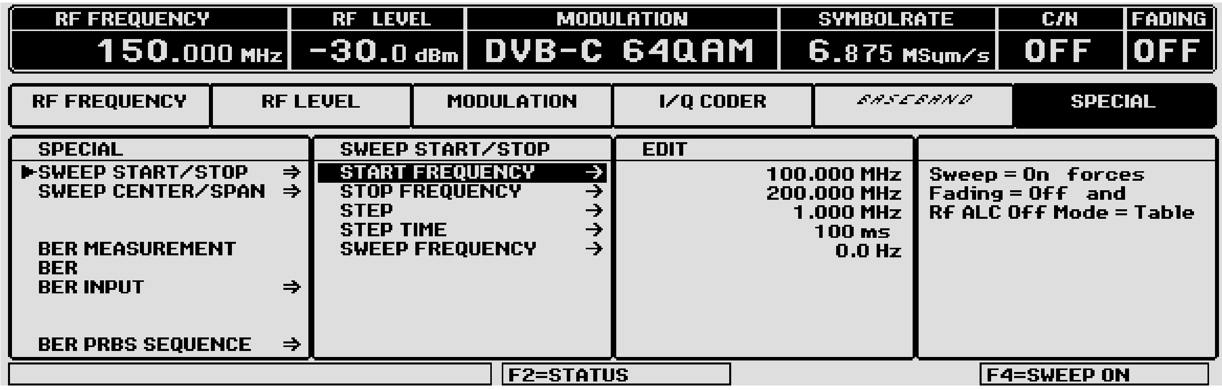


Fig.: 2.2.6-1 SWEEP START/STOP Submenu

START FREQUENCY:

Here the start frequency is entered. The unit is always [MHz]. The lowest start frequency is 0.300 MHz, the highest 3300.000 MHz.

If a start frequency higher than the stop frequency is entered, the user is informed accordingly.

STOP FREQUENCY:

Here the stop frequency is entered in [MHz]. The lowest start frequency is 0.300 MHz, the highest 3300.000 MHz.

If a stop frequency lower than the start frequency is entered, the user if informed. In addition, the stop frequency must be at least one step higher than the start frequency.

STEP:

Here the frequency step width is entered. The unit is always [MHz]. The minimum step width that can be entered is 0.000001 MHz. The maximum step width depends on the start and stop frequency. The step width must not be greater than the stop frequency less the start frequency so that at least one sweep step can be performed.

STEP TIME:

Here the time required for a frequency step during a SWEEP is entered. The STEP TIME is entered in [ms]. A minimum step time of 30 ms can be entered, the maximum is 1000 ms.

Note:	*To achieve the minimum STEP TIME of 30 ms, automatic fading is deactivated upon starting the sweep and the RF ALC off mode is switched to TABLE (see information in display of SFQ).*

SWEEP FREQUENCY:

This menu item facilitates the sweep definition for RF jitter measurements.
Upon entry of the sweep limits (START/STOP) the SFQ automatically sets the minimum step width and the minimum STEP TIME (30 ms) of the frequency steps (STEP FREQUENCY) that is required to perform a sawtooth sweep with the stated SWEEP FREQUENCY.

2.2.6.2 SWEEP CENTER/SPAN

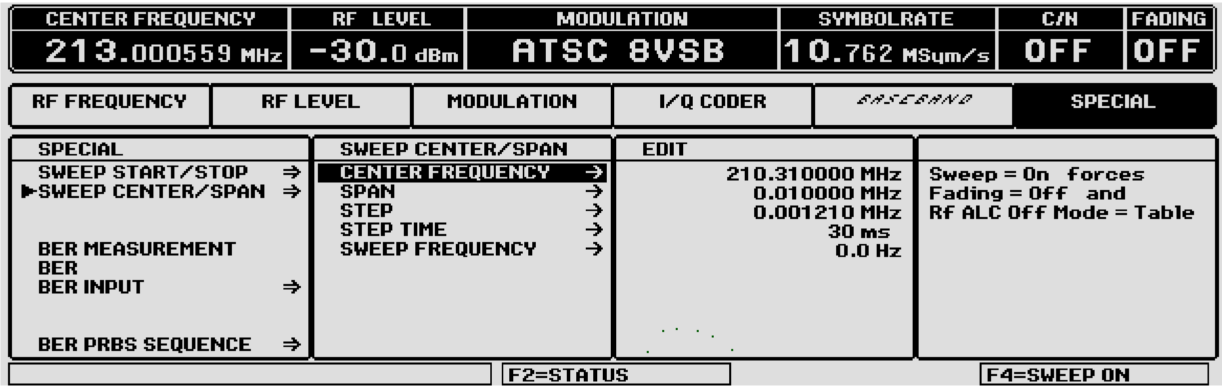


Fig.: 2.2.6-2 SWEEP CENTER/SPAN

CENTER FREQUENCY:

Here the center frequency can be entered. The unit is always [MHz]. A center frequency between 0.300 Hz and 3300.000 MHz can be chosen.

SPAN:

The frequency range swept around the center frequency is entered. A sweep is performed over ±one half of the span at both sides of the center frequency. The unit is [MHz]. The minimum SPAN that can be entered is 0.000001 MHz, the maximum span is limited by the overall frequency range of 0.300 to 3300.000 MHz. The set span must not exceed this range and not be smaller than the set step width and be wide enough so that at least one sweep step can be performed. The user is informed when incorrect settings have been made.

STEP:

Here the frequency step is entered. The unit is [MHz]. A minimum step width of 0.000001 MHz can be set. The maximum step width depends on the set span. A step must not be wider than the set span so that at least one step can be performed.

STEP TIME:

Here the duration of a frequency step for SWEEP is entered in [ms]. The minimum STEP TIME is 30 ms, the maximum 1000 ms.

Note:	*To achieve the minimum STEP TIME of 30 ms, automatic fading is deactivated upon starting the sweep and the RF ALC off mode is switched to TABLE (see information in display of SFQ).*

SWEEP FREQUENCY:

This menu item facilitates the sweep definition for RF jitter measurements.
Upon entry of the sweep limits (CENTER/SPAN) the SFQ automatically sets the minimum step width and the minimum STEP TIME (30 ms) of the frequency steps (STEP FREQUENCY) that is required to perform a sawtooth sweep with the stated SWEEP FREQUENCY.

2.2.6.3 BER submenu

BER MEASUREMENT **BER** **BER INPUT** **BER PRBS SEQUENCE**	Input values for influencing the BER measurement see chapter 2.2.9

2.2.7 NOISE

The noise generator for the SFQ is available in **two different models.**

- Standard noise generator (SFQ-B5 2072.7579.02) with good C/N accuracy (±0.5 dB).
- Self-Calibrating Noise Generator (SFQ-B5 2072.7579.03/04) providing recalibration of the C/N ratio to obtain very good C/N accuracy.

The type of noise generator (board No.: IDENT NO, VAR) used can be identified via **SETUP-HARDWARE-EQUIPMENT** see following table:

Type of noise generator board In SETUP-HARDWARE-EQUIPMENT	Noise generator
2072.7504.02	Standard Noise Generator: SFQ-B5 2072.7579.**02**
2081.9258.02	Self-Calibrating Noise Generator: SFQ-B5 2072.7579.**03**
2110.0059.02	Self-Calibrating Noise Generator: SFQ-B5 2072.7579.**04** (in addition SFQ-B27 Impulsive Noise can be installed)

2.2.7.1 Operation

The NOISE menu item is accessed via the modulation menu.

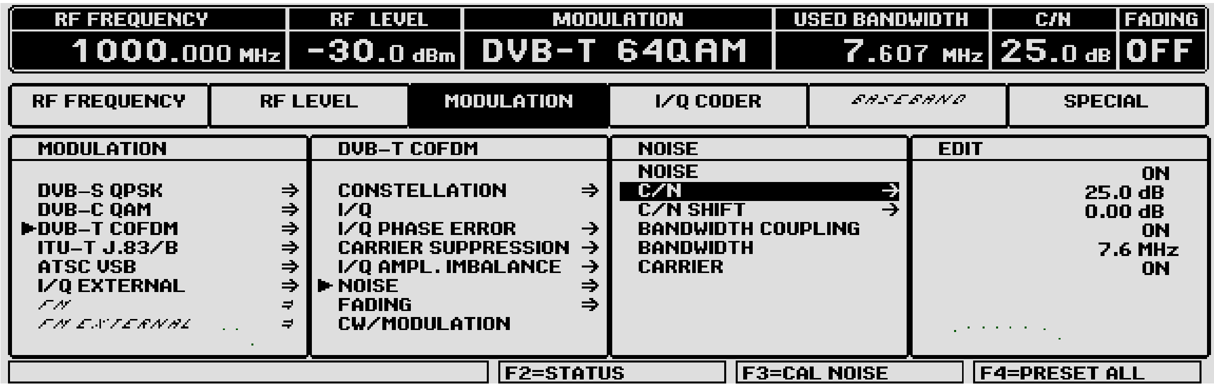


Fig.: 2.2.7-1 NOISE

NOISE:

The noise signal can be switched on or off.

Note:	*When the noise signal is switched on, the RF ALC OFF MODE is automatically set to TABLE (see chapter 2.2.2.1. RF LEVEL).*

C/N:

In this menu item the carrier-to-noise ratio can be set. The unit is [dB], the resolution 0.1 dB.

The effective power of the I/Q-modulated carrier is taken as the carrier power. The noise power is determined by the given noise power density, the bandwidth depends on the set receiver bandwidth.

The set receiver bandwidth is used for calculating the C/N ratio.

Since the bandwidth of the noise signal generated by the SFQ is in any case wider than the set receiver bandwidth [10 MHz or 60 (80) MHz], realistic conditions can be simulated.

The setting range of the noise attenuator is 0.0 to 60.0 dB

Refer to the data sheet for the minimum settable C/N ratio for the modulation currently selected.

C/N SHIFT:

SFQ features very good C/N accuracy, especially with the self-calibrating model 03 of the noise generator. This menu item increases the accuracy further. Using a spectrum analyzer and the Carrier off function, it is easy to check the equality of C (carrier) and N (noise) at 0 dB C/N and to correct slight deviations by modifying the C/N shift. C/N SHIFT is stored in a non-volatile memory for each type of modulation.

BANDWIDTH COUPLING:

The receiver bandwidth, i.e. the noise bandwidth used for calculating the C/N, is coupled with the set SYMBOL RATE or USED BANDWIDTH of the active coder.

This coupling is selected with COUPLING ON/OFF.

BANDWIDTH:

Here the equivalent noise bandwidth of the receiver is set in [MHz]. Values between 0.1 MHz and 80.0 MHz are available.

This menu item can only be selected if bandwidth coupling is switched off.

For I/Q modulation, a bandwidth setting equal to the symbol rate is useful (e.g. QPSK: 27.5 Msymbols/s ->BW = 27.5 MHz).

The set receiver bandwidth will be used for calculating the C/N ratio.

CARRIER ON/OFF:

The carrier can be switched off for checking the C/N value. Thus, checking the noise at 0 dB C/N can easily be performed using a spectrum analyzer. Note: When the noise menu is exited, the carrier is automatically switched on again.

F3 = NOISE CAL.:

Calibration of the noise generator for the **currently selected modulation mode** can be started with function key F3.

Calibration is not possible if

- the standard noise generator is installed
- MODULATION I/Q EXT is selected
- the activated coder signals UNLOC
- a transport stream is present at the TS PARALLEL input of units without input interface. After calibration has been started, a window requests disconnection.

After calibration has been started, the user is informed about the calibration process in a display window.

The calibration result is indicated at the bottom left in the display (CAL failed! Check SETUP/HARDWARE/CAL)

However, this is a summary indication; if previous SFQ calibrations FAILED, the display remains FAILED.

In the **SETUP-HARDWARE-CALIBRATING** menu item, the calibration of the noise generator can be triggered for **all** the **modulation modes** installed (NOISE ALL).

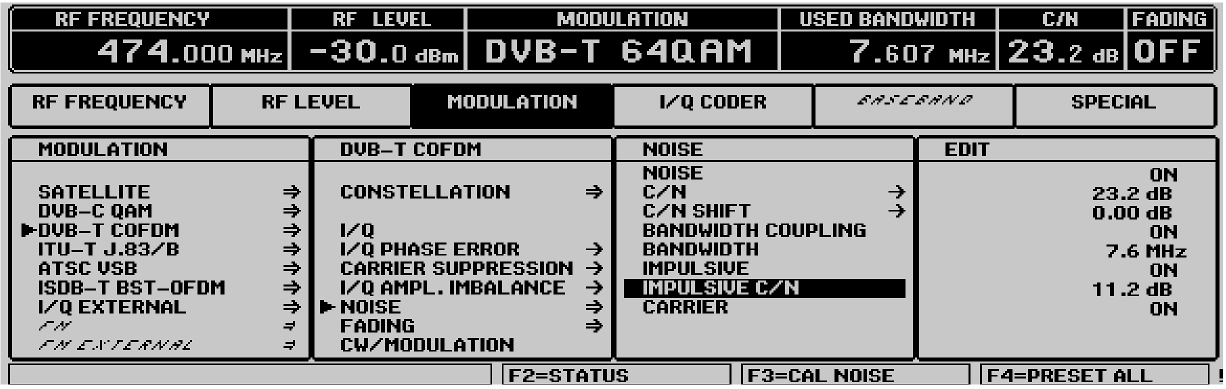
The calibration values for the various modulation methods are stored in a nonvolatile memory.

Notes:

1. *The noise is switched off upon every change of the modulation mode (NOISE = OFF).*
2. *When the noise generator is switched on, the RF ALC OFF MODE is preset to TABLE.*
3. *In the SFQ the noise signal is added to the useful signal at 300 MHz. Through the subsequent conversion to the output frequency the noise spectrum may be mirrored at 0 Hz depending on the bandwidth. Please note the data sheet specifications at low frequencies (<15 MHz or <60 MHz).*
4. *When retrofitting a standard noise generator, please observe chapter* 1.6.5.1 C/N Adjustment after Installation of SFQ-B2 or SFQ-B52.
5. *When retrofitting a coder option in an SFQ with standard noise generator, please observe chapter* 1.6.7.1 Level Adjustment

2.2.7.2 Impulsive Noise

If the option SFQ-B27 is installed, the menu item NOISE is extended by two additional instructions:



IMPULSIVE:

If IMPULSIVE is set to ON, the impulsive noise can be switched on and off by X30.3 at the rear side (Level: TTL high impedance, High-Level = Noise on). The impulsive Noise gets superimposed the normal Noise. Therefore Noise can be switched over with X30.3 between two C/N ratios. Shall Noise be switched on/off, the C/N of the normal Noise must be set towards large values.

If the normal noise signal is switched off in the menu, then also impulsive Noise is switched off.

IMPULSIVE C/N:

In this menu item the carrier-to-noise ratio of impulsive noise can be set. The numerical value corresponds to the C/N ratio at Noise permanently switched on.The unit is [dB], the resolution 0.1 dB. The fractional digit is taken by the setting of the normal Noise.

2.2.7.3 Testing diversity receivers:

The Self-Calibrating Noise Generator (SFQ-B5 2072.7579.04) can provide additional outputs for the internally generated I/Q signals of the I/Q coders. These outputs can be used for the configuration of diversity test sets. Special cabling (SFQ-Z5) of the I/Q signals is however required for this purpose.

2.2.8 FADING

By means of the option Fading Simulator SFQ-B11, multipath fading signals can be generated. Two implementation stages are available in SFQ: with one option, 6-path fading is possible, with a second option, 12-path fading. The two paths can be set independently.

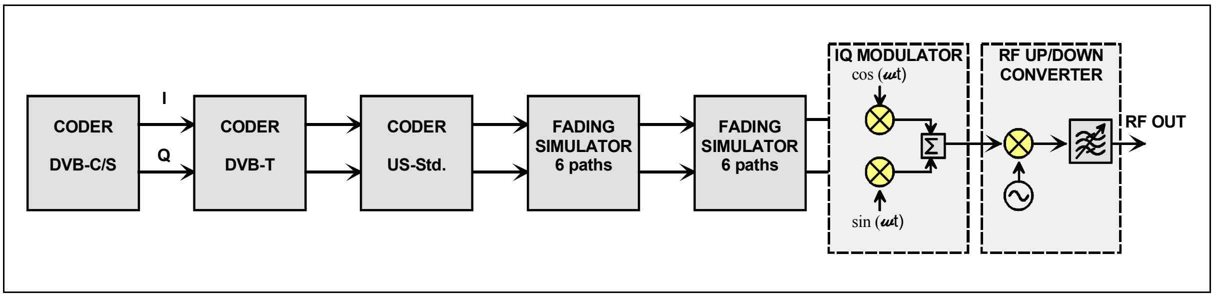


Fig.: 2.2.8-1 Fading simulator in SFQ

The input signals for the fading simulator can be applied by either the different I/Q coders or the external I and Q components. The output signals of the fading simulator is passed on to the IQ modulator and then mixed to the set RF.

Note: *A self-calibration routine for fading can be called up at the same time with the I/Q MODULATION calibration (Menu SETUP \ HARDWARE \ CALIBRATING). The calibration routine should be called up after temperature changes of more than 5 degrees (UTILITIES-CALIB-FSIM).*

Output power with fading

If one signal path is switched on with PATH LOSS set to 0 dB, the fading simulator has a 12 dB to 18 dB insertion loss on the IQ signals applied. This insertion loss will be corrected automatically in SFQ.

This means:

If the fading simulator is switched on with only one path at 0 dB, the average power at the RF output of SFQ is the same as with the fading switched off. If further paths are switched on, the output signals of these paths are superimposed. The average power at the RF output is the RF level shown in the SFQ display.

Due to the insertion loss of the fading simulator the maximum available output power of SFQ is reduced by up to 18 dB.

The Fading menu item is accessed via the modulation menu.

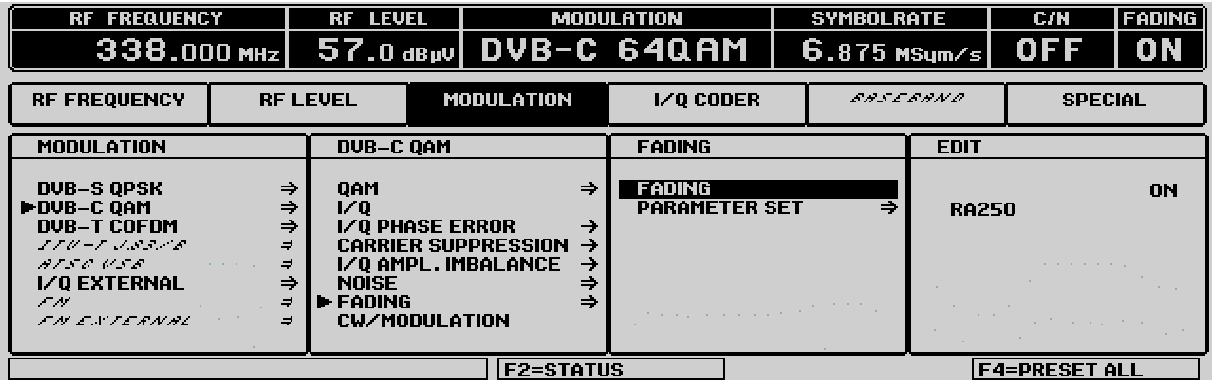


Fig.: 2.2.8-2 FADING

FADING:

The fading modulator can be switched on or off.

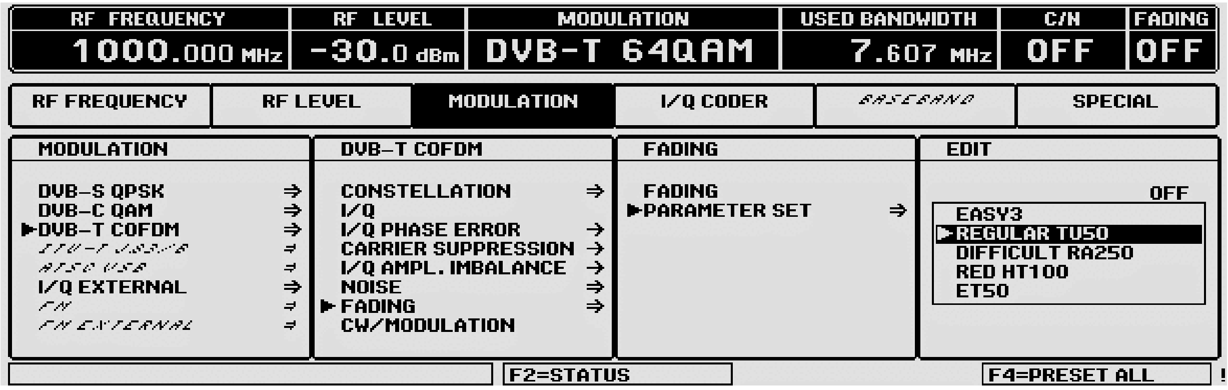


Fig.: 2.2.8-3 PARAMETER SET

PARAMETER SET:

One of five editable sets can be selected. The sets can be selected or edited in SETUP/FADING PARAMETER (see 2.2.8.1).

2.2.8.1 FADING PARAMETER Submenu

Fading simulation settings are accessible in the SETUP FADING PARAMETER menu.

Note: *Please observe the setting of SETUP - PRESET - FADING -REFERENCE (see chapter 2.2.13.5.).*

The user can create five different fading parameter sets. These can be filled either by predefined standardized settings or by individual values.

Note: *If individual parameter sets are activated within the MODULATION menu, MODIFY will be displayed in the message window of the MODULATION menu.*

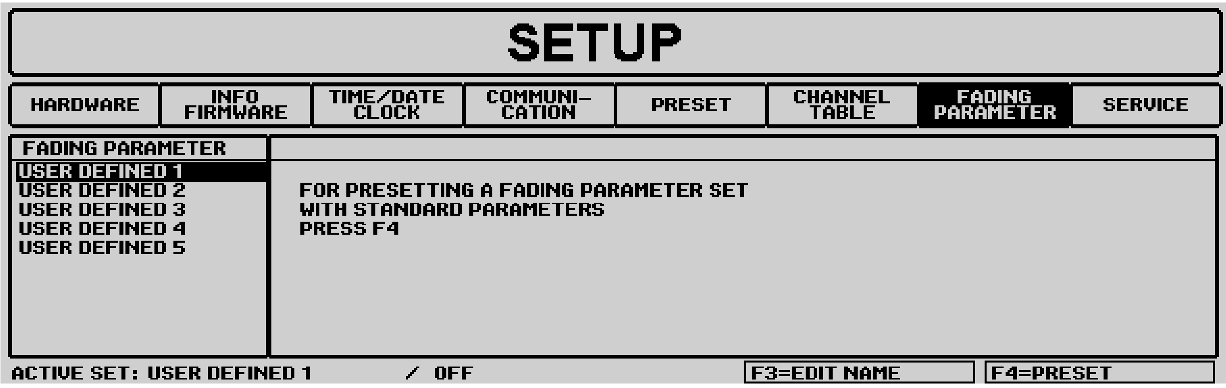


Fig.: 2.2.8-4 FADING PARAMETER submenu

After pressing the F4 function key, the selection of possible presets for fading parameter sets is opened.

First of all, the user has to select either DVB or ATTC.

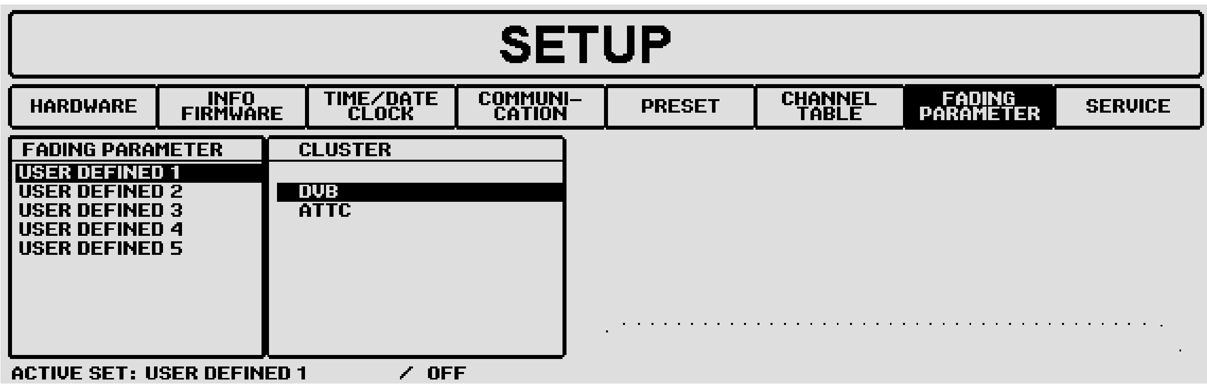


Fig.: 2.2.8-5 Selection between DVB and ATTC

After selecting the cluster, the possible presettings for the fading parameter sets can be selected.

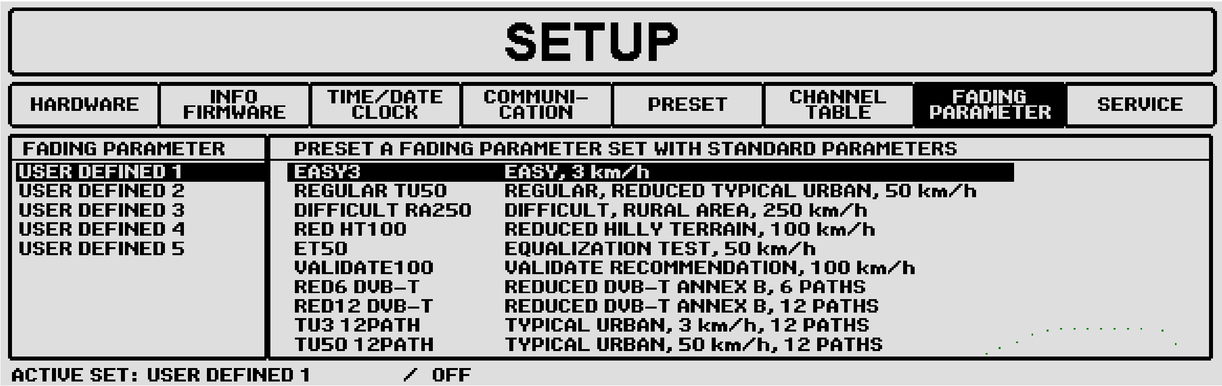


Fig.: 2.2.8-6 Presets EASY3 (Cluster DVB)

The preset values of the desired fading scenarios can be copied into the selected set of fading parameters.

(Cluster DVB)

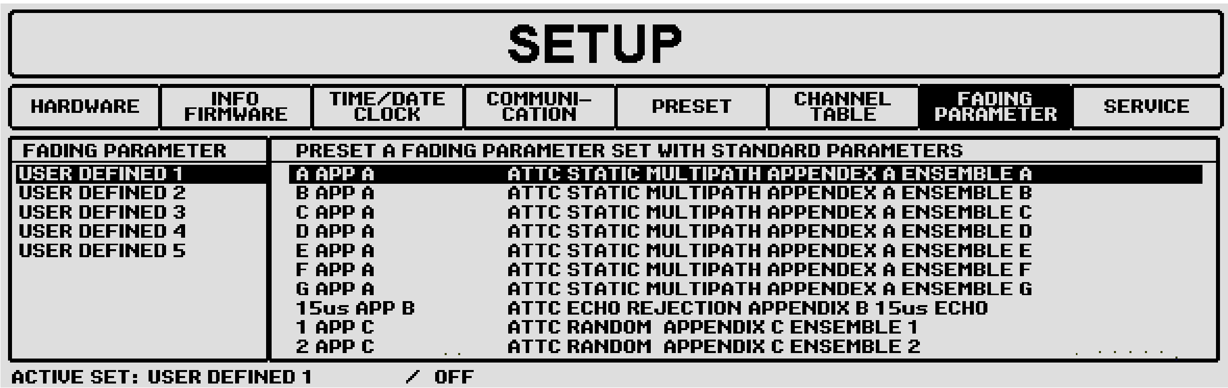


Fig.: 2.2.8-7 Presets A APP A (Cluster ATTC)

The preset values of the desired fading scenarios can be copied into the selected set of fading parameters.

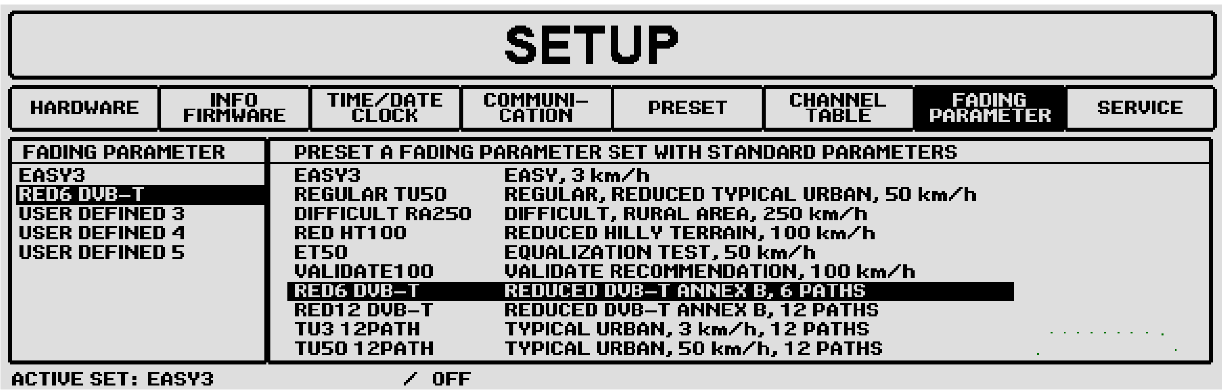


Fig.: 2.2.8-8 RED6 DVB-T

Some of the presets for fading parameter sets need 12 paths. These can only be selected if SFQ is equipped with two fading simulator modules.

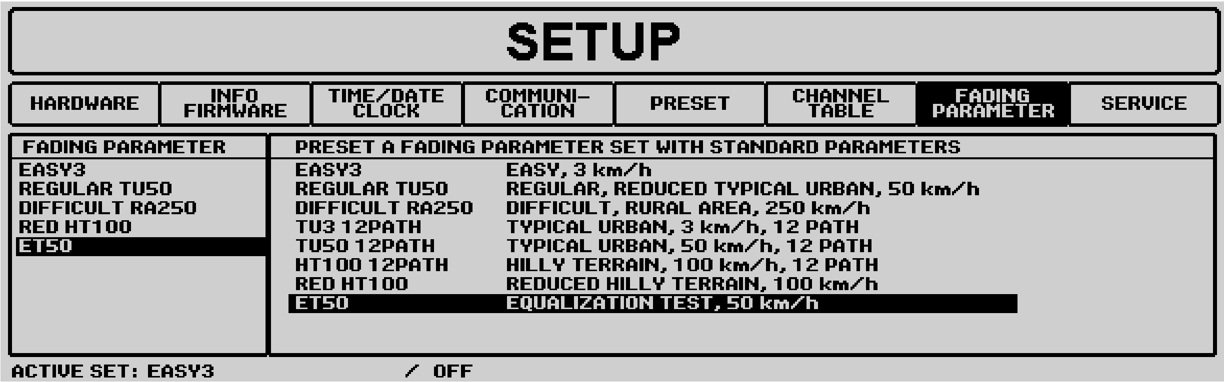


Fig.: 2.2.8-9 ET50

As soon as one of the parameters of a predefined fading parameter set is varied manually, the prefix USER will be added to the parameter designation.

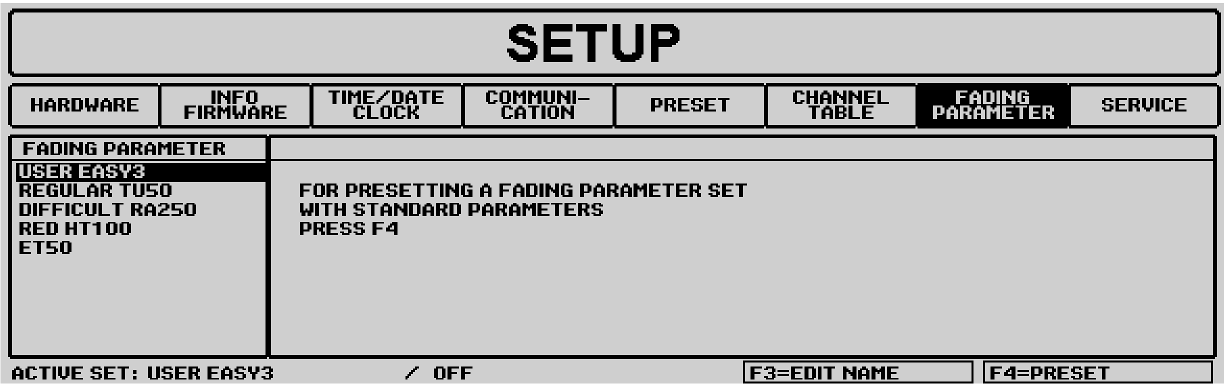
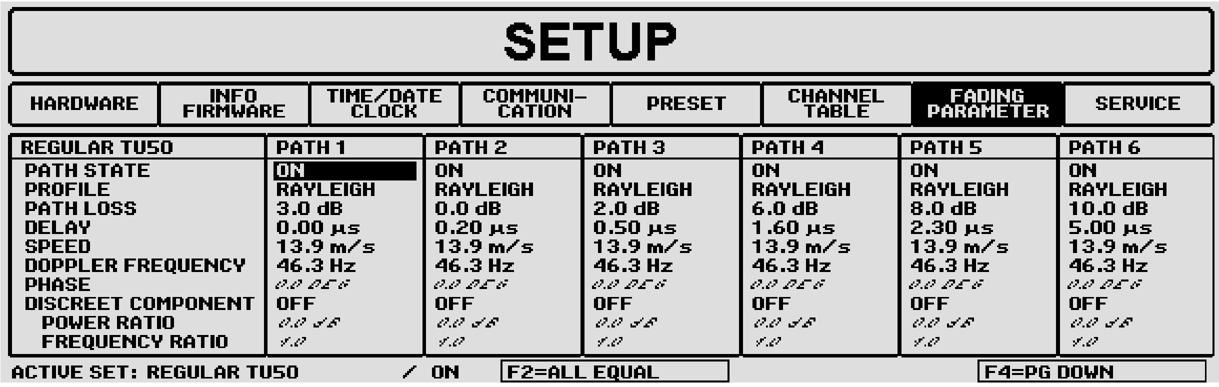


Fig.: 2.2.8-10 USER EASY3

Note:	*If modified parameter sets are activated within the MODULATION menu, MODIFY will be displayed in the message window of the MODULATION menu.*

The name of the fading parameter set currently edited is displayed at the top left of the fading value table. The name of the fading parameter set selected for transmission in the modulation menu is displayed in the status line of the menu after ”ACTIVE SET:”. The operating state of the fading simulator is also indicated with OFF or ON.



SETUP

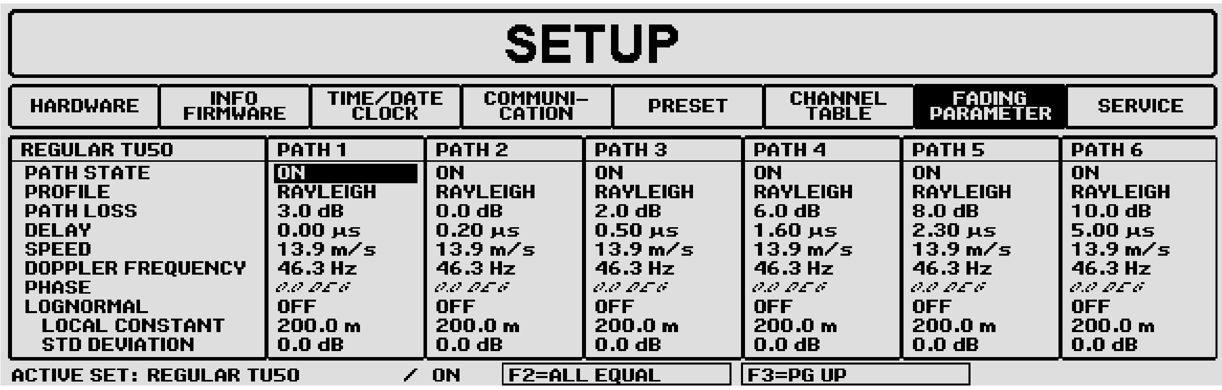
HARDWARE | INFO FIRMWARE | TIME/DATE CLOCK | COMMUNI- CATION | PRESET | CHANNEL TABLE | FADING PARAMETER | SERVICE

REGULAR TU50	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6
PATH STATE	ON	ON	ON	ON	ON	ON
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	3.0 dB	0.0 dB	2.0 dB	6.0 dB	8.0 dB	10.0 dB
DELAY	0.00 µs	0.20 µs	0.50 µs	1.60 µs	2.30 µs	5.00 µs
SPEED	13.9 m/s	13.9 m/s	13.9 m/s	13.9 m/s	13.9 m/s	13.9 m/s
DOPPLER FREQUENCY	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz
PHASE	0.0 DEG	0.0 DEG	0.0 DEG	0.0 DEG	0.0 DEG	0.0 DEG
DISCREET COMPONENT	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQUENCY RATIO	1.0	1.0	1.0	1.0	1.0	1.0

ACTIVE SET: REGULAR TU50 / ON F2=ALL EQUAL F4=PG DOWN

Fig.: 2.2.8-11 Modulation menu for transmission of selected fading parameter set

Scrolling within the table and between the parameters is possible using function keys F4 = PG DOWN and F3 = PG UP.



SETUP

HARDWARE | INFO FIRMWARE | TIME/DATE CLOCK | COMMUNI- CATION | PRESET | CHANNEL TABLE | FADING PARAMETER | SERVICE

REGULAR TU50	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6
PATH STATE	ON	ON	ON	ON	ON	ON
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	3.0 dB	0.0 dB	2.0 dB	6.0 dB	8.0 dB	10.0 dB
DELAY	0.00 µs	0.20 µs	0.50 µs	1.60 µs	2.30 µs	5.00 µs
SPEED	13.9 m/s	13.9 m/s	13.9 m/s	13.9 m/s	13.9 m/s	13.9 m/s
DOPPLER FREQUENCY	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz
PHASE	0.0 DEG	0.0 DEG	0.0 DEG	0.0 DEG	0.0 DEG	0.0 DEG
LOGNORMAL	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONSTANT	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEVIATION	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

ACTIVE SET: REGULAR TU50 / ON F2=ALL EQUAL F3=PG UP

Fig.: 2.2.8-12 Parameter selection

The desired path or parameter is selected with the cursor keys. If more than 6 fading paths are available, the display range of the table can be shifted towards the higher paths.

PATH	Display of paths for the following parameters. These parameters can be set separately for each path.
STATE	Switching on and off a path. If the cursor is placed onto a path in the diagram, it may be switched on and off by pressing one of the unit keys (toggle function).
PROFILE	Selection of the fading profile.

P.DOPPLER	(Pure Doppler) Simulation of a transmission path having a single direct connection from the transmitter to the moving receiver (discrete component). The Doppler frequency shift is determined by the parameters DOPPLER FREQ and FREQ RATIO.
RAYLEIGH	Simulation of a radio field, where a multitude of strongly scattered partial waves hit a moving receiver. The resulting receiving amplitude is time-varying. The probability density function of the receiving amplitude is described by a Rayleigh distribution. The fading spectrum is a classical Doppler spectrum.
RICE	Simulation of a radio field, where apart from a multitude of scattered partial waves, one strong direct wave (discrete component) hits a moving receiver. The probability density function of the receiving amplitude is described by a Rice distribution. The fading spectrum of an unmodulated signal is an overlapping of a classical Doppler spectrum with a discrete spectrum line.
C.PHASE	(Constant Phase) A radio field without direct or random waves is generated for this fading type (no discrete and static component). The path is multiplied by a constant "pointer“ corresponding to the path-specific parameter.

DISCRETE COMPONENT	Shows the switch-on/off status of the discrete component.
POWER RATIO	Entry of the power ratio of the discrete component and distributed component with Ricean fading switched on. If POWER RATIO is changed the sum of both components remains constant.

FREQENCY RATIO Entry of the ratio of the actual Doppler frequency shift to the Doppler frequency setting with Ricean fading or FDOP fading switched on. The actual Doppler frequency shift depends on the simulated angle of incidence of the discrete component.

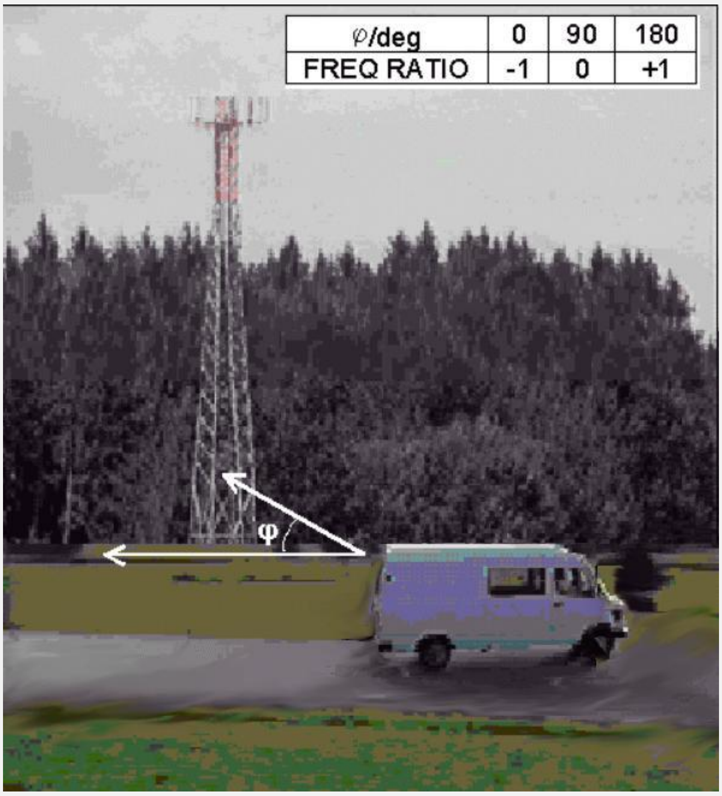


Fig.: 2.2.8-13 Doppler frequency shift with moving receiver

SPEED

Entry of the speed v of the moving receiver.

The Doppler frequency f_D (DOPPLER FREQ) is calculated from the speed and the frequency of the RF output signal f_{RF}. On changing SPEED the parameter DOPPLER FREQ is automatically adjusted.

Setting range: $v_{min} = \frac{0.03 \cdot 10^9 \, m/s^2}{f_{RF}}$ $v_{max} = \frac{479 \cdot 10^9 \, m/s^2}{f_{RF}}$

$v_{max} \leq 99999 \, km/h$

Note: If DOPPLER FREQUENCY has been selected as the parameter under SETUP - PRESET - FADING –REFERENCE, the selected SPEED will be recalculated when the RF frequency varies, whereas the Doppler frequency remains constant.

DOPPLER FREQ Entry of the magnitude of the maximum Doppler Frequency shift (cf. FREQ RATIO).

On changing the Doppler frequency f_D the parameter SPEED is automatically adjusted.

With $c = 2.998 \cdot 10^8 \, m/s$ it is $\frac{v}{c} = \frac{f_D}{f_{RF}}$

Note: If SPEED has been selected as the parameter under SETUP - PRESET - FADING –REFERENCE, the selected DOPPLER FREQ will be recalculated when the RF frequency varies, whereas the SPEED remains constant.

PATH LOSS Entry of the attenuation of the path.

DELAY Entry of the signal delay of the path.

LOGNORM STATE Switching on or off log-normal fading.

With log-normal fading set, an additional, rather slowly fluctuating amplitude of a moving receiver is simulated. Log-normal fading has a multiplying effect on the path loss. The multiplication factor is time-varying and has a logarithmic normal distribution. If a Rayleigh profile is set simultaneously, this results in Suzuki fading.

LOCAL CONST Entry of the area constant.

The area constant L (LOCAL CONST) and the speed v of the moving receiver determine the limit frequency f_L of log-normal fading: $f_L = v / L$

The power density spectrum of an unmodulated carrier consists of a discrete spectrum line at f_{RF} and a frequency-dependent continuous component described by:

$$S(f) = const \cdot e^{-0.5 \cdot \left| \frac{f - f_{RF}}{f_L} \right|^2}$$

The lower limit of the range is dependent on the RF frequency f_{RF}.

The following equation applies: $L_{min} = \frac{12 \cdot 10^9 \, m/s}{f_{RF}}$

STD DEV Entry of the standard deviation of log-normal fading.

CONST PHASE Entry of CONST PHASE for CPHAS fading. The corresponding path is multiplied with this phase.

2.2.8.2 Special Level Conditions in Case of Fading

The fading processes of the different paths are normally statically independent. In this case the average sum power of all paths is usually constant. There are however special cases, two of which being described in the following:

- If for instance two paths are selected with the same parameters but different phases, different values are obtained for the RF level. Phases of 0 ° and 180 ° cause cancellation of the path signals. The RF level is increased by 3 dB if both phases are set to 0°.

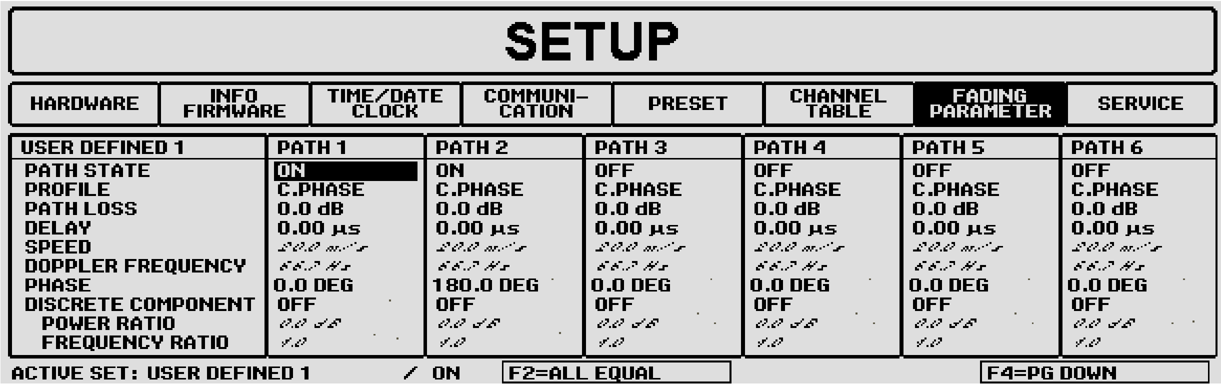


Fig.: 2.2.8-14 Special level conditions in case of fading

- The level is also increased if two equal paths with P.DOPPLER profiles exhibit the same FREQUENCY RATIO.

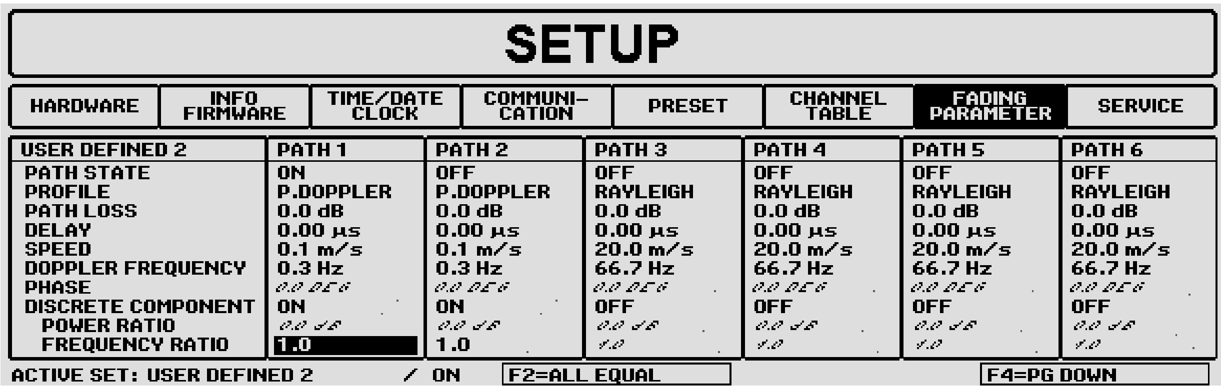


Fig.: 2.2.8-15 Two equal paths with P.DOPPLER profiles exhibiting same FREQUENCY RATIO

Note:	*In the special cases shown above the resulting RF sum power does not agree with the RF LEVEL indicated in the SFQ menu.*

2.2.9 BER (Bit Error Ratio) Measurement

General

The BER measurement function is independent of other SFQ settings. The current BER is continuously displayed in a line. Messages regarding the BER measurement are displayed in the SPECIAL field of the menu bar.

The BER measurement can be carried out both by the DVB-T coder module and the input interface 2. The BER measurement is activated in the DVB-T coder if the SFQ is equipped with this coder. Otherwise, the BER measurement is activated on input interface 2. The option can only be activated if one of these modules is fitted. The difference between the two versions is that input interface 2 uses the transport stream input TS PARALLEL (X60) as a parallel input and the DVB-T coder the transport stream input TS PARALLEL AUX (X61).

(2^{23}-1 and 2^{15}-1 to ITU-T Rec. O.151)

2.2.9.1 Inputs

2.2.9.1.1 Serial Input

Three BNC connectors for clock, data and enable (TTL level) are provided on the rear of the SFQ.

X8: BER data input

X7: BER clock input

X6: BER enable input

The inputs are internally terminated into 75 Ω. The enable input doesn't have to be used. The rising edge of the clock signal should be in bit centre of data. The set-up- and hold-times are typically 2 ns.

2.2.9.1.2 Parallel Input

The additional parallel transport stream input TS PARALLEL AUX (X61) at the rear can either be used as additional transport stream input (AUX) for hierarchical coding with DVB-T or as parallel input for BER measurements (LVDS level). If the DVB-T coder is not fitted and the BER measurement is activated on input interface 2, the transport stream input TS PARALLEL (X60) is used as a parallel input. Switchover is effected via software. Possible conflicts are recognized and communicated to the user by means of a message window.

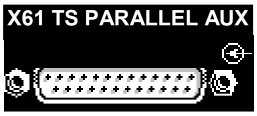
Specification of parallel input:

Input impedance: 100 Ω

Input signal amplitude: 100 mV pp to 2 Vpp

Data transfer on rising clock edge

Pin assignment: 25-pin Sub-D connector



Pin	Signal line	Pin	Signal line
1	Clock A	14	Clock B
2	System Gnd	15	System Gnd
3	Data 7 A(MSB)	16	Data 7 B
4	Data 6 A	17	Data 6 B
5	Data 5 A	18	Data 5 B
6	Data 4 A	19	Data 4 B
7	Data 3 A	20	Data 3 B
8	Data 2 A	21	Data 2 B
9	Data 1 A	22	Data 1 B
10	Data 0 A	23	Data 0 B
11	DVALID A	24	DVALID B
12	PSYNC A	25	PSYNC B
13	Cable Shield		

2.2.9.2 Operating Menu

2.2.9.2.1 BER MEASUREMENT: ON/OFF

The BER measurement can be switched on and off in this menu. When the BER measurement is activated, a line is displayed below the menu bar. This line indicates the currently measured BER. Two values are displayed (in brackets) behind the BER value, for example (152/1000).

The first value indicates the bits used for the measurement (*1E6) (events). The second value is a proposal based on the current BER. For further explanations see below.

As long as the BER measurement is activated, the line indicating the BER is displayed all the time.

All error messages regarding the BER measurement are displayed in the field SPECIAL of the menu bar.

The following messages may occur:

Message	Possible error source	Priority
NO BER CLOCK	Signal is not present (wrong level), wrong input selected	1
NO BER DATA	Signal is not present (wrong level), wrong input selected, no valid ENABLE signal (if ENABLE is activated).	2
NO BER SYNC	Data is inverted, wrong PRBS sequence, too many bit errors, wrong BER MODE	3

The message with the highest priority is displayed.

2.2.9.2.2 BER: Display

The currently measured BER is displayed here. After the BER value, two values are indicated in brackets (events*1E6/proposal*1E6).

The same values as those in the line below the menu bar are displayed.

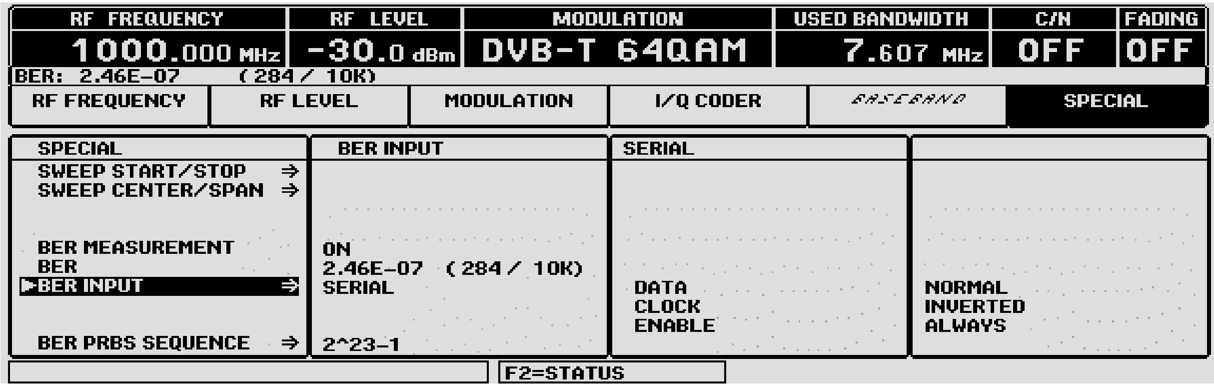


Fig.: 2.2.9-1 BER INPUT

The proposal is calculated based on the assumption that 1000 errors should occur for a sufficient accuracy of the result due to the statistical distribution of bit errors.

A display (152/1000) thus signifies that 152 000 000 bits were evaluated. To get a statistical accuracy of better than 10%, , 1000 000 000 bits must be evaluated.

Example:

The BER display is updated once per second.

At a bit rate of 27 Mbit/s this means an increase of events per display by 27, i.e. (152/1000), (179/1000), (196/1000), ...

The user would have to wait about another 24 seconds until the proposal - and thus a statistical accuracy of better than 10 % - is attained. To provide a measured value for the user, the measured value is indicated together with the number of evaluated bits (events) and the proposal.

Error values are stored for each measurement until the proposal is attained. Only then are previous values discarded and new values come up (floating BER calculation).

If bit errors do not occur during the measurement time, a proposal is not possible. This error-free case is treated in a special way.

The leading zeros of the mantissa show that no error has occurred during the measurement time period, e.g. 0.00 E-7.

To recognize the length of the measurement time, the exponent of the BER is modified:

e.g. after a new start:	0.00 E-5 (26/100),
after some seconds:	0.00 E-6 (524/1G)
after some minutes:	0.00 E-7 (1283/1G)

from 100 (*1E6) evaluated bits and above, E-6 is displayed,

from 1000 (*1E6) evaluated bits and above, E-7 is displayed,

from 10k (= 10000) (*1E6) evaluated bits and above, E-8 is displayed etc.

2.2.9.2.3 BER INPUT: SERIAL/PARALLEL

Selecting the input:

Selection can be made between the serial input (BNC connector, TTL level) and the parallel input (Sub-D connector, LVDS level).

With the parallel input selected, a conflict may occur if the input is used as AUX transport stream input with DVB-T hierarchical coding (see Parallel Input).

Serial input:

All inputs (clock, data, enable) are internally terminated into 75 Ω.

With the serial input selected, clock (X7) and data (X8) always have to be applied.

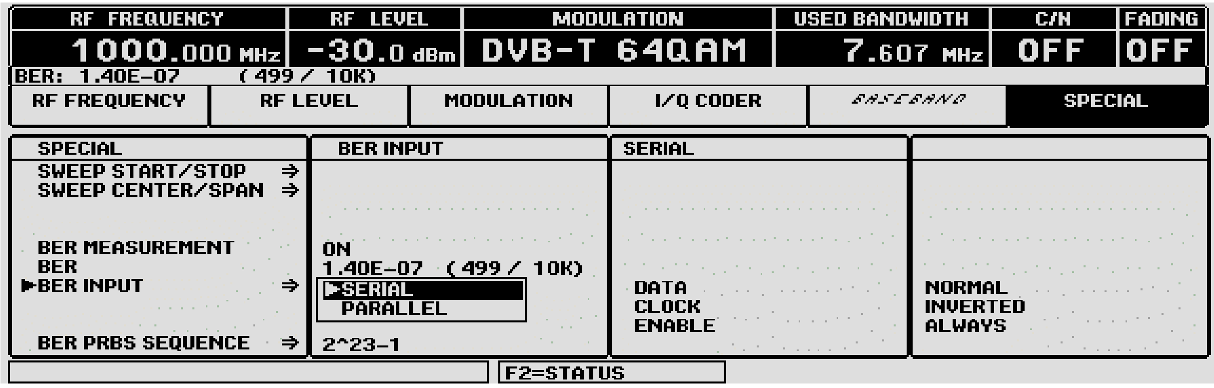


Fig.: 2.2.9-2

DATA NORMAL	- for a normal PRBS (as specified in ITU-T Rec. O.151)
DATA INVERS	- for an inverted PRBS
CLOCK NORMAL	- data is transferred on a rising clock edge
CLOCK INVERS	- data is transferred on a falling clock edge

The enable signal (X6) can be set as follows:

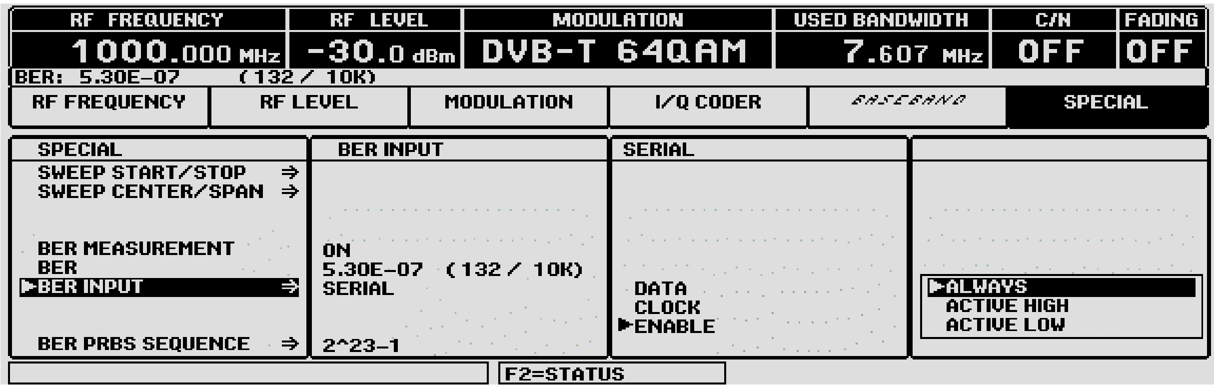


Fig.: 2.2.9-3

ALWAYS	- data is transmitted on every active clock edge
ACTIVE HIGH	- if the enable signal is high on the active clock edge, data is transmitted.
ACTIVE LOW	- if the enable signal is low on the active clock edge, data is transmitted.

Parallel input:

The data and the clock can be applied to connector X61 TS PARALLEL AUX with the LVDS (low voltage differential signalling) level. If the option is activated on input interface 2, the data is applied via TS PARALLEL (X60).

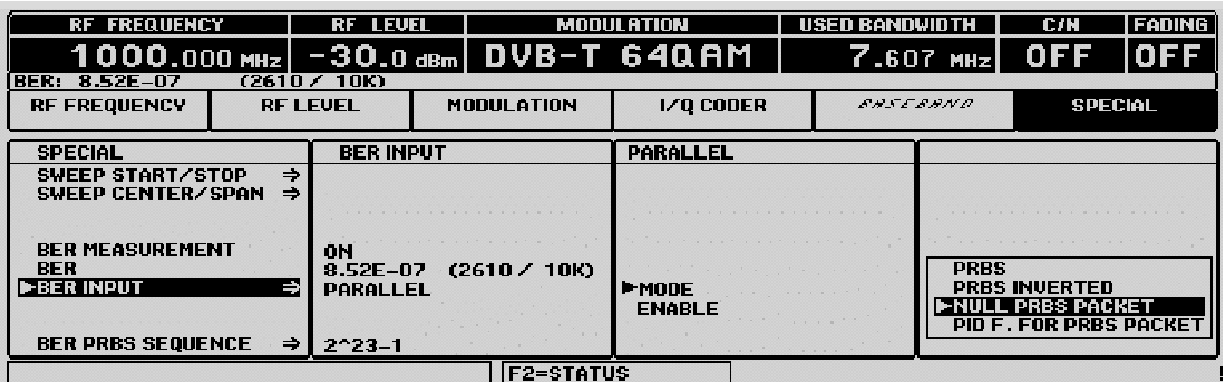


Fig.: 2.2.9-4

The following settings can be selected:

MODE:

PRBS	-	pure PRBS – applied byte by byte (MSB first)
PRBS INVERS	-	inverted PRBS – applied byte by byte (MSB first)
NULL PRBS PACKETS	-	MPEG2 transport stream with PRBS as payload
PID for NULL PRBS P.	-	MPEG2 transport stream with null packets having PRBS as payload (PID=1FFF hex)

With the setting NULL PRBS PACKET and PID FILTER FOR PRBS PACKET, a valid MPEG2 transport stream with PSYNC is expected.

With the setting NULL PRBS PACKET, the header (4 bytes) of the packet is removed. The payload (184 bytes) is evaluated.

This measurement is also possible with very high BERs (e.g. 1E-3) as the PSYNC is used for the recognition of the sync byte. But the PSYNC may also be missing.

With medium BERs, the setting PID FILTER FOR PRBS PACKET only works within limits. The BER measuring device has to evaluate the PID in the header. If errors occur in the PID of the frame to be evaluated, the data of this frame cannot be evaluated. This causes a new initialization of the BER measurement.

ENABLE:

ALWAYS	- data is transmitted on every active clock edge
DVALID	- if the DVALID signal is high on the active clock edge, data is transmitted.

Possible conflicts when selecting the input:

With the parallel input (TS PARALLEL AUX X61) selected, conflicts occur if the input is to be used at the same time as the AUX transport stream input with DVB-T hierarchical coding and as the parallel input for the BER measurement.

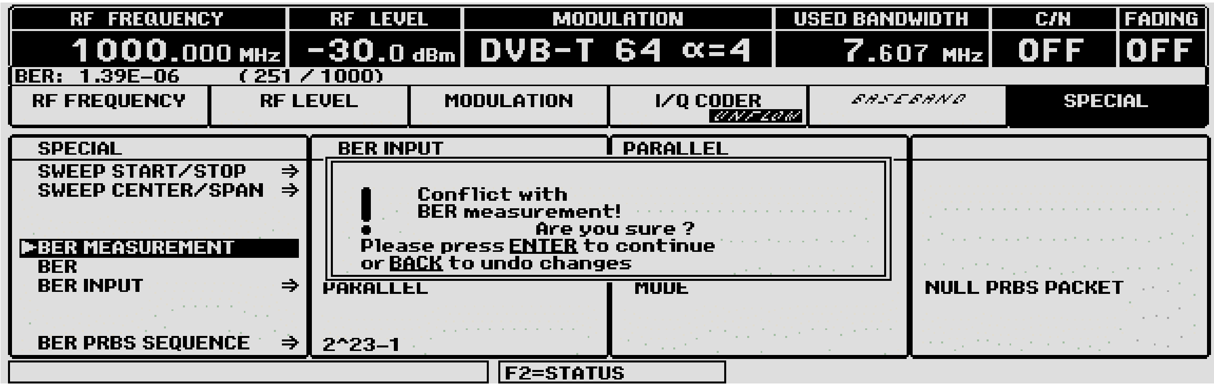


Fig.: 2.2.9-5

The user is warned if input X61 (TS PARALLEL AUX) is already used as the AUX input for the hierarchical DVB-T coding but the parallel input is to be used for the BER measurement. In this case, the parallel input is not available for BER measurement.

Remedy: In this case, the user can switch the MODE of the AUX path to a setting other than DATA in the DVB-T coder menu, i.e. PRBS or null packets.

If the user has switched the MODE of the AUX path to PRBS (other than DATA) and activates the parallel input for the BER measurement, the MODE of the AUX path can no longer be switched to DATA at a later time. A warning is issued. The BER measurement must be switched off first or the serial input selected.

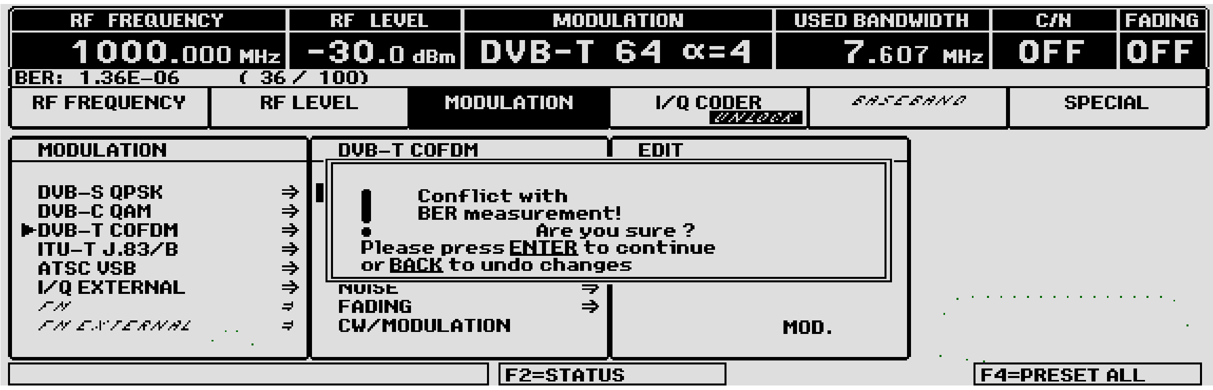


Fig.: 2.2.9-6

If the parallel input has already been selected for the BER measurement and hierarchical coding is switched on afterwards in the DVB-T coder menu (with MODE=DATA in AUX path), a warning will be issued. In this case, hierarchical DVB-T coding has priority – the input of the BER measurement is switched to SERIAL and the BER measurement is switched off (off).

There will be no conflicts if the BER measurement is activated on input interface 2. In this case, the coder also receives data from the parallel input.

2.2.9.2.4 BER PRBS SEQUENCE: 2^{23}-1 / 2^{15}-1

The user can select whether a PRBS 2^{23} -1 or a PRBS 2^{15} -1 is to be evaluated. Both are implemented according to ITU-T Rec. O.151. If the SFQ is used as the data source, the selection should be the same as the setting in SETUP-PRESET-PRBS SEQ.

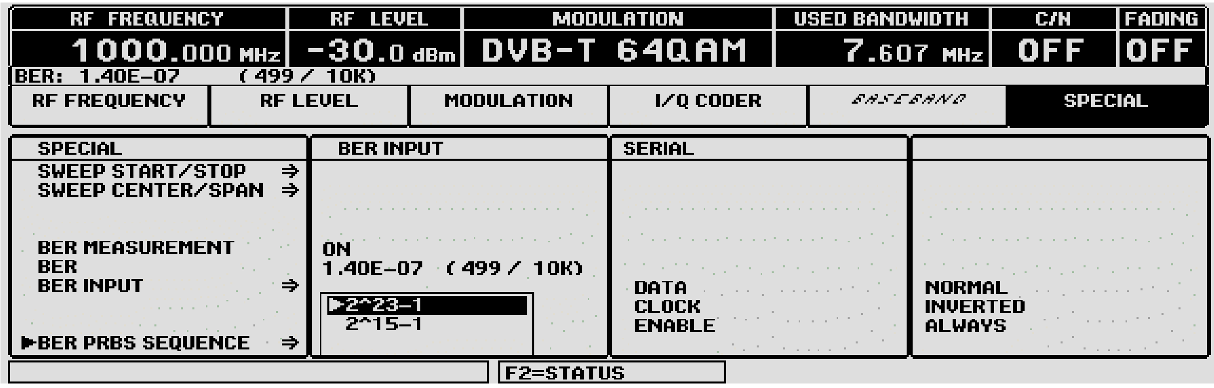
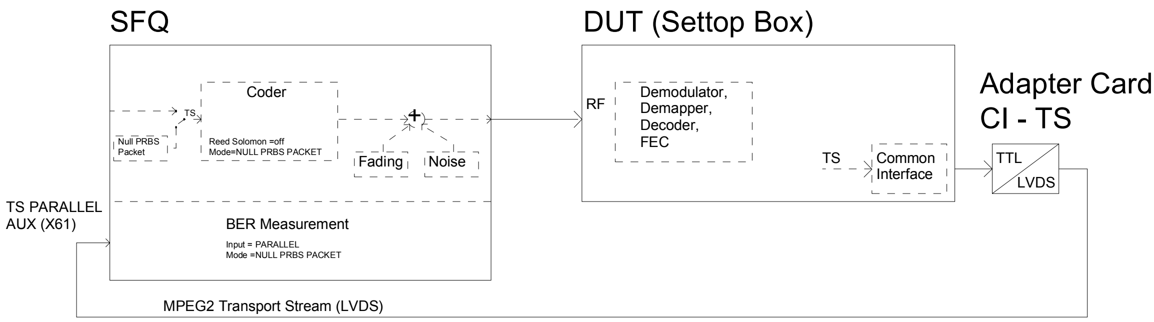


Fig.: 2.2.9-7

2.2.9.3 Applications

2.2.9.3.1 Application 1: BER Measurement Before Reed-Solomon Decoder

Test setup for determining the BER before the Reed-Solomon decoder for a set-top box by means of an adapter card for the common interface:



SFQ setting - coder:

Mode = NULL PRBS PACKET

Special: Reed Solomon = OFF

SFQ setting - preset:

PRBS = 2^23 –1

SFQ setting - special:

BER = ON

BER INPUT = PARALLEL

MODE = NULL PRBS PACKET

BER PRBS SEQUENCE = 2^23 -1

The data - in this case NULL PRBS PACKET (null packet whose payload consists of PRBS bytes) – is transmitted in the normal way. The channel coding is complete, and only the Reed-Solomon encoder is switched off.

The Reed-Solomon decoder in the receiver (DUT) thus recognizes more than 8 seemingly erroneous bytes (which it could be correct). It sets an error flag and lets the transport stream pass in unchanged form. The BER can thus be measured in a simple way before the Reed-Solomon decoder.

With a set-top box, the transport stream is available at the common interface (TTL level). An adapter card converts the TTL signals into LVDS signals. These signals are applied to the BER measurement via the parallel input. In the BER measuring device, the header (4 bytes) is removed in setting NULL PRBS PACKET. The 184 byte payload comprises the PRBS which is evaluated for the determination of the BER.

The measurement before the Reed-Solomon decoder is important as the latter is highly efficient and yields an output error rate of 1E-11 (QEF – quasi error-free) at an input error rate of 2E-4.

Slight changes of the input error rate in this range result in very strong changes of the output BER. The measurement results are very susceptible to inaccuracies of the interference source, e.g. the noise power in the measurement of the C/N versus BER. Moreover, the measurement time largely increases with small BERs, e.g. after the Reed-Solomon decoder (data rate 100 Mbit/s BER 1E-11, 1000 error events for a statistical accuracy of better than 10% -> measuring time approx. 11 days (the average time for measuring one error is about 16 minutes)).

Higher BERs are measured before the Reed-Solomon decoder. This reduces the measurement time. Moreover, the C/N versus BER curves are much flatter. Therefore inaccuracies of the interference source have less impact on the BER.

Pin assignment of COMMON INTERFACE (DVB Document A017):

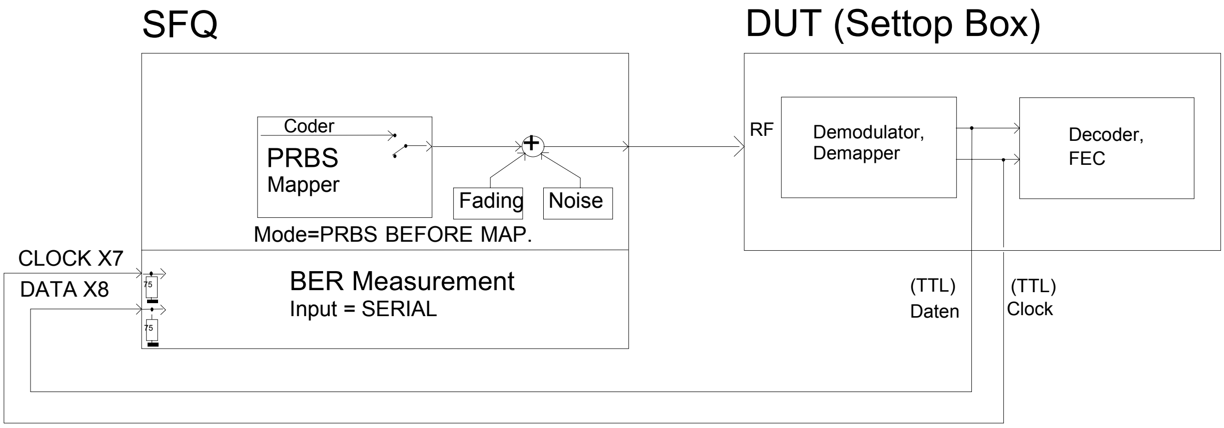
Pin	Signal	I/O	Function
1	GND		Ground
2	D3	I/O	Data bit 3
3	D4	I/O	Data bit 4
4	D5	I/O	Data bit 5
5	D6	I/O	Data bit 6
6	D7	I/O	Data bit 7
7	CE1#	I	Card enable 1
8	A10	I	Address bit 10
9	OE#	I	Output enable
10	A11	I	Address bit 11
11	A9	I	Address bit 9
12	A8	I	Address bit 8
13	A13	I	Address bit 13
14	A14	I	Address bit 14
15	WE#	I	Write enable
16	IREQ#	O	Interrupt request
17	VCC		Vcc
18	VPP1		Program voltage 1
19	MIVAL	I	MP in valid
20	MCLKI	I	MPEG-2 Clock input
21	A12	I	Address bit 12
22	A7	I	Address bit 7
23	A6	I	Address bit 6
24	A5	I	Address bit 5
25	A4	I	Address bit 4
26	A3	I	Address bit 3
27	A2	I	Address bit 2
28	A1	I	Address bit 1
29	A0	I	Address bit 0
30	D0	I/O	Data bit 0
31	D1	I/O	Data bit 1
32	D2	I/O	Data bit 2
33	IOIS16#		16bit I/O (always high)
34	GND		Ground

Pin	Signal	I/O	Function
35	GND		Ground
36	CD1#	O	Card detect 1
37	MDO3	O	MP data out 3
38	MDO4	O	MP data out 4
39	MDO5	O	MP data out 5
40	MDO6	O	MP data out 6
41	MDO7	O	MP data out 7
42	CE2#	I	Card enable 2
43	VS1#	O	Voltage sense 1
44	IORD#	I	I/O read
45	IOWR#	I	I/O write
46	MISTRT	I	MP in start
47	MDI0	I	MP data in 0
48	MDI1	I	MP data in 1
49	MDI2	I	MP data in 2
50	MDI3	I	MP data in 3
51	VCC		Vcc
52	VPP2		Program voltage 2
53	MDI4	I	MP data in 4
54	MDI5	I	MP data in 5
55	MDI6	I	MP data in 6
56	MDI7	I	MP data in 7
57	MCLKO	O	MPEG-2 Clock output
58	RESET	I	Card reset
59	WAIT#	O	Extend bus cycle
60	INPACK#	O	Input port ack
61	REG#	I	Register select
62	MOVAL	O	MP out valid
63	MOSTRT	O	MP out start
64	MDO0	O	MP data out 0
65	MDO1	O	MP data out 1
66	MDO2	O	MP data out 2
67	CD2#	O	Card detect 2
68	GND		Ground

MPDO[7:0] MPEG2 transport stream data output
MCLKO MPEG2 transport stream clock output
MOSTRT MPEG2 transport stream PSYNC output
MOVAL MPEG2 transport stream DVALID output

2.2.9.3.2 Application 2: BER Measurement After Demapper for DVB-T

Test setup for determining the BER after the demapper with a set-top box.



SFQ setting - coder:
Mode = PRBS BEFORE MAPPER

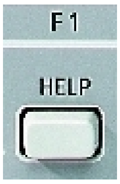
SFQ setting - preset:
PRBS = 2^23 -1

SFQ setting - special:
BER = ON
BER INPUT = SERIAL
CLOCK = NORMAL (also INVERTED, if possible)
DATA = NORMAL
ENABLE = ALWAYS
BER PRBS SEQUENCE = 2^23 -1

The mapper generates a PRBS in the coder which is transmitted instead of data.

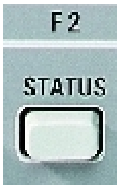
Interference can be generated in the subsequent transmission path, i.e. by adding Gaussian distributed white noise and/or fading. The receiver demodulates the signal. After the demapper, data (clock and data) is available in serial form. The data is now fed into the serial input of the BER measuring device (TTL level into 75 Ω) and evaluated there.

2.2.10 HELP Menu



The corresponding help page is displayed by pressing the **F1** key.

2.2.11 STATUS Menu



Call up status menu by pressing F2 (STATUS).

Exit the status menu by pressing **F2** again (EXIT).

2.2.11.1 Satellite (-B23)

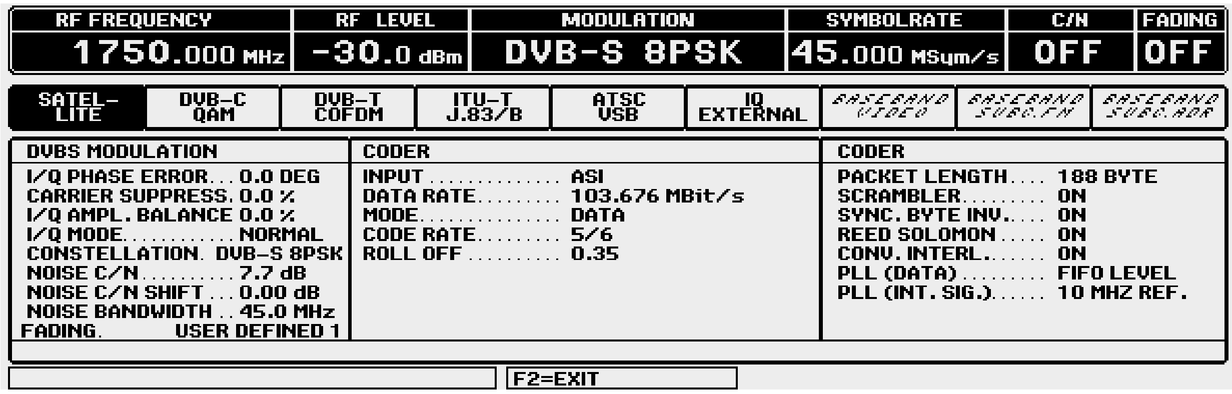


Fig. **2.2.11-1**

Lefthand column:

Modulation settings:

I/Q PHASE ERROR	[DEG]	selected phase error in degrees
CARRIER SUPPRESS.	[%]	selected carrier leakage in %
I/Q AMPL. BALANCE	[%]	selected amplitude imbalance in %
I/Q MODE	[NORMAL, CHANGED]	I and Q data streams interchanged/
not interchanged		
CONSTELLATION	[DVB-S QPSK, DVB-S 8PSK, DVB-S 16QAM]	selected modulation standard
NOISE C/N	[dB]	selected carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	selected correction of carrier-to-noise ratio
NOISE BANDWIDTH	[MHz]	selected noise bandwidth
FADING	active fading parameter set, see SETUP - FADING PARAMETERS	

Middle column:

INPUT	input interface selected for transport stream
DATA RATE	transmission data rate derived from symbol rate and other parameters
MODE	selected mode: transmission of external or internal signals
CODE RATE	code rate of inner coder
ROLL OFF	selected roll-off factor α for square root raised cosine filtering

Righthand column:

PACKET LENGTH	[188, 204]	selected packet length for MPEG-2 transport stream
SCRAMBLER	[ON, OFF]	energy dispersal on/off
SYNC. BYTE INV.	[ON, OFF]	sync word inversion on/off
REED SOLOMON	[ON, OFF]	Reed-Solomon encoder on/off
CONV. INTERL.	[ON, OFF]	convolutional interleaver on/off
PLL (DATA)	[FIFO LEVEL, TS CLOCK]	control mode for symbol rate with external signal transmission (DATA)
PLL (INT. SIG.)	[10 MHz REF, TCXO, VCXO]	reference for symbol rate with internal signal transmission

2.2.11.2 DVB-C QAM (-B21)

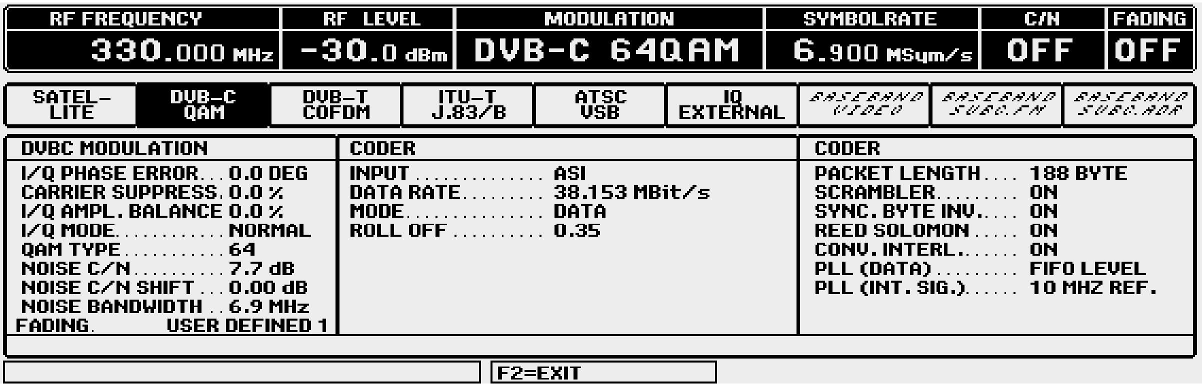


Fig.: 2.2.11-2

Lefthand column:

Modulation settings:

PHASE ERROR	[DEG]	selected phase error in degrees
CARRIER SUPPRESS.	[%]	selected carrier leakage in %
I/Q AMPL. BALANCE	[%]	selected amplitude imbalance in %
I/Q MODE	[NORMAL, CHANGED]	I and Q data streams interchanged/ not interchanged
QAM TYPE	[16, 32, 64, 128, 256]	selected order of QAM
NOISE C/N	[dB]	selected carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	selected correction of carrier-to-noise ratio
NOISE BANDWIDTH	[MHz]	selected noise bandwidth
FADING	active fading parameter set, see SETUP - FADING PARAMETERS	

Middle column:

INPUT	input interface selected for transport stream
DATA RATE	transmission data rate derived from symbol rate and other parameters
MODE	selected mode: transmission of external or internal signals
ROLL OFF	selected roll-off factor α for square root raised cosine filtering

Righthand column:

PACKET LENGTH	[188, 204]	selected packet length for MPEG2 transport stream
SCRAMBLER	[ON, OFF]	energy dispersal on/off
SYNC. BYTE INV.	[ON, OFF]	sync word inversion on/off
REED SOLOMON	[ON, OFF]	Reed-Solomon encoder on/off
CONV. INTERL.	[ON, OFF]	convolutional interleaver on/off
PLL (DATA)	[FIFO LEVEL, TS CLOCK]	control mode for symbol rate with external signal transmission (DATA)
PLL (INT. SIG.)	[10 MHz REF, TCXO, VCXO]	reference for symbol rate with internal signal transmission

2.2.11.3 DVB-S QPSK (-B15)

In the QPSK status menu the following parameters are displayed:

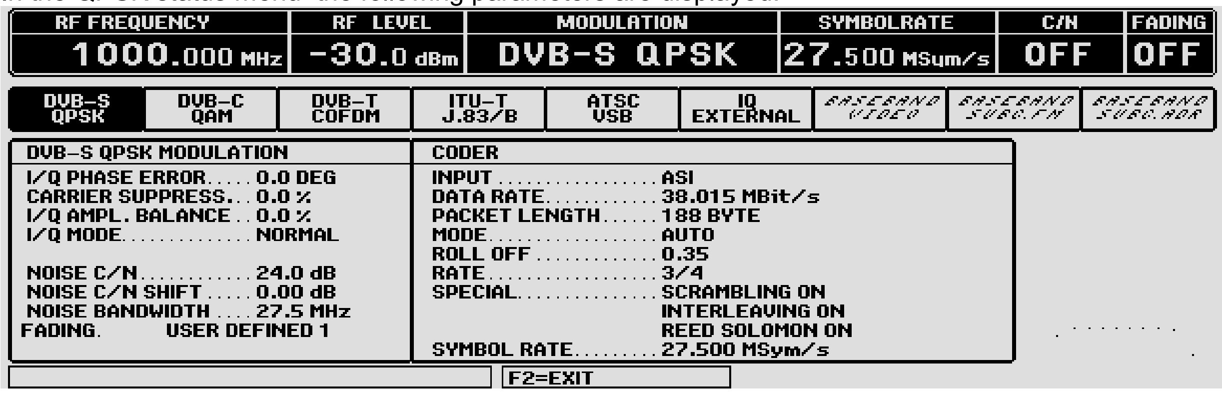


Fig.: 2.2.11-3 DVB-S QPSK

In the left-hand column the settings of the QPSK modulator:

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
I/Q MODE	[NORMAL/CHANGED]	I and Q normal/changed
NOISE C/N	[dB]	Carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING		Active fading parameter set, see SETUP – FADING PARAMETER

In the right-hand column the settings of the I/Q coder:

INPUT	[TS PARALLEL]	Selected transport stream input
DATA RATE	[Mbit/s]	Selected MPEG2 transport stream input data rate
MODE	[DATA, AUTO, PRBS, NULL TS PACKET, CW]	Selected operating mode
ROLL OFF	[0.25, 0.30, 0.35, 0.40, 0.45]	Alpha factor of roll-off filtering
RATE	[1/2, 2/3, 3/4, 5/6, 7/8]	Puncturing rate
SPECIAL	SCRAMBLING [ON, OFF]	Energy dispersal
	INTERLEAVING [ON, OFF]	Convolutional interleaver
	REED SOLOMON [ON, OFF]	Reed-Solomon encoder

2.2.11.4 DVB-C QAM (-B15)

In the QAM status display the following parameters are displayed:

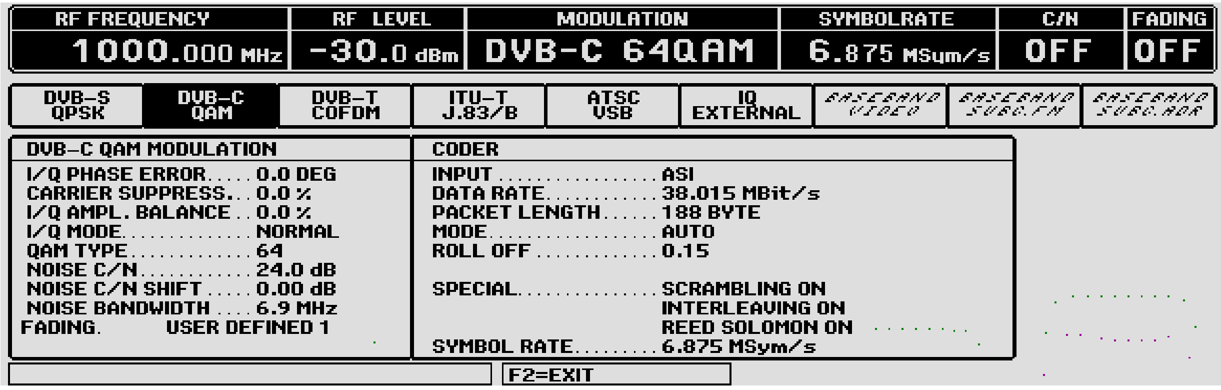


Fig.: 2.2.11-4 DVB-C QAM

In the left-hand column the settings of the QPSK modulator:

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
MODE	[NORMAL/CHANGED]	I and Q normal/changed
QAM TYPE	[16, 32, 64, 128, 256]	Selected QAM order
NOISE C/N	[dB]	Carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING		Active fading parameter set, see SETUP – FADING PARAMETER

In the right-hand column the settings of the I/Q coder:

INPUT	[TS PARALLEL]		Selected transport stream input
DATA RATE	[Mbit/s]		Selected MPEG2 transport stream input data rate
MODE	[DATA, AUTO, PRBS, NULL TS PACKET, CW]		Selected operating mode
ROLL OFF	[0.1, 0.125, 0.15, 0.175, 0.2]		Alpha factor of roll-off filtering
SPECIAL	SCRAMBLING	[ON, OFF]	Energy dispersal
	INTERLEAVING	[ON, OFF]	Convolutional interleaver
	REED SOLOMON	[ON, OFF]	Reed-Solomon encoder

2.2.11.5 DVB-T COFDM

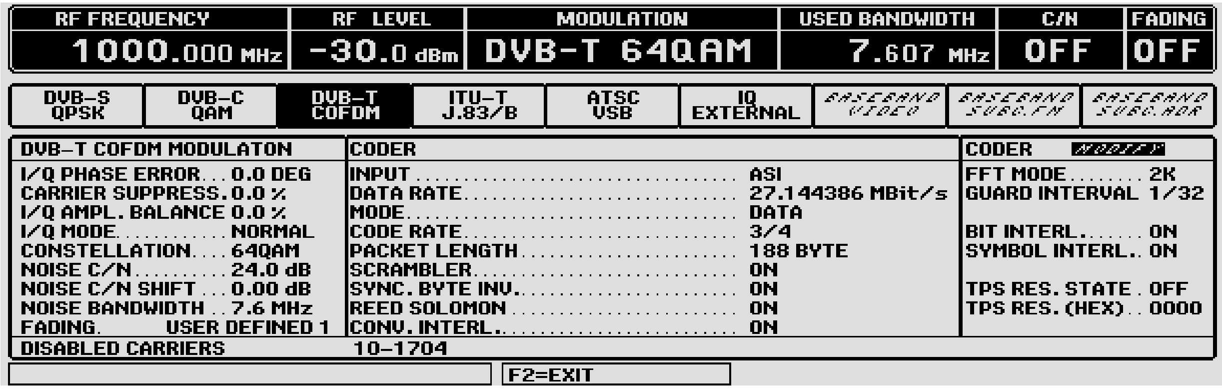


Fig.: 2.2.11-5 DVB-T COFDM with non-hierarchical coding

In the left-hand column the settings of the COFDM modulator:

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
I/Q MODE	[NORMAL/CHANGED]	I and Q normal/changed
CONSTELLATION	[QPSK, 16QAM, 64QAM]	Selected constellation of data carrier
NOISE C/N	[dB]	Carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING		Active fading parameter set, see SETUP – FADING PARAMETER

In the right-hand column the settings of the coder:

INPUT	[TS PARALLEL, ASI, SPI, ASI EXT. CLOCK, SPI EXT. CLOCK]	Selected transport stream input
DATA RATE	[Mbit/s]	Set MPEG2 transport stream input data rate
MODE	[DATA, AUTO, PRBS, NULL TS PACKET, CW]	Selected operating mode
CODE RATE	[1/2, 2/3, 3/4, 5/6, 7/8]	Set code rate
PACKET LENGTH	[188, 204]	Set packet length
SCRAMBLER	[ON, OFF]	Energy dispersal
SYNC.BYTE INV.	[ON, OFF]	Sync word inversion
REED SOLOMON	[ON, OFF]	Reed-Solomon encoder
CONV. INTERL.	[ON, OFF]	Convolutional interleaver
FFT MODE	[2K, 8K]	FFT mode
GUARD INTERVAL	[1/4, 1/8, 1/16, 1/32, OFF]	Guard interval length
BIT INTERL.	[ON, OFF]	Bit interleaver
SYMBOL INTERL.	[ON, OFF]	Symbol interleaver

In the bottom line:

DISABLED CARRIERS	<carrier numbers>	Switched-off carriers

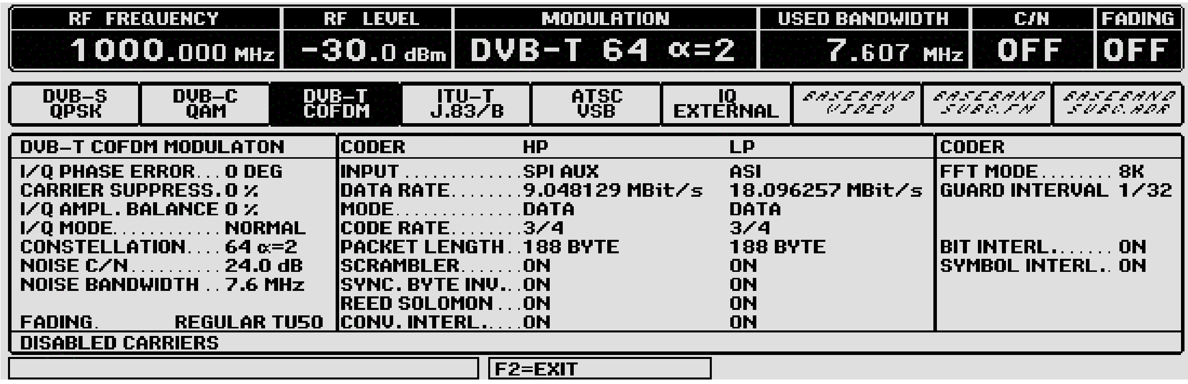


Fig.: 2.2.11-6 DVB-T COFDM with hierarchical coding

In the left-hand column the settings of the COFDM modulators:

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
I/Q MODE	[NORMAL/CHANGED]	I and Q normal/changed
CONSTELLATION	[16 α=1, 16 α=2, 16 α=4, 64 α=1, 64 α=2, 64 α=4]	Selected constellation of data carrier (16 = 16QAM, 64 = 64 QAM), with the factor α
NOISE C/N	[dB]	Carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING		Active fading parameter set, see SETUP – FADING PARAMETER

In the right-hand column the settings of the coder:

	HIGH PRIO	LOW PRIO	Columns for high-priority and low-priority transport stream
INPUT	[TS PARALLEL, ASI, SPI, ASI EXT. CLOCK, SPI EXT. CLOCK]	[TS PARALLEL AUX, SPI AUX]	Selected transport stream input MAIN input -> high-priority path AUX input -> low-priority path
	[TS PARALLEL AUX, SPI AUX]	[TS PARALLEL, ASI, SPI, ASI EXT. CLOCK, SPI EXT. CLOCK]	Selected transport stream input AUX input -> high-priority path MAIN input -> low-priority path
DATA RATE	[Mbit/s]	[Mbit/s]	Set MPEG2 transport stream input data rate
MODE	[DATA, AUTO, PRBS, NULL TS PACKET, CW]	[DATA, AUTO, PRBS, NULL TS PACKET, CW]	Selected operating mode
CODE RATE	[1/2, 2/3, 3/4, 5/6, 7/8]	[1/2, 2/3, 3/4, 5/6, 7/8]	Set code rate
PACKET LENGTH	[188, 204]	[188, 204]	Set packet length
SCRAMBLER	[ON, OFF]	[ON, OFF]	Energy dispersal
SYNC.BYTE INV.	[ON, OFF]	[ON, OFF]	Sync word inversion
REED SOLOMON	[ON, OFF]	[ON, OFF]	Reed-Solomon encoder
CONV. INTERL.	[ON, OFF]	[ON, OFF]	Convolutional interleaver

FFT MODE	[2K, 8K]	FFT mode
GUARD INTERVAL	[1/4, 1/8, 1/16, 1/32, OFF]	Guard interval length
BIT INTERL.	[ON, OFF]	Bit interleaver
SYMBOL INTERL.	[ON, OFF]	Symbol interleaver

In the bottom line:

DISABLED CARRIERS	<carrier numbers>	Switched off carriers

2.2.11.6 ITU-T J.83/B

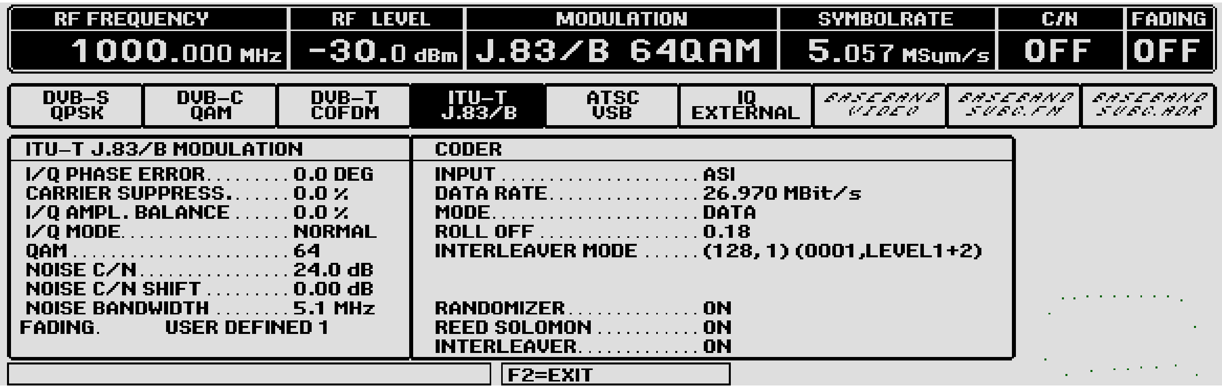


Fig.: 2.2.11-7 Status menu J.83/B

Press key F2 to display the status menu.
The J.83/B modulation settings are displayed in the left column.

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude balance
I/Q MODE		I/Q modulation normal/changed
QAM		[64QAM, 256QAM]
NOISE C/N	[dB]	Carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING	Active fading parameter set, see SETUP - FADING PARAMETER	

The I/Q coder settings are displayed in the right-hand column

INPUT	[ASI]	Selected transport stream input
DATA RATE	[Mbit/s]	Set MPEG2 transport stream input data rate
MODE	[DATA, NULL TS PACKET, NULL PRBS PACKET, PRBS BEFORE TRELLIS, PRBS AFTER TRELLIS]	Selected mode of the J.83/B coder
ROLL OFF	Permanently set roll-off filtering of 0.18 with 64 QAM and 0.12 with 256 QAM	
RANDOMIZER	[ON, OFF]	Energy dispersal
REED SOLOMON	[ON, OFF]	Reed-Solomon encoder
INTERLEAVER	[ON, OFF]	Convolutional interleaver

2.2.11.7 ATSC VSB

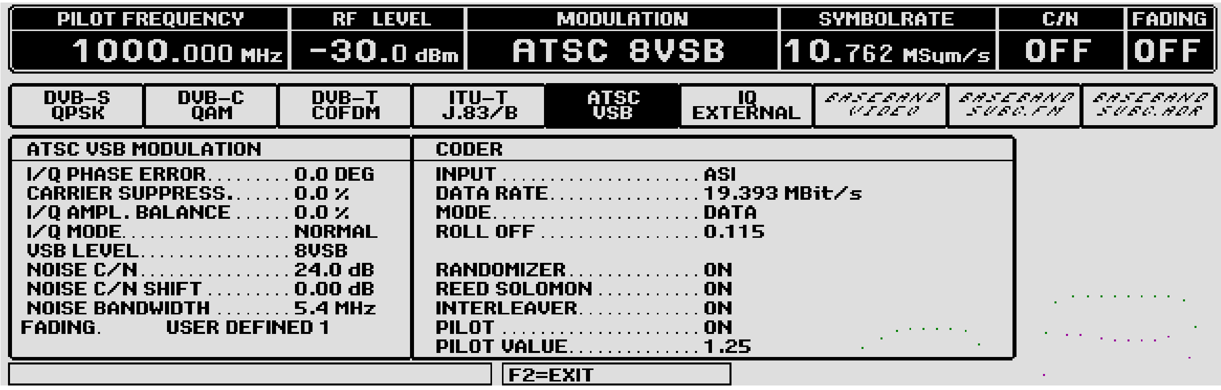


Fig.: 2.2.11-8 ATSC VSB

The ATSC modulation settings are displayed in the left column.

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
I/Q MODE		I and Q normal/changed
VSB LEVEL	[8VSB, 16VSB]	
NOISE C/N	[dB]	Carrier-to-noise ratio
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING		Active fading parameter set, see SETUP – PARAMETER FADING
		The I/Q coder settings are shown in the right column
INPUT	[ASI]	Selected transport stream input
DATA RATE	[Mbit/s]	Set MPEG2 transport stream input data rate
MODE	[DATA, NULL TS PACKET, NULL PRBS PACKET, PRBS BEFORE TRELLIS, PRBS AFTER TRELLIS]	Selected operating mode for ATSC coder
ROLL OFF		Fixed roll-off of 0.115
RANDOMIZER	[ON, OFF]	Energy dispersal
REED SOLOMON	[ON, OFF]	Reed-Solomon encoder
INTERLEAVER	[ON, OFF]	Convolutional interleaver
PILOT	[ON, OFF]	Pilot for receiver synchronization
PILOT VALUE	[0 to 5]	Set value of pilot

2.2.11.8 ISDB-T

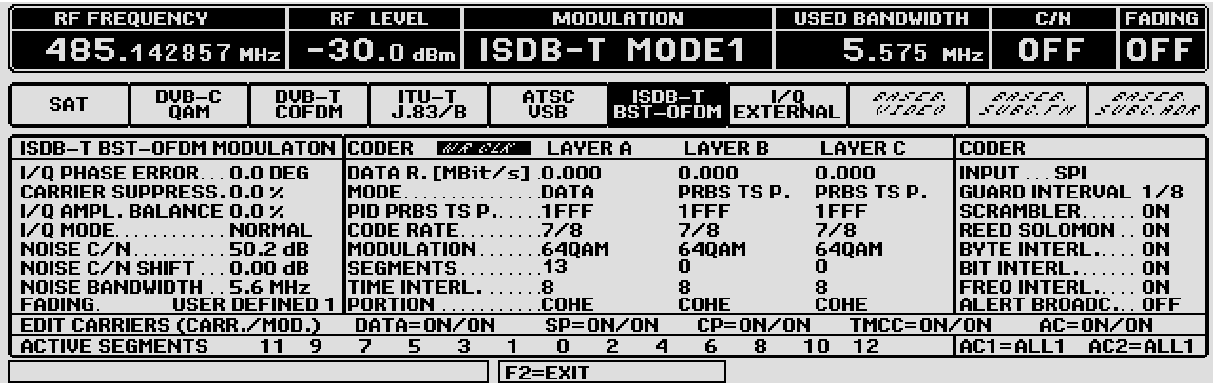


Fig.: 2.2.11-9 State menu of the ISDB-T coder

The F2 key is used to change from the Coder menu to the State menu. In this menu, all states of the ISDB-T coder are grouped in a window. Pressing the F2 key again opens the Coder menu.

The left column contains the modulator settings.

I/Q PHASE ERROR	[DEG]	Phase error of the I/Q signal
CARRIER SUPPRESS	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
I/Q MODE	[NORMAL/CHANGED]	I/Q interchange
NOISE C/N	[dB]	Noise ratio
NOISE C/N SHIFT	[dB]	Noise ratio correction
NOISE BANDWIDTH	[MHz]	Noise bandwidth
FADING		Fading parameter set (PRESET menu)

The center column contains the hierarchical settings of the ISDB-T coder:

DATA R.[Mbit/s]		Useful data rate of the layers
MODE		Type of transmitted data
PID PRBS TS P.	[hex]	PID for the transmitted PRBS packets
CODE RATE	[1/2, 2/3, 3/4, 5/6, 7/8]	Code rate set
MODULATION	[DQPSK, QPSK, 16QAM, 64QAM]	Selected constellation of data carriers
SEGMENTS		Number of OFDM segments per layer
TIME INTERL.	[0, 1, 2, 4, 8, 16]	Parameter I of the time interleaver
PORTION	[PART, DIFF, COHE]	Selected type of transmission

The right column contains the general settings of the ISDB-T coder:

INPUT	[TS PARALLEL+AUX, ASI, SPI]	Selected input
GUARD INTERVAL	[1/4, 1/8, 1/16, 1/32, OFF]	Selected guard interval
SCRAMBLER	[ON, OFF]	Energy dispersal
REED SOLOMON	[ON, OFF]	Reed-Solomon coder
BYTE INTERL.	[ON, OFF]	Byte interleaver
BIT INTERL.	[ON, OFF]	Bit interleaver
FREQ INTERL.	[ON, OFF]	Frequency interleaver
ALERT BROADC.	[ON, OFF]	State of the alert broadcasting flags

2.2.11.9 IQ EXTERNAL

The following parameters are shown in the IQ EXTERNAL status display:

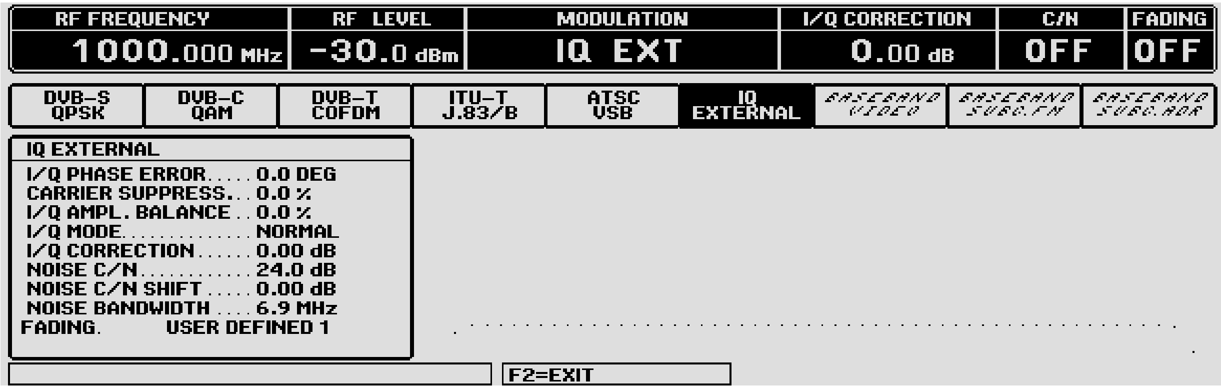


Fig.: 2.2.11-10 IQ EXTERNAL

In the I/Q EXTERNAL mode, external modulation signals can be applied to the modulation inputs I (X40.1) and Q (X40.2) to subject the RF carrier to complex modulation.
The following parameters are shown in the IQ EXTERNAL status display:

I/Q PHASE ERROR	[DEG]	Phase error of I/Q signal
CARRIER SUPPRESS.	[%]	Carrier suppression
I/Q AMPL. BALANCE	[%]	I/Q amplitude imbalance
I/Q MODE	[NORMAL/CHANGED]	I and Q normal/changed
NOISE C/N	[dB]	Defined C/N value
NOISE C/N SHIFT	[dB]	Modification of S/N ratio
NOISE BANDWITH	[MHz]	Noise bandwidth
FADING	Active fading parameter set, see SETUP - FADING PARAMETER	

2.2.11.10 BASEBAND VIDEO

The following parameters are shown in the BASEBAND VIDEO status display:

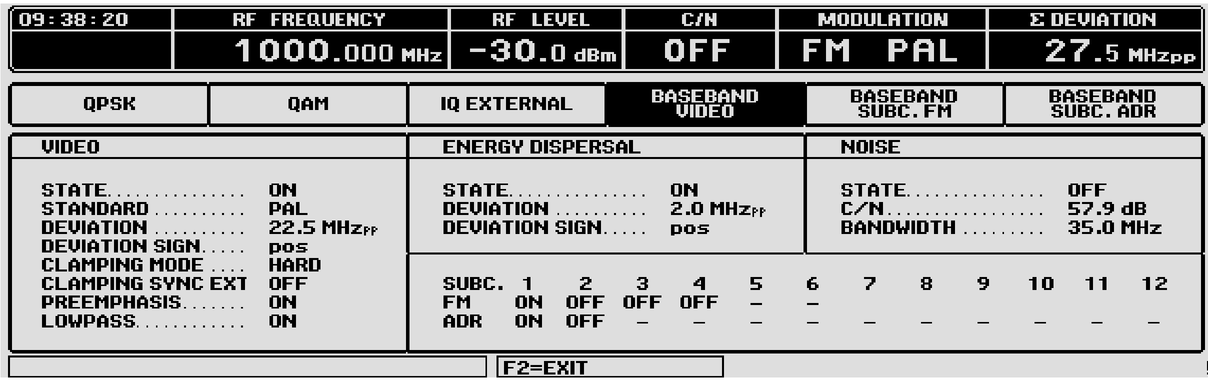


Fig.: 2.2.11-11 BASEBAND VIDEO

2.2.11.11 BASEBAND SUBC. FM

The following parameters are shown in the BASEBAND SUBC.FM status display:

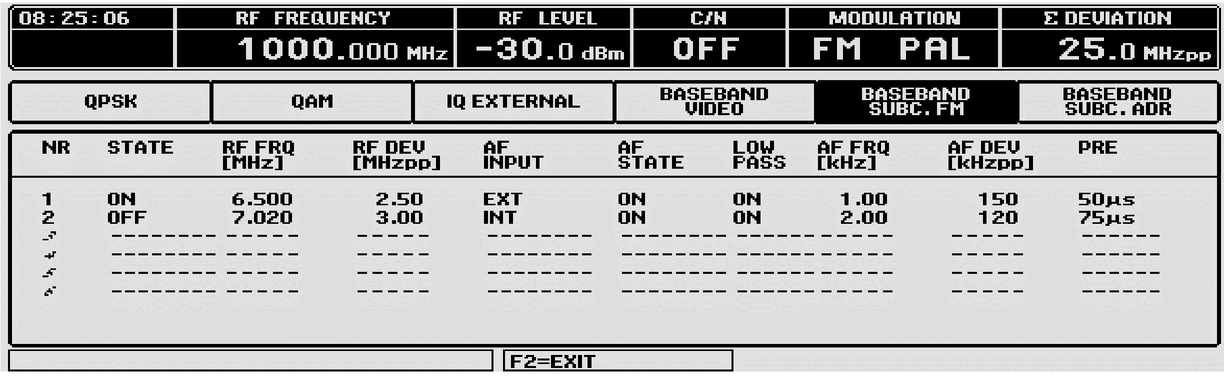


Fig.: 2.2.11-12 BASEBAND SUBC. FM

Press key F2 to call the status menu. The submenu for the FM subcarriers (BASEBAND SUBC. FM) can be chosen in the horizontal menu bar.

This status menu provides a clear overview of all information concerning the FM subcarriers.

2.2.11.12 BASEBAND SUBC. ADR

The following parameters are shown in the BASEBAND SUBC.ADR status display:

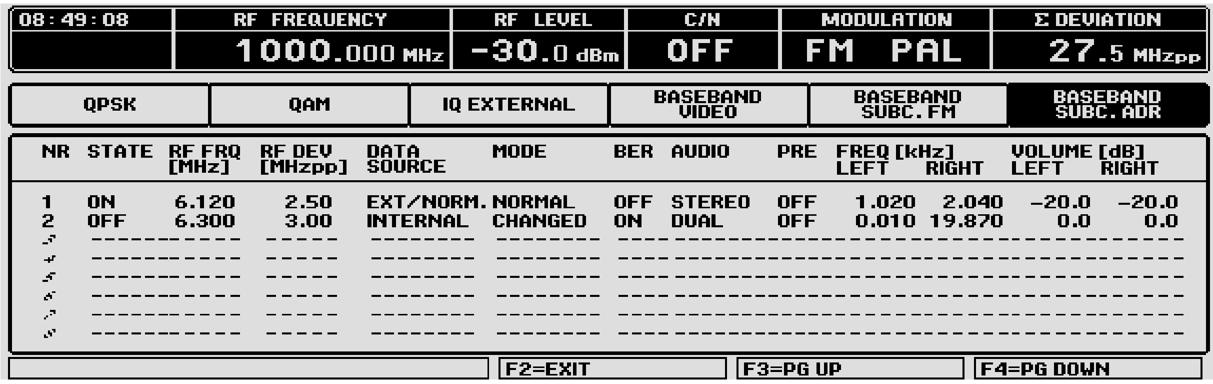
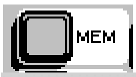


Fig.: 2.2.11-13 BASEBAND SUBC. ADR

Press key F2 to call the status menu. The submenu for the ADR subcarriers (BASEBAND SUBC. ADR) can be chosen in the horizontal menu bar.

This status menu provides a clear overview of all information concerning the ADR subcarriers.

2.2.12 MEMORY Menu



Use the MEM hardkey to call the MEMORY menu.

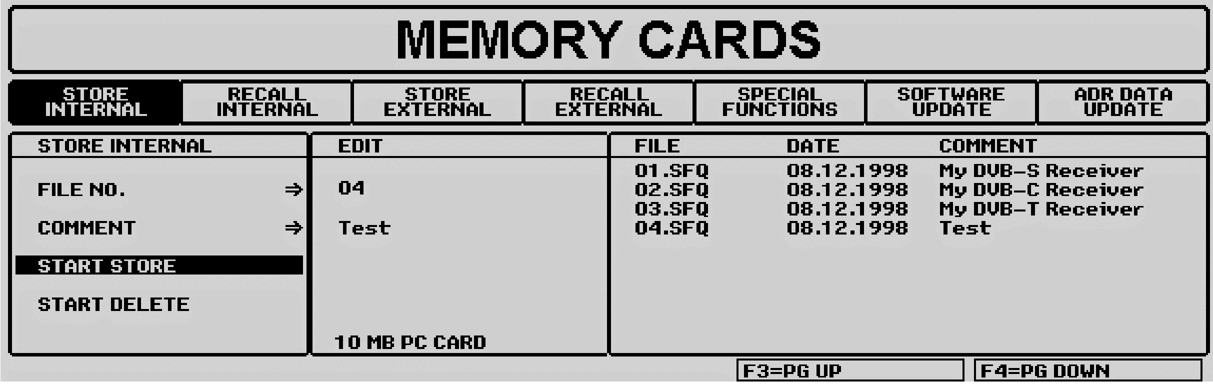


Fig.: 2.2.12-1 MEMORY Menu

The following actions can be selected and performed in the **MEMORY menu:**

STORE INTERN.
RECALL INTERN.

STORE EXTERN.
RECALL EXTERN.

SPECIAL FUNCTIONS

SOFTWARE UPDATE

and **ADR DATA UPDATE**

2.2.12.1 Storage of Instrument Setups

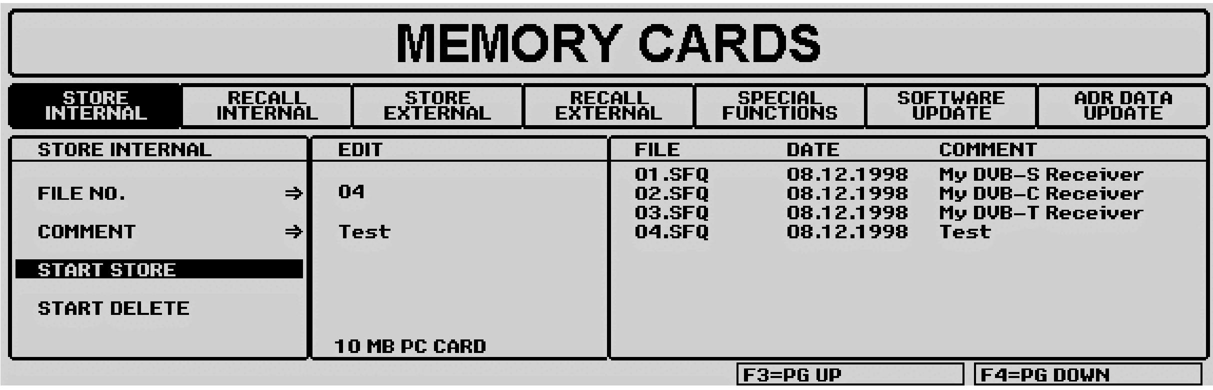


Fig.: 2.2.12-2 **START STORE**

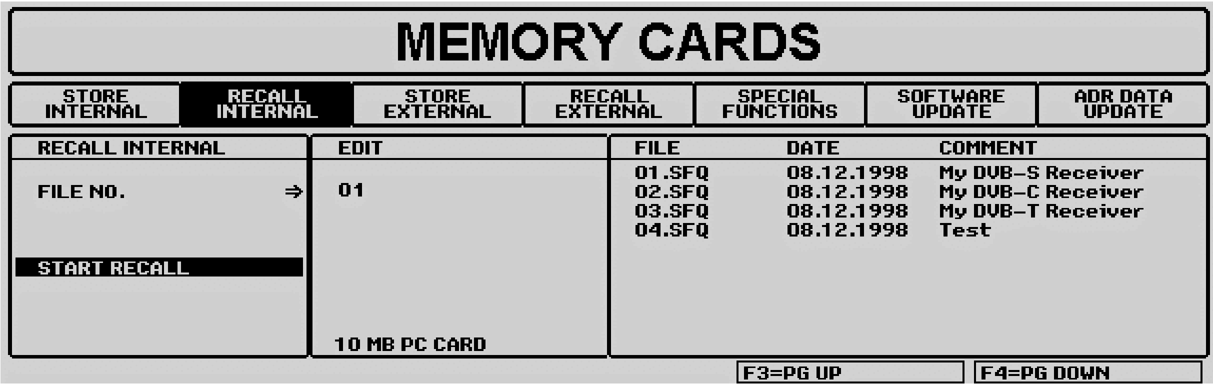


Fig.: 2.2.12-3 START RECALL

Selecting **STORE INTERNAL or STORE EXTERNAL** results in the display of an overview of all occupied memory locations, a maximum of 99 locations being available.

After selection of a memory location via the FILE NO., a short comment can be entered via COMMENT using either the editor provided in the program and operated with the aid of the cursor keys or a PC keyboard.

The comment may consist of a maximum of 15 characters.

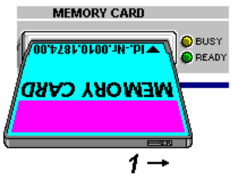
Storage is triggered with START STORE.

A name identifying the memory location is automatically assigned to the stored file and the storage date is recorded. If the selected memory location is occupied already, the user is asked whether the location is to be overwritten.

The complete instrument setup is stored.

Files to be deleted are selected via the FILE NO and deleted by START DELETE.

If an external MEMORY CARD is used, the following should be observed:



With the aid of the write-protection switch (***1***) the MEMORY CARD can be protected against inadvertent clearing.
Fully insert the MEMORY CARD. In this position the green READY LED is on.

Caution:
In the case of a write or read operation on the external MEMORY CARD the yellow BUSY LED lights. The MEMORY CARD may under no circumstances be removed from the slot while the BUSY lamp is on.

The memory card can be obtained from the R&S spare parts service under the **Order No. 0010.1874.00.**

The following types of memory cards may also be used:

Intel Series1:	**AMD Series A:**	**TI Series I:**
iMC001FLKA	AmC001AFLKA	TMS28F010A 1MBIT
iMC002FLKA	AmC002AFLKA	
iMC004FLKA	AmC004AFLKA	
Intel Series2:	**AMD Series B:**	**SST Flash Chips:**
iMC004FLSA	AmC002BFLKA	
iMC010FLSA		
iMC020FLSA		
Intel Series2+:	**AMD Series C:**	**Atmel:**
iMC004FLSP	AmC002CFLKA	AT29C010
iMC020FLSP	AmC004CFLKA	AT 29C040
iMC040FLSP	AmC010CFLKA	
Intel ATA:		
iFD005P2SA		
iFD010P2SA		

2.2.12.2 Loading of Instrument Setups

Selecting **RECALL INTERN. or RECALL EXTERN.** results in the display of an overview of all occupied memory locations.
After selection of a file via **FILE NO.** the file can be reloaded via **START RECALL.**
The complete instrument setup will be loaded.

2.2.12.3 Special Functions

2.2.12.3.1 Formatting of MEMORY CARDS

A new MEMORY CARD can be formatted via the MEM - SPECIAL FUNCTIONS - FORMAT EXTERNAL menu.

FORMAT 1 MB	Formatting an external MEMORY CARD with a storage capacity of 1 MB
FORMAT 2 MB	Formatting an external MEMORY CARD with a storage capacity of 2 MB
FORMAT 4 MB	Formatting an external MEMORY CARD with a storage capacity of 4 MB
FORMAT 10 MB	Formatting an external MEMORY CARD with a storage capacity of 10 MB
FORMAT 20 MB	Formatting an external MEMORY CARD with a storage capacity of 20 MB

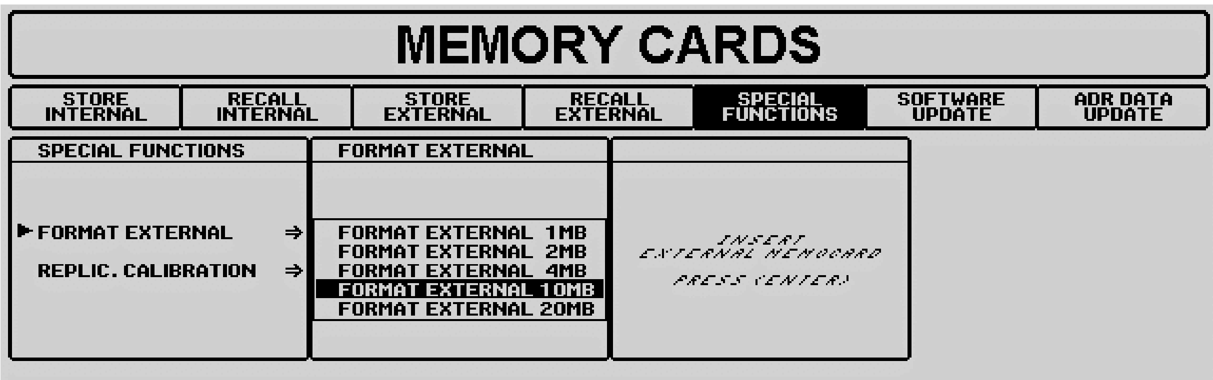


Fig.: 2.2.12-4 **Formatting of MEMORY CARDS**

2.2.12.3.2 Copying of Device-Specific Calibration Data

The device-specific calibration data can be copied from the internal to the external memory card and vice versa via the MEM - SPECIAL FUNCTIONS - REPLIC.CALIBRATION menu. This process is for instance necessary when replacing a 4 MB MEMORY CARD by a 10 MB MEMORY CARD.
If the REPLIC.CALIBRATION menu is selected with Enter, the calibration data found are displayed in the INTERNAL and EXTERNAL columns and the direction of the copying process in the REPLICATE CALIBRATION column.

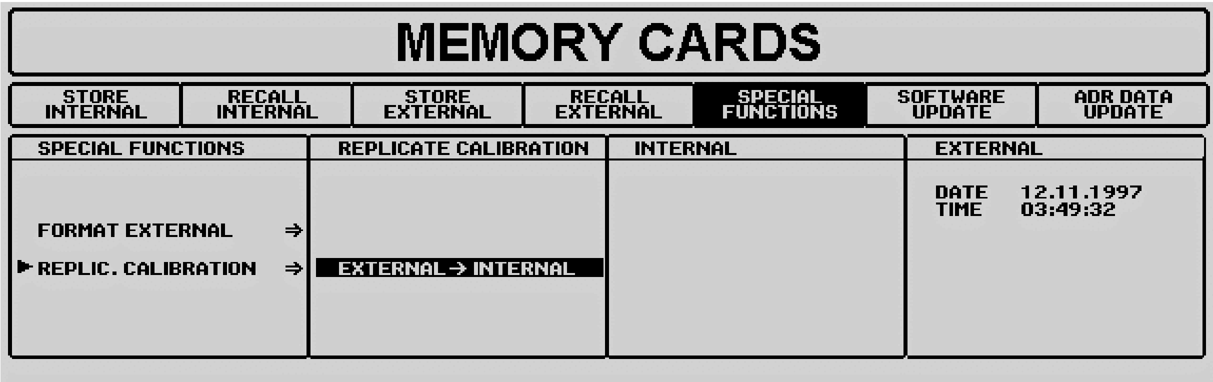


Fig.: 2.2.12-5 **Copying of device-specific calibration data**

If there is only one set of calibration data, copying can be started in the REPLICATE CALIBRATION column by Enter.

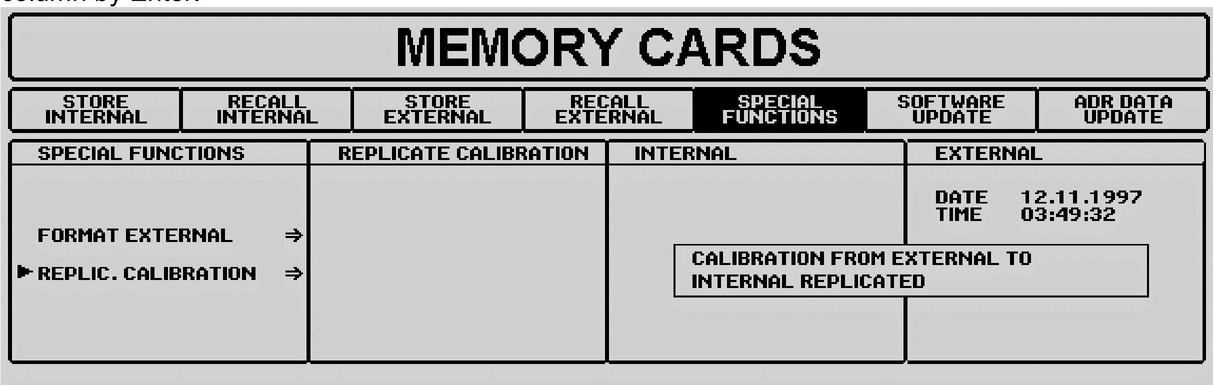


Fig.: 2.2.12-6

A message window is displayed after successful copying.

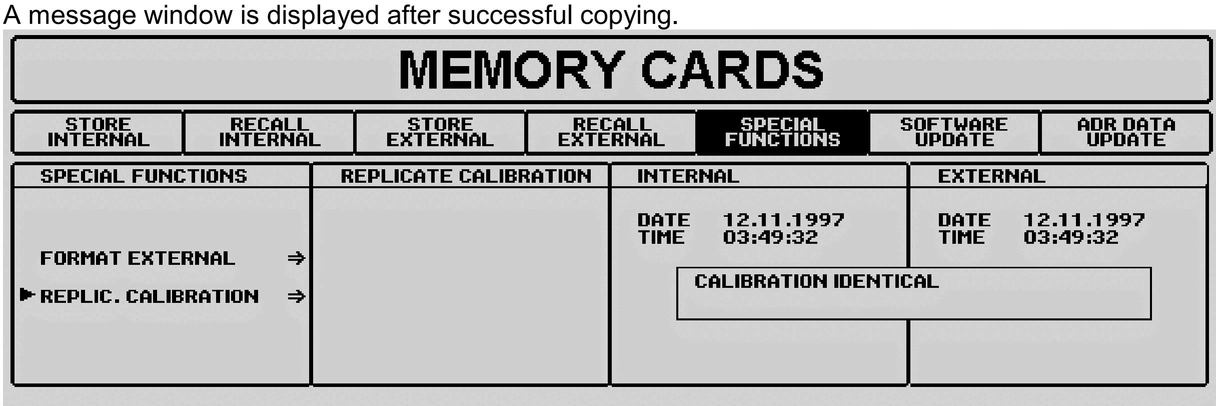
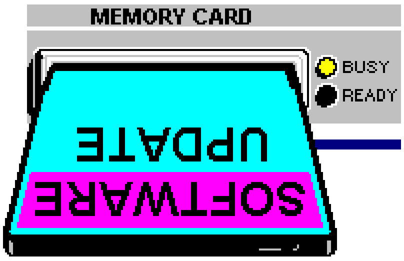


Fig.: 2.2.12-7

If both the external and the internal MEMORY CARD contain calibration data, a corresponding message is displayed in a window and copying cannot be started in the REPLICATE CALIBRATION column.

2.2.12.4 Software Update

2.2.12.4.1 Software Update with External MEMORY CARD



The MEMORY CARD with the program update is inserted into the front-panel slot and the appropriate menu is activated.

The yellow BUSY LED will flash throughout this process.

Caution:

The MEMORY CARD may under no circumstances be removed from the slot during copying.

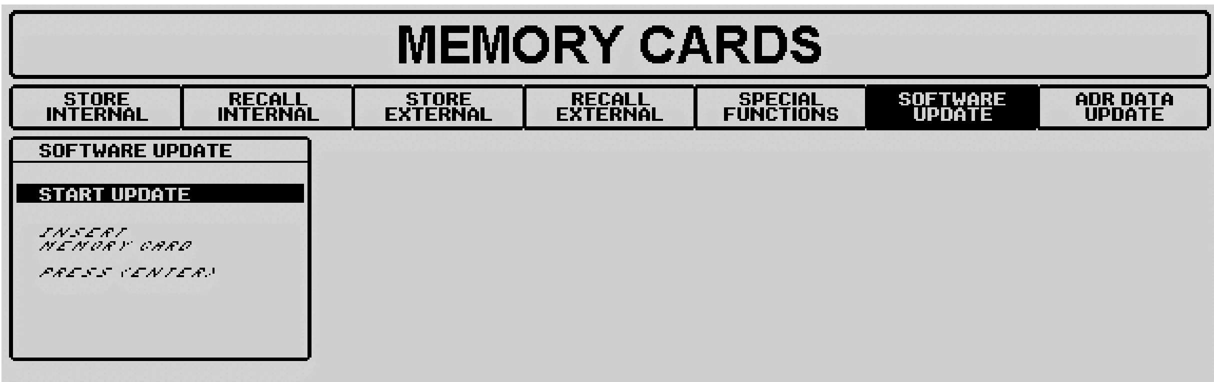
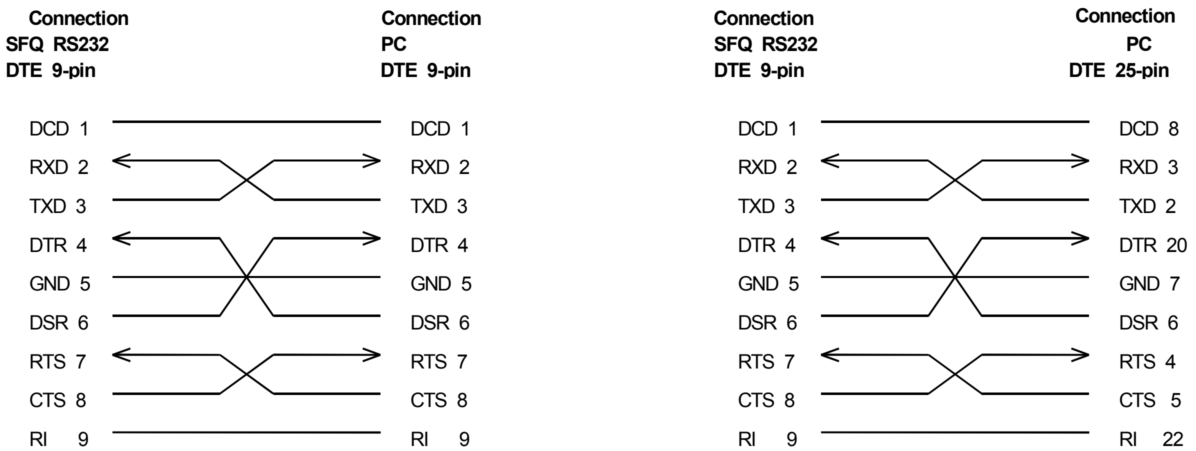


Fig.: 2.2.12-8 Software Update

2.2.12.4.2 Software Update Via Serial Interface and Detached PC

The serial PC interface (COM1 or COM2) has to be connected to the RS232 interface of SFQ via a null modem cable.

The cable must have the following pin assignment:



The cable should be suitable for standard-conforming transmission at 115200 baud. Therefore its length should not exceed a few meters.

A 9-pin COM interface cable can be ordered from R&S under Stock No. 1050.0346.

Proceed as follows:

1. Switch off the SFQ (POWER OFF).
2. Insert the update disk into the PC and change to the drive you are using.
3. To start an update from disk drive A: for example, enter `A:>UPDATE COM1` (or `COM2`).
4. Wait until you are asked to switch on the target. Then switch on the SFQ and follow the instructions on the PC screen until the update has been completed.

Update of new ADR DATA files with external MEMORY CARD for Option SFQ-B4

New ADR data can be loaded into SFQ via the MEM-ADR DATA UPDATE menu.

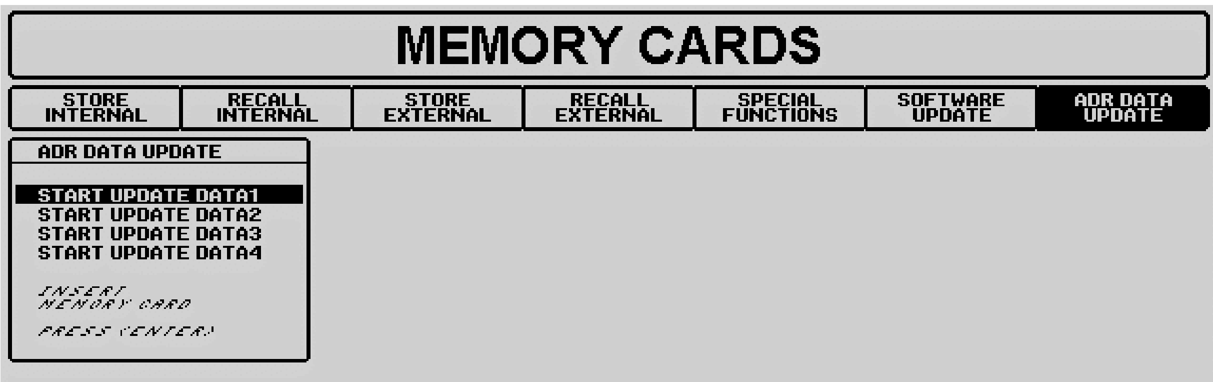
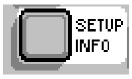


Fig.: 2.2.12-9

2.2.13 SETUP / INFO - Menu



Direct access via HARDKEY.

Select the desired menu or submenu by means of the cursor keys without confirming your selection by means of the ENTER key.

HARDWARE and INFO FIRMWARE:
The current configuration of the instrument can be queried.

TIME / DATE, COMMUNICATION and **PRESET**
The instrument default settings and the operating status of the interfaces can be defined in this menu.

CHANNEL TABLE
The user can edit his own channel or frequency tables in this menu.

FADING PARAMETER
The fading simulator can be configured in this menu (see also 2.2.8 FADING)

Service:
This menu provides service functions.

2.2.13.1 HARDWARE Submenu

The HARDWARE submenu allows the user to check the setup of the system. TV Test Transmitter SFQ comes in a basic version equipped with various options.

FUNCTION CIRCUIT
FUNCTION CIRCUIT displays the current block diagram.

Depending on the equipment selected, different blocks are shown.

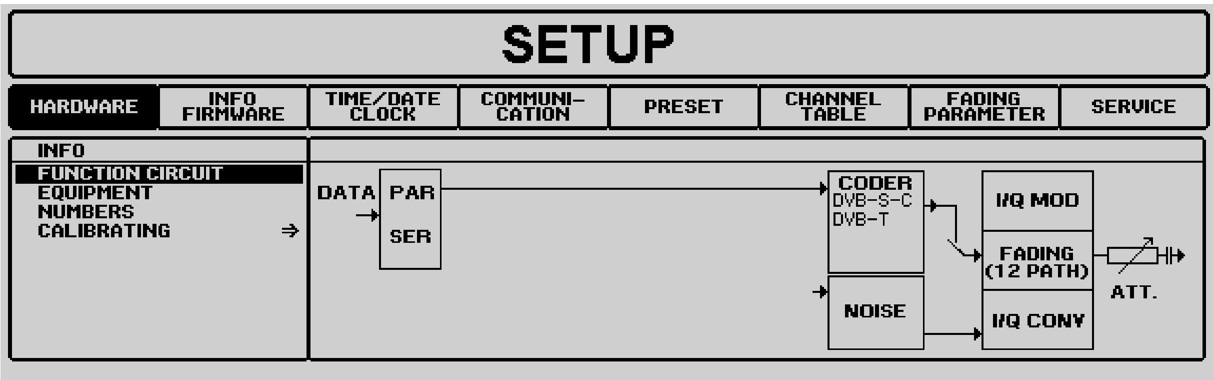


Fig.: 2.2.13-1 FUNCTION CIRCUIT

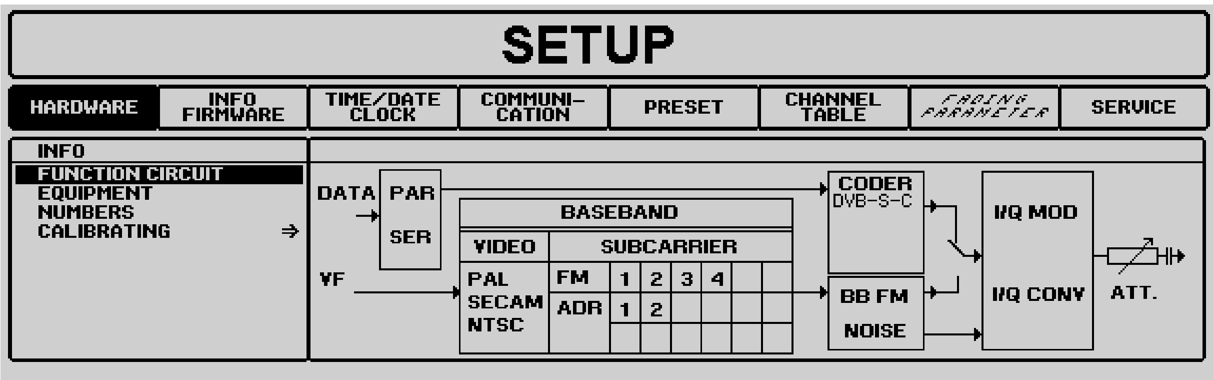


Fig.: 2.2.13-2 FUNCTION CIRCUIT

EQUIPMENT

The EQUIPMENT submenu lists all modules installed, stating their order numbers (Ident No), codes and change indices (CI). If the module produces an error upon initialization, this error will be shown in the ERROR REPORT column.

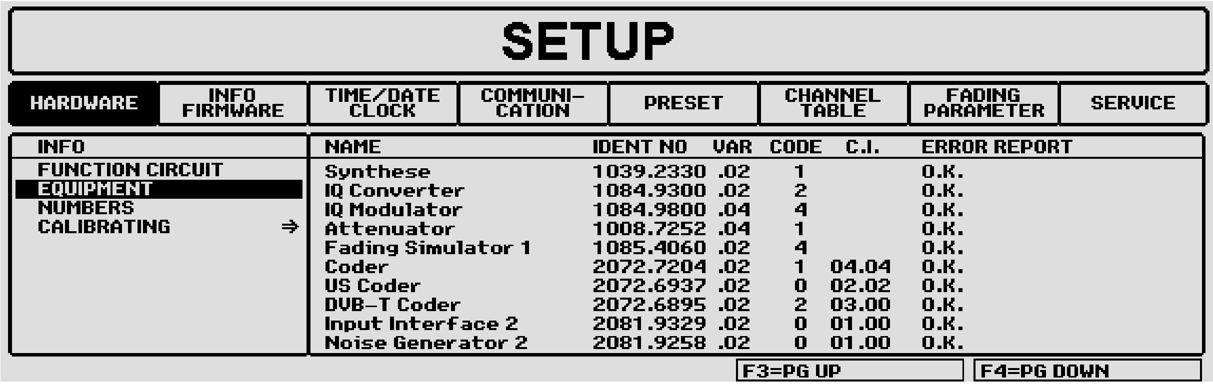


Fig.: 2.2.13-3 EQUIPMENT

NUMBERS

Upon calling up NUMBERS, the order number and the serial number of the basic unit are displayed.

2.2.13.1.1 Calibration

Internal calibrations for the synthesizer, level setting, ALC learn table, noise and, of particular importance, for the I/Q modulator can be called with CALIBRATING.

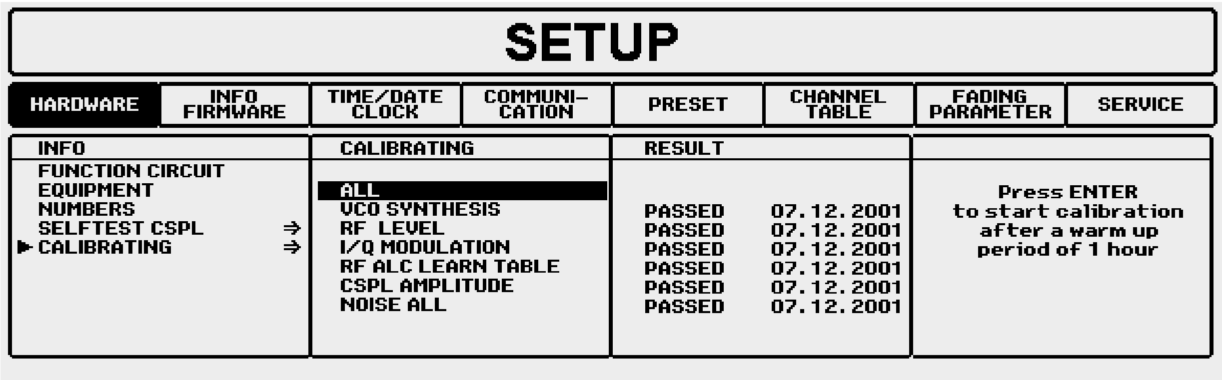


Fig.: 2.2.13-4 **CALIBRATING**

Note:	*Perform calibrations only after a warmup time of approx. 1 hour. This applies to the I/Q modulator in particular. If there are ambient temperature variations (>5 K), a recalibration has to be performed.*
Note:	*The "Calibration failed" message is displayed in the bottom left-hand corner of the SFQ screen, if one of the SFQ calibrations was not performed successfully. This message does not necessarily refer to the last calibration performed.*

The following calibrations can be started by pressing Enter. After successful calibration, PASSED or FAILED is entered in the RESULT column, followed by the date.

ALL
All SFQ calibrations (see text below) are performed successively.
This calibration takes several minutes.

VCO SYNTHESIS
To ensure synchronization, the oscillators are preset with values so close to the nominal frequency that the PLL can lock. The presettings are stored in a table and can be updated with the VCO SNYTHESIS calibration routine.

RF LEVEL
For all frequency and level settings, a control element is set to the optimum operating point. The set values for the control element are stored in a table and can be updated with the RF LEVEL internal calibration routine.

I/Q MODULATION
The vector modulator is adjusted for carrier suppression, I/Q imbalance and quadrature offset. If options (e.g. coder or fading) are fitted, calibrations are also called for those modules for which the module offset and the I/Q imbalance have to be calibrated. All calibration routines are run internally for all coders. The calibration should be called after an SFQ warmup time of >1 hour or if there are temperature variations of more than 5°C.

Calibration of the I/Q MODULATION can also be performed upon selecting the MODULATION menu by means of the F3 key (CAL I/Q ONCE). In this case, however, only the current device setting is calibrated, i.e. only the active coder with its current symbol rate. The advantage is a considerably shorter calibration time.

RF ALC LEARN TABLE
The correction values for the function ALC OFF MODE -TABLE (level control voltage from the table) are regenerated.

NOISE ALL

The NOISE calibration for all modulation modes present is performed. If the noise calibration of a modulation fails, FAILED is displayed in the right part of the window. This calibration takes several minutes

The NOISE calibration only for the currently selected modulation mode can be started in the MODULATION - XX - NOISE menu by pressing the F3 key (see 2.2.7. NOISE).

2.2.13.2 INFO FIRMWARE Submenu

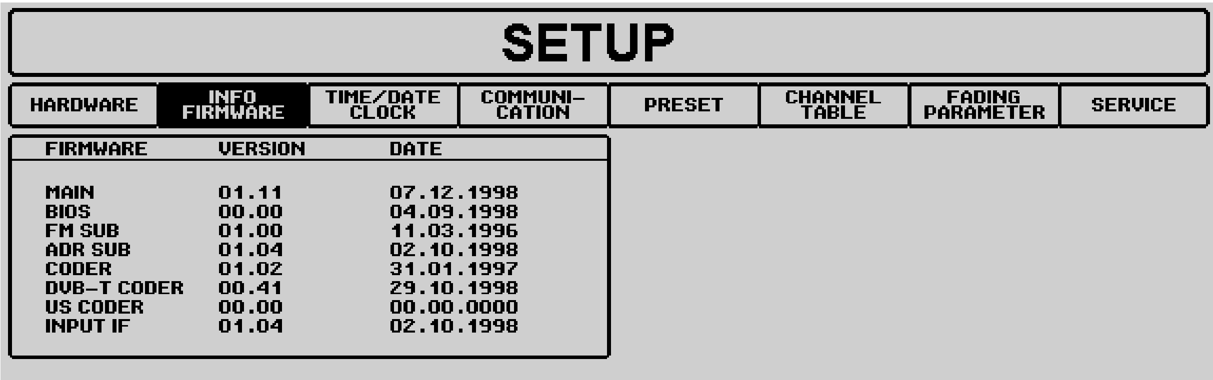


Fig.: 2.2.13-5 **INFO FIRMWARE submenu**

The firmware versions used are displayed in the INFO FIRMWARE submenu.

2.2.13.3 TIME / DATE / CLOCK Submenu

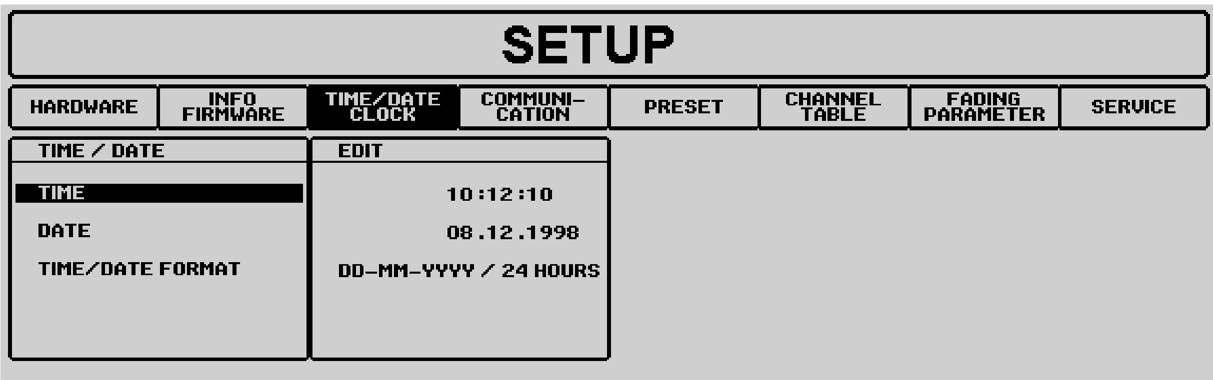


Fig.: 2.2.13-6 **TIME /DATE /CLOCK submenu**

The TIME / DATE / CLOCK submenu enables the user to set the time of day and date and to select the display format.

2.2.13.4 COMMUNICATION Submenu

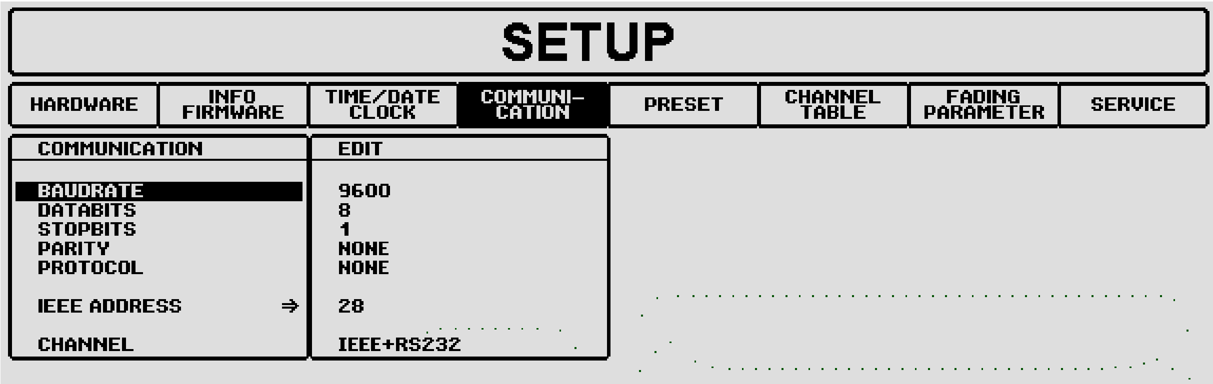


Fig.: 2.2.13-7 **COMMUNICATION submenu**

The COMMUNICATION submenu allows the user to set the IEC/IEEE-bus address and to select the settings of the serial as well as of the remote-control interface.

Ranges:

BAUDRATE: 100; 300; 600; 1200; 2400; 9600; 19200
DATABITS: 7/8
STOPBITS: 1/2
PARITY: NONE; DD; EVEN; SPACE; MARK
PROTOCOL: NONE;XON; RTS/CTS
IEEE ADDRESS: 1 to 30

2.2.13.5 PRESET Submenu

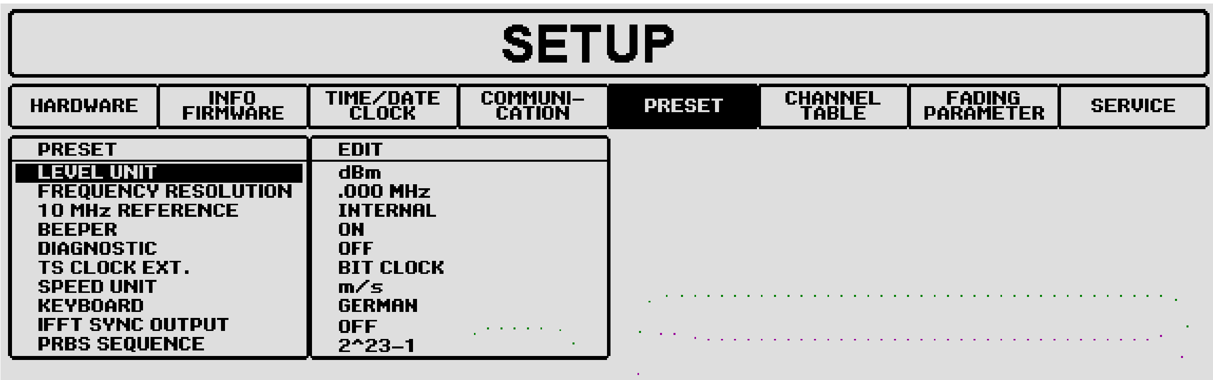


Fig.: 2.2.13-8 **PRESET submenu**

The PRESET submenu allows various instrument settings to be made.

LEVEL UNIT
The units for entering the level can be adapted to the application. Selectable units: dBm, dBμ, mW

FRQUENCY RESOLUTION
A 3- or 6-digit frequency resolution is possible.

Note:	*The selected setting influences the* **RF FREQUENCY** *parameter*.

10 MHz REFERENCE
The user can select either the internal or external 10 MHz reference oscillator.

BEEPER
BEEPER ON switches on the built-in loudspeaker that signals errors or inadmissible settings, BEEPER OFF switches it off.

DIAGNOSTICS
Enables the display in the main menu of the diagnosis point selected.

TS CLOCK EXT.
Switchover of the reference for the external symbol rate clock between bit clock and byte clock.

FADING

SPEED UNIT
The speed of the fading simulator can be selected to be displayed in m/s, km/h or mps.

REFERENCE
The parameter to remain constant when the RF frequency varies can be defined.

SPEED: Speed remains constant and the Doppler frequency is recalculated.

DOPPLER FREQUENCY: Doppler frequency remains constant and speed is recalculated.

POWER

MULTIPATH:. The RF level displayed in the main screen is the sum of all paths involved in the output signal. A C/N setting refers the RF level displayed in the main screen therefore the sum level.

MAIN: The RF level displayed in the main screen is the level of the main path (Path with lowest Path Loss). The sum power of all paths involved in the output signal is displayed in the RF level menu as a fading power. A C/N setting refers the RF level displayed in the main screen therefore the main path.

General note: The displayed RF level applies only to uncorrelated paths. Constant phase relations between the paths aren't taken into account in the RF level.

KEYBOARD
Switchover between German and US keyboard.

IFFT SYNC OUTPUT
The IFFT sync signal can be selected for output at the rear panel or not. As a prerequisite the appropriate coaxial cable must be connected to X6 at the rear panel. The connector is assigned two functions if option SFQ-B17 (BER measurement) is fitted. As soon as the BER measurement is activated, the IFFT sync output is disabled.

PRBS SEQUENCE

Switchover of the random sequence between 2^{23}-1 and 2^{15}-1. The random sequences are generated in line with ITU-T Rec. O.151. The random sequence switchover affects all PRBS sequences that are generated in the various coder modules, including the NULL PRBS PACKET.

2.2.13.6 CHANNEL TABLE Submenu

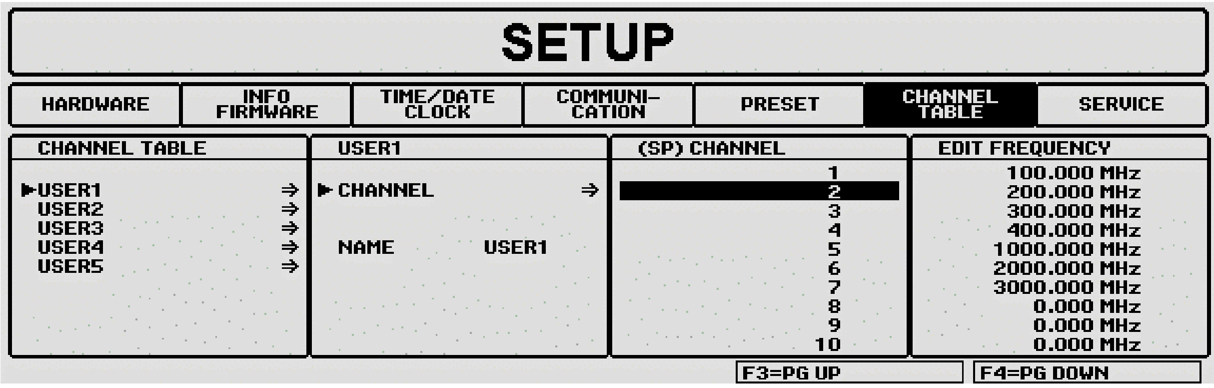


Fig.: 2.2.13-9 CHANNEL TABLE submenu

Five frequency tables with up to 99 entries can be created in the CHANNEL TABLE submenu. A name of up to 5 characters can be assigned to such a table. A user-defined channel table can be selected in the RF FREQUENCY menu.

Note: *The frequency tables can also be loaded via the RS232 or IEC/IEEE-bus device interfaces (see chapter 3.6).*

2.2.13.7 SERVICE Submenu

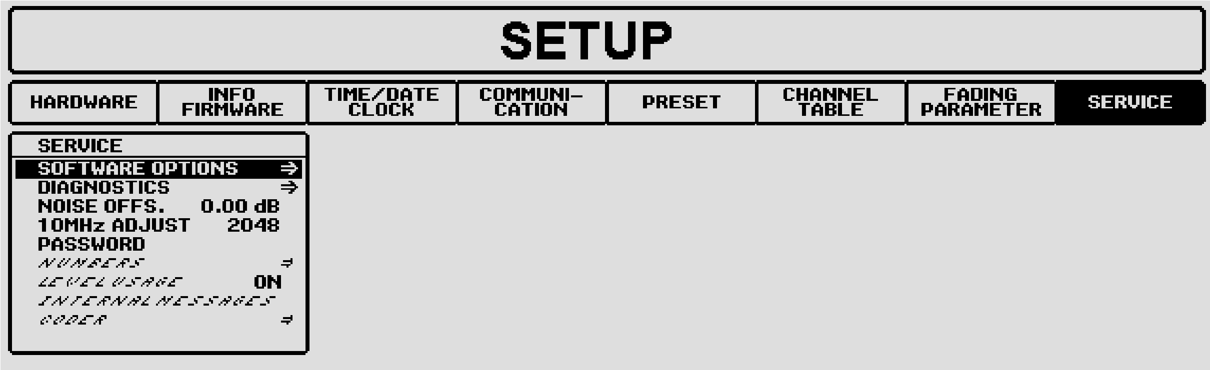


Fig.: 2.2.13-10 SERVICE submenu

SOFTWARE OPTIONS see 2.2.13.7.1

DIAGNOSTICS After selection of ADDRESS and POINT, the currently measured value of the selected testpoint is displayed under VALUE.

NOISE OFFS. For adaptation of the C/N ratio after installation of option SFQ-B2 or of the optional standard noise generator (SFQ-B5 2072.7579.02). If a self-calibrating noise generator is fitted (SFQ-B5 2072.7579.03), this menu item is replaced by the DIVERSITY OFFSET menu item.

DIVERSITY OFFSET For the offset adjustment of external I/Q outputs of the self-calibrating noise generator (SFQ-B5 2072.7579.03). The offset at the I/Q outputs determines the carrier suppression of the second SFQ involved. A special cabling has to be installed for using the outputs. This menu item is only available if the self-calibrating noise generator (SFQ-B5 2072.7579.03) is installed. To optimize the carrier suppression of the second SFQ fed with I/Q signals, the menu item allows the carrier to be switched off. When the menu is exited, the carrier is automatically switched on again.

10 MHZ ADJUST Values in the range 0 to 4095 for setting the internal reference frequency. Adjusting range $\pm 4x10^{-6}$.

PASSWORD Some items of the SERVICE submenu can only be accessed by the service personnel after entry of a password. This menu allows system configuration as well as the entry of instrument data.

2.2.13.7.1 Enabling Software Options

SOFTWARE OPTIONS

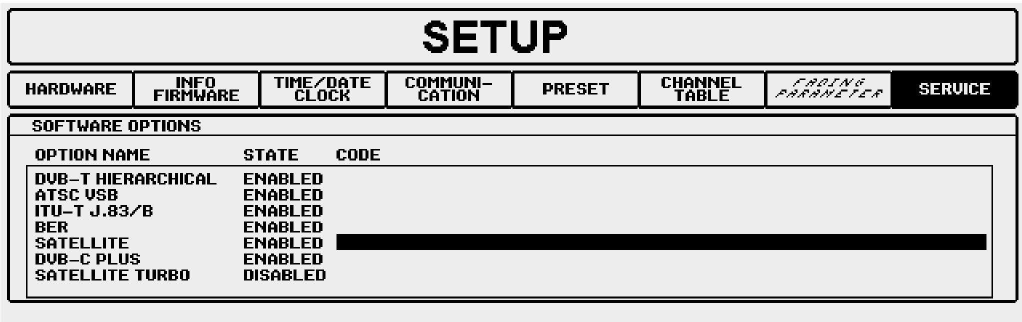


Fig.: 2.2.13-11 Entering the code for enabling software options

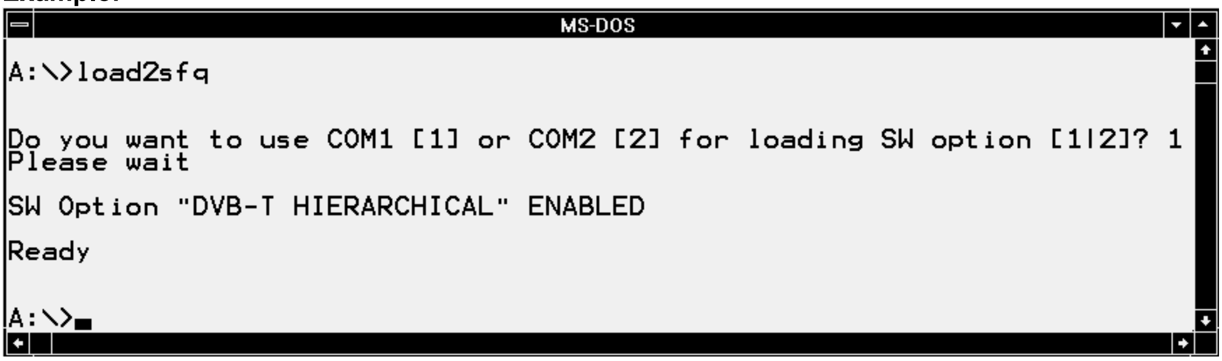
To enable a specific software option, select SOFTWARE OPTIONS in the SETUP submenu of the SERVICE menu. Enter the desired OPTION NAME and write the supplied enable code into the CODE field. The option is enabled as soon as the correct code has been entered and confirmed by <ENTER>.
The STATE display switches from DISABLED to ENABLED.
The enable software option is permanently stored in the instrument.
If a wrong code has been entered or specific hardware requirements are not complied with, the STATE display will continue to show DISABLED.

List of hardware requirements:

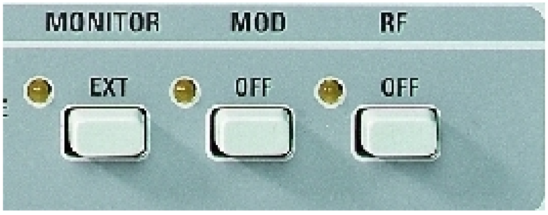
DVB-T Hierarchical	DVB-T Coder SFQ-B10
ATSC VSB	J.83/B Coder SFQ-B13 or ATSC/8VSB Coder SFQ-B12
ITU-T J.83/B	ATSC/8VSB Coder SFQ-B12 or J.83/B Coder SFQ-B13 Input Interface SFQ-B6
BER	DVB-T Coder SFQ-B10
Satellite	DVB-C Coder SFQ-B21 or DVC-S Coder SFQ-B23 Either no input interface or Input interface SFQ-B6 model 03
DVB-C Plus	DVC-S Coder SFQ-B23 or DVB-C Coder SFQ-B21
Turbo Coding	DVC-S Coder SFQ-B23 or SFQ-B24
Impulsive Noise	Noise Generator III

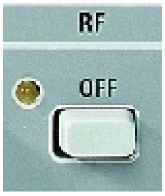
Alternatively, software options can also be enabled via the RS232 interface of SFQ.
The two files LOAD2SFQ.EXE and SWOPTION.TXT are made available to the user for this purpose.
If the user has received these files by e-mail, he must detach the two files and copy them into the same directory.
After connecting the serial connecting cable between PC and SFQ, LOAD2SFQ.EXE can be executed.
The user will be asked for the PC interface used (COM1 or COM2).
Enabling takes about two seconds.

Example:



2.2.14 Special Keys





With the **RF** OFF key the RF output signal is switched off.

With the **MOD** OFF key all modulation signals of the currently used system are switched off:

Digital modulation:
The vector-modulated RF carrier is set to CW (continuous wave).

Analog modulation:
The video and AF frequencies of the FM subcarriers are switched off. The subcarrier frequencies (6 to 9 MHz) are then unmodulated but the RF carrier is still FM-modulated with the unmodulated subcarriers.

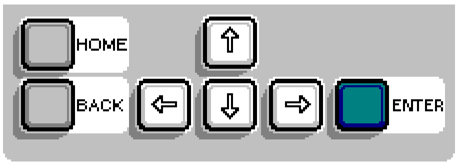
If a pure CW carrier is desired, the line CW/MODULATION has to be selected in the [Baseband] menu (toggle function).

With the **MONITOR** EXT key the display is switched to the monitor output. At the same time the built-in LC display is blanked and the yellow MONITOR EXT LED lights.

Anhang/Annex A Der Menübaum / Menu Tree

Die Menü-Bedienung erfolgt über die Cursor-Tasten und die schrittweise Änderung von Datenvariablen.

Menu operation is by means of the cursor keys and by inrementing or decrementing data variables.



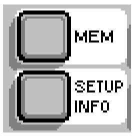
Mit der HOME-Taste gelangt man in das Einstiegsmenü für:

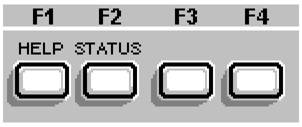
The HOME key is used for calling up the following opening menus:

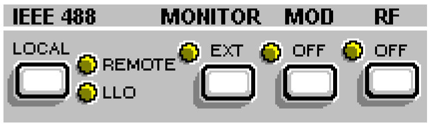
RF FREQUENCY	RF LEVEL	MODULATION	I/Q CODER	BASEBAND	SPECIAL

Eine weitere Auswahl erfolgt je nach Display-Anzeige mit folgenden Hardkeys:

Another selection is made with the following hardkeys depending on the display:







Im folgenden wird der Menü-Ablauf dargestellt.

An overview of the menus is given on the following pages.

A.1 RF FREQUENCY

|- **FREQUENCY** --------------------<wert / value > (except ATSC / VSB)
|- **PILOT** ------------------------------<wert / value > (only ATSC / VSB)
|- **ACTUAL CENTER** --------------<wert / value > (only ATSC / VSB)
|- **NOMINAL CENTER** ------------<wert / value > (only ATSC / VSB)
|- **FREQUENCY SHIFT** -----------<wert / value >
|- **CHANNEL**-------------------------<wert / value >
|- **CHANNEL TABLE** --------------|-NONE
|-USER1
|-USER2
|-USER3
|-USER4
|-USER5

A.2 RF LEVEL

|- **RF LEVEL** ------------------------<wert / value >
|- **RF LEVEL SHIFT** ---------------<wert / value >
|
|- **RF FADING POWER** <wert / value > nur bei /only in case of
| FADING=ON und /and
| setup \ preset \ FADING POWER = MAIN
| und nicht bei /and not in case of
| MOD = OFF
|- **RF LEVEL MODE** ----------------|-NORMAL
|-CONTINUOUS
|- **RF ALC MODE** ------------------|-AUTO
|-OFF
|-ON
|- **RF ALC OFF MODE**------------|-TABLE
|-SAMPLE&HOLD
|- **RF ALC SEARCH ONCE** <Funktionsaufruf / Function call >
|- **RF ALC LEARN TABLE** <Funktionsaufruf mit “WAIT” / Function call using “WAIT”>

A.3 MODULATION

A.3.1 DVB-S QPSK

```
|- DVB-S QPSK---------------------|- I/Q ------------------------ |- NORMAL
|                                 |                              |- CHANGED
|                                 |
|                                 |- I/Q PHASE ERROR------------------------------------------ <wert / value>
|                                 |
|                                 |- CARRIER SUPRESSION ---------------------------------- <wert / value>
|                                 |
|                                 |- I/Q AMPL. IMBALANCE ------------------------------------ <wert / value>
|                                 |
|                                 |- NOISE------------------- |- NOISE --------------------------- ON/OFF
|                                 |                          |
|                                 |                          |- C/N ------------------------------- <wert / value>
|                                 |                          |
|                                 |                          |- C/N SHIFT--------------------- <wert / value>
|                                 |                          |
|                                 |                          |- BANDWIDTH COUPLING-- ON/OFF
|                                 |                          |
|                                 |                          |- BANDWIDTH ------------------ <wert / value>
|                                 |                          |
|                                 |                          |- IMPULSIVE -------------------- ON/OFF
|                                 |                          |
|                                 |                          |- IMPULSIVE C/N -------------- <wert / value>
|                                 |                          |
|                                 |                          |- CARRIER----------------------- OFF/ON
|                                 |
|                                 |- FADING----------------- |- FADING ------------------------ ON/OFF
|                                 |                          |
|                                 |                          |- PARAMETER SET --- |- USER DEFINED 1
|                                 |                                             |- USER DEFINED 2
|                                 |                                             |- USER DEFINED 3
|                                 |                                             |- USER DEFINED 4
|                                 |                                             |- USER DEFINED 5
|                                 |
|                                 |- CW / MODULATION   |- CW  (RF ONLY)
|                                                      |- MODULATION
|
```

A.3.2 SATELLITE

- **SATELLITE**
  - CONSTELLATION
    - DVB-S QPSK
    - DVB-S 8PSK
    - DVB-S 16 QAM
    - QPSK TURBO
    - 8PSK TURBO
  - I/Q
    - NORMAL
    - CHANGED
  - I/Q PHASE ERROR ---- <wert / value>
  - CARRIER SUPRESSION ---- <wert / value>
  - I/Q AMPL. IMBALANCE ---- <wert / value>
  - NOISE
    - NOISE ---- ON/OFF
    - C/N ---- <wert / value>
    - C/N SHIFT ---- <wert / value>
    - BANDWIDTH COUPLING ---- ON/OFF
    - BANDWIDTH ---- <wert / value>
    - IMPULSIVE ---- ON/OFF
    - IMPULSIVE C/N ---- <wert / value>
    - CARRIER ---- OFF/ON
  - FADING
    - FADING ---- ON/OFF
    - PARAMETER SET
      - USER DEFINED 1
      - USER DEFINED 2
      - USER DEFINED 3
      - USER DEFINED 4
      - USER DEFINED 5
  - CW / MODULATION
    - CW (RF ONLY)
    - MODULATION

A.3.3 DVB-C QAM

```
|- DVB-C QAM ----------------------|- QAM --------------------- |- 16 QAM
|                                  |                            |- 32 QAM
|                                  |                            |- 64 QAM
|                                  |                            |- 128 QAM
|                                  |                            |- 256 QAM
|                                  |
|                                  |- I/Q ------------------------ |- NORMAL
|                                  |                               |- CHANGED
|                                  |
|                                  |- I/Q PHASE ERROR------------------------------------------ <wert / value>
|                                  |
|                                  |- CARRIER SUPRESSION ---------------------------------- <wert / value>
|                                  |
|                                  |- I/Q AMPL. IMBALANCE ------------------------------------ <wert / value>
|                                  |
|                                  |- NOISE------------------- |- NOISE --------------------------- ON/OFF
|                                  |                           |
|                                  |                           |- C/N -------------------------------- <wert / value>
|                                  |                           |
|                                  |                           |- C/N SHIFT---------------------- <wert / value>
|                                  |                           |
|                                  |                           |- BANDWIDTH COUPLING-- ON/OFF
|                                  |                           |
|                                  |                           |- BANDWIDTH ------------------ <wert / value>
|                                  |                           |
|                                  |                           |- IMPULSIVE -------------------- ON/OFF
|                                  |                           |
|                                  |                           |- IMPULSIVE C/N ------------- <wert / value>
|                                  |                           |
|                                  |                           |- CARRIER ----------------------- OFF/ON
|                                  |
|                                  |- FADING----------------- |- FADING ------------------------ ON/OFF
|                                  |                          |
|                                  |                          |- PARAMETER SET --- |- USER DEFINED 1
|                                  |                                               |- USER DEFINED 2
|                                  |                                               |- USER DEFINED 3
|                                  |                                               |- USER DEFINED 4
|                                  |                                               |- USER DEFINED 5
|                                  |
|                                  |- CW / MODULATION  |- CW  (RF ONLY)
|                                                      |- MODULATION
|
```

A.3.4 DVB-T COFDM

```
|- DVB-T COFDM ------------------|- CONSTELLATION --- |- QPSK
                                 |                    |- 16 QAM
                                 |                    |-  64 QAM
                                 |                    |- HIERARCH. 16 QAM α=1
                                 |                    |- HIERARCH. 16 QAM α=2
                                 |                    |- HIERARCH. 16 QAM α=4
                                 |                    |- HIERARCH. 64 QAM α=1
                                 |                    |- HIERARCH. 64 QAM α=2
                                 |                    |- HIERARCH. 64 QAM α=4
                                 |
                                 |- I/Q ------------------------ |- NORMAL
                                 |                               |- CHANGED
                                 |
                                 |- I/Q PHASE ERROR------------------------------------------ <wert / value>
                                 |
                                 |- CARRIER SUPRESSION ---------------------------------- <wert / value>
                                 |
                                 |- I/Q AMPL. IMBALANCE ------------------------------------ <wert / value>
                                 |
                                 |- NOISE------------------- |- NOISE --------------------------- ON/OFF
                                 |                           |
                                 |                           |- C/N ------------------------------- <wert / value>
                                 |                           |
                                 |                           |- C/N SHIFT---------------------- <wert / value>
                                 |                           |
                                 |                           |- BANDWIDTH COUPLING-- ON/OFF
                                 |                           |
                                 |                           |- BANDWIDTH ------------------ <wert / value>
                                 |                           |
                                 |                           |- IMPULSIVE -------------------- ON/OFF
                                 |                           |
                                 |                           |- IMPULSIVE C/N -------------- <wert / value>
                                 |                           |
                                 |                           |- CARRIER----------------------- OFF/ON
                                 |
                                 |- FADING----------------- |- FADING ------------------------- ON/OFF
                                 |                          |
                                 |                          |- PARAMETER SET --- |- USER DEFINED 1
                                 |                                               |- USER DEFINED 2
                                 |                                               |- USER DEFINED 3
                                 |                                               |- USER DEFINED 4
                                 |                                               |- USER DEFINED 5
                                 |
                                 |- CW / MODULATION  |- CW  (RF ONLY)
                                                     |- MODULATION
```

A.3.5 ATSC VSB

```
|- ATSC VSB ------------------------|- VSB LEVEL ------------ |- 8 VSB
|                                   |
|                                   |- I/Q ------------------ |- NORMAL
|                                   |                         |- CHANGED
|                                   |- I/Q PHASE ERROR------------------------------------------- <wert / value>
|                                   |- CARRIER SUPRESSION ---------------------------------- <wert / value>
|                                   |- I/Q AMPL. IMBALANCE ------------------------------------- <wert / value>
|                                   |- NOISE------------------ |- NOISE ---------------------------- ON/OFF
|                                   |                          |- C/N -------------------------------- <wert / value>
|                                   |                          |- C/N SHIFT---------------------- <wert / value>
|                                   |                          |- BANDWIDTH COUPLING-- ON/OFF
|                                   |                          |- BANDWIDTH ------------------ <wert / value>
|                                   |                          |- IMPULSIVE -------------------- ON/OFF
|                                   |                          |- IMPULSIVE C/N -------------- <wert / value>
|                                   |                          |- CARRIER ----------------------- OFF/ON
|                                   |- FADING---------------- |- FADING ------------------------- ON/OFF
|                                   |                          |- PARAMETER SET --- |- USER DEFINED 1
|                                   |                                               |- USER DEFINED 2
|                                   |                                               |- USER DEFINED 3
|                                   |                                               |- USER DEFINED 4
|                                   |                                               |- USER DEFINED 5
|                                   |- CW / MODULATION        |- CW  (RF ONLY)
|                                                             |- MODULATION
|
```

A.3.6 ITU-T J.83/B

```
|- ITU-T J.83/B --------------------|- QAM --------------------- |- 64 QAM
|                                   |                            |- 256 QAM
|                                   |
|                                   |- I/Q ---------------------- |- NORMAL
|                                   |                            |- CHANGED
|                                   |
|                                   |- I/Q PHASE ERROR------------------------------------------ <wert / value>
|                                   |
|                                   |- CARRIER SUPRESSION --------------------------------- <wert / value>
|                                   |
|                                   |- I/Q AMPL. IMBALANCE ------------------------------------ <wert / value>
|                                   |
|                                   |- NOISE------------------- |- NOISE --------------------------- ON/OFF
|                                   |                            |
|                                   |                            |- C/N ------------------------------- <wert / value>
|                                   |                            |
|                                   |                            |- C/N SHIFT--------------------- <wert / value>
|                                   |                            |
|                                   |                            |- BANDWIDTH COUPLING-- ON/OFF
|                                   |                            |
|                                   |                            |- BANDWIDTH ------------------ <wert / value>
|                                   |                            |
|                                   |                            |- IMPULSIVE -------------------- ON/OFF
|                                   |                            |
|                                   |                            |- IMPULSIVE C/N ------------- <wert / value>
|                                   |                            |
|                                   |                            |- CARRIER ----------------------- OFF/ON
|                                   |
|                                   |- FADING----------------- |- FADING ------------------------ ON/OFF
|                                   |                            |
|                                   |                            |- PARAMETER SET --- |- USER DEFINED 1
|                                   |                                                 |- USER DEFINED 2
|                                   |                                                 |- USER DEFINED 3
|                                   |                                                 |- USER DEFINED 4
|                                   |                                                 |- USER DEFINED 5
|                                   |
|                                   |- CW / MODULATION          |- CW  (RF ONLY)
|                                                                |- MODULATION
```

A.3.7 ISDB-T BST-OFDM

```
|- ISDB-T BST-OFDM  |- LAYER ASSIGNMENT [A|BC]  |- PORTION---------|- PART  DIFF  DIFF
|                   |                          |                 |- PART  DIFF  COHE
|                   |                          |                 |- PART  COHE  COHE
|                   |                          |                 |- DIFF  DIFF  DIFF
|                   |                          |                 |- DIFF  DIFF  COHE
|                   |                          |                 |- DIFF  COHE  COHE
|                   |                          |                 |- COHE  COHE  COHE
|                   |                          |
|                   |                          |- CONSTELLATION     |- DQPSK
|                   |                          |                    |- QPSK
|                   |                          |                    |- 16QAM
|                   |                          |                    |- 64QAM
|                   |                          |
|                   |                          |- SEGMENTS ----------- <wert / value>
|                   |
|                   |- I/Q ------------------------------------ |- NORMAL
|                   |                                           |- CHANGED
|                   |
|                   |- I/Q PHASE ERROR ---------------------------------------------------- <wert / value>
|                   |
|                   |- CARRIER SUPRESSION --------------------------------------------- <wert / value>
|                   |
|                   |- I/Q AMPL. IMBALANCE ----------------------------------------------- <wert / value>
|                   |
|                   |- NOISE ----------------------------- |- NOISE --------------------------- ON/OFF
|                   |                                      |
|                   |                                      |- C/N ------------------------------- <wert / value>
|                   |                                      |
|                   |                                      |- C/N SHIFT ---------------------- <wert / value>
|                   |                                      |
|                   |                                      |- BANDWIDTH COUPLING-- ON/OFF
|                   |                                      |
|                   |                                      |- BANDWIDTH ------------------ <wert / value>
|                   |                                      |
|                   |                                      |- IMPULSIVE -------------------- ON/OFF
|                   |                                      |
|                   |                                      |- IMPULSIVE C/N -------------- <wert / value>
|                   |                                      |
|                   |                                      |- CARRIER ----------------------- OFF/ON
|                   |
|                   |- FADING --------------------------- |- FADING ------------------------ ON/OFF
|                   |                                      |
|                   |                                      |- PARAMETER SET --- |- USER DEFINED 1
|                   |                                                           |- USER DEFINED 2
|                   |                                                           |- USER DEFINED 3
|                   |                                                           |- USER DEFINED 4
|                   |                                                           |- USER DEFINED 5
|                   |
|                   |- CW / MODULATION ----------- |- CW  (RF ONLY)
|                                                  |- MODULATION
```

A.3.8 EXTERNAL

```
|- I/Q EXTERNAL ------------------|- I/Q INPUT SIGNAL -- |- NOMINAL (0.0 dB)
|                                 |                      |- DVB-T FROM SFQ (6.5 dB)
|                                 |                      |- EDIT CORRECTION----- <wert / value>
|                                 |
|                                 |- I/Q ---------------------- |- NORMAL
|                                 |                             |- CHANGED
|                                 |
|                                 |- I/Q PHASE ERROR---------------------------------- <wert / value>
|                                 |
|                                 |- CARRIER SUPRESSION ------------------------------ <wert / value>
|                                 |
|                                 |- I/Q AMPL. IMBALANCE ----------------------------- <wert / value>
|                                 |
|                                 |- NOISE------------------- |- NOISE ------------------- ON/OFF
|                                 |                           |- C / N ------------------- <wert / value>
|                                 |                           |- C/N SHIFT---------------- <wert / value>
|                                 |                           |- BANDWIDTH --------------- <wert / value>
|                                 |                           |- IMPULSIVE --------------- ON/OFF
|                                 |                           |- IMPULSIVE C/N ----------- <wert / value>
|                                 |
|                                 |- FADING----------------- |- FADING  ON/OFF
|                                 |                          |- PARAMETER SET --- |- USER DEFINED 1
|                                 |                                               |- USER DEFINED 2
|                                 |                                               |- USER DEFINED 3
|                                 |                                               |- USER DEFINED 4
|                                 |                                               |- USER DEFINED 5
|                                 |
|                                 |- CW / MODULATION  |- CW (RF ONLY)
|                                                     |- MODULATION
|
|- FM                              (→ BASEBAND)
|
|- FM EXTERNAL -------------------|- SOURCE --------------- |- ON
                                  |                         |- OFF
                                  |
                                  |- DEVIATION------------ <wert / value>
                                  |
                                  |- DEVIATION------------ |- "+"
                                  |                        |- "-"
                                  |
                                  |- NOISE------------------- |- NOISE ------------------- ON/OFF
                                  |                           |- C/N --------------------- <wert / value>
                                  |                           |- C/N SHIFT---------------- <wert / value>
                                  |                           |- BANDWIDTH --------------- <wert / value>
                                  |
                                  |- INPUT IMPEDANCE  |- 50 Ω
                                  |                   |- 75 Ω
                                  |                   |- 10 kΩ
                                  |
                                  |- COUPLING ------------ |- AC
                                                           |- DC                F3 = DC OFFS. CAL
```

A.4 I/Q CODER

A.4.1 DVB-S QPSK

```
|- INPUT SELECT------------------|- ASI
|                                |- SPI
|                                |- TS PARALLEL
|                                |- ASI EXT.CLOCK
|                                |- SPI EXT.CLOCK
|
|- INPUT DATA RATE ------------<wert / value>------<messwert / measure value >    F3 = ACCEPT
|
|- USEFUL DATA RATE ----------------------------------<messwert / measure value >
|
|- SYMBOL RATE -----------------<wert / value>
|
|- PACKET LENGHT---------------|- 188-----------------<messwert / measure value >
|                                |- 204
|
|- MODE  -----------------------------|- DATA
|                                |- AUTO
|                                |- PRBS
|                                |- NULL TS PACKET
|                                |- NULL PRBS PACKET
|
|- ROLL OFF  -----------------------|- 0.25
|                                |- 0.30
|                                |- 0.35
|                                |- 0.40
|                                |- 0.45
|
|- RATE  ------------------------------|- 1/2
|                                |- 2/3
|                                |- 3/4
|                                |- 5/6
|                                |- 7/8
|
|- SPECIAL  -------------------------|- SCRAMBLING  ------- ON/OFF
                                 |- INTERLEAVING  ----- ON/OFF
                                 |- REED SOLOMON --- ON/OFF
```

A.4.2 SATELLITE

```
|- INPUT SELECT------------------|- ASI
|                                |- SPI
|                                |- TS PARALLEL
|                                |- ASI EXT.CLOCK
|                                |- SPI EXT.CLOCK
|
|- INPUT DATA RATE ------------<wert / value>------ <messwert / measure value >
|
|- USEFUL DATA RATE --------------------------------- <messwert / measure value >
|
|- SYMBOL RATE -----------------<wert / value>
|
|- MODE  -----------------------|- DATA
|                                |- NULL TS PACKET
|                                |- NULL PRBS PACKET
|                                |- PRBS BEFORE CONV.
|
|- RATE  -----------------------|- 1/3  (                                           8PSK TURBO)
|                                |- 1/2  (DVB-S QPSK,                                          )
|                                |- 2/3  (DVB-S QPSK, 8PSK,          QPSK TURBO, 8PSK TURBO)
|                                |- 3/4  (DVB-S QPSK,        16QAM                             )
|                                |- 5/6  (DVB-S QPSK, 8PSK,                                    )
|                                |- 7/8  (DVB-S QPSK,        16QAM                             )
|                                |- 8/9  (DVB-S        8PSK                        8PSK TURBO)
|
|- ROLL OFF  -------------------|- 0.25
|                                |- 0.30
|                                |- 0.35
|                                |- 0.40
|                                |- 0.45
|
|- SPECIAL  --------------------|- PACKET LENGHT  -- 188 / 204
                                 |
                                 |- SCRAMBLER --------- ON / OFF
                                 |
                                 |- SYNC. BYTE INV.  --- ON / OFF
                                 |
                                 |- REED SOLOMON --- ON / OFF
                                 |
                                 |- CONV. INTERL.  ----- ON / OFF
                                 |
                                 |- PLL (DATA)  ----------- FIFO LEVEL / TS CLOCK
                                 |
                                 |- PLL (INT. SIG.) ------- |- 10 MHZ REF.
                                                            |- TCXO
                                                            |- VCXO
```

A.4.3 DVB-C QAM (I/Q Coder)

```
|- INPUT SELECT------------------|- ASI
|                                |- SPI
|                                |- TS PARALLEL
|                                |- ASI EXT.CLOCK
|                                |- SPI EXT.CLOCK
|
|- INPUT DATA RATE ------------<wert / value>------ <messwert / measure value>     F3 = ACCEPT
|
|- USEFUL DATA RATE ---------------------------------- <messwert / measure value>
|
|- SYMBOL RATE -----------------<wert / value>
|
|- PACKET LENGHT--------------|- 188----------------- <messwert / measure value>
|                             |- 204
|
|- MODE  -----------------------------|- DATA
|                                     |- AUTO
|                                     |- PRBS
|                                     |- NULL TS PACKET
|                                     |- NULL PRBS PACKET
|
|- ROLL OFF ------------------------|- 0.1
|                                   |- 0.13
|                                   |- 0.15
|                                   |- 0.175
|                                   |- 0.20
|
|- SPECIAL  -------------------------|- SCRAMBLING  ------- ON/OFF
                                     |- INTERLEAVING  ----- ON/OFF
                                     |- REED SOLOMON --- ON/OFF
```

A.4.4 DVB-C (CSPL Coder)

```
|- INPUT SELECT------------------|- ASI
|                                |- SPI
|                                |- TS PARALLEL
|                                |- ASI EXT.CLOCK
|                                |- SPI EXT.CLOCK
|
|- INPUT DATA RATE ------------<wert / value>------ <messwert / measure value >
|
|- USEFUL DATA RATE --------------------------------- <messwert / measure value >
|
|- SYMBOL RATE -----------------<wert / value>
|
|- MODE  ------------------------|- DATA
|                                |- NULL TS PACKET
|                                |- NULL PRBS PACKET
|                                |- PRBS BEFORE MAPPER
|
|- ROLL OFF ---------------------|- 0.1
|                                |- 0.13
|                                |- 0.15
|                                |- 0.175
|                                |- 0.20
|
|- SPECIAL  ---------------------|- PACKET LENGHT  -- 188 / 204
                                 |
                                 |- SCRAMBLER --------- ON / OFF
                                 |
                                 |- SYNC. BYTE INV.  --- ON / OFF
                                 |
                                 |- REED SOLOMON --- ON / OFF
                                 |
                                 |- CONV. INTERL.  ----- ON / OFF
                                 |
                                 |- PLL (DATA)  ----------- FIFO LEVEL / TS CLOCK
                                 |
                                 |- PLL (INT. SIG.) ------- |- 10 MHZ REF.
                                                            |- TCXO
                                                            |- VCXO
```

A.4.5 DVB-T COFDM

```
|                         HIGH PRIO       LOW PRIO / NONHIERARCHICAL
|- INPUT SELECT-----------|- ASI
|                         |- SPI
|                         |- TS PARALLEL
|                         |- ASI EXT.CLOCK
|                         |- SPI EXT.CLOCK
|
|                         HIGH PRIO       LOW PRIO / NONHIERARCHICAL
|- INPUT DATA RATE -------<wert / value>-----------<messwert / measure value>
|
|                         HIGH PRIO       LOW PRIO / NONHIERARCHICAL
|- USEFUL DATA RATE ---------------------------------<messwert / measure value>
|
|                         HIGH PRIO       LOW PRIO / NONHIERARCHICAL
|- MODE ------------------|- DATA
|                         |- PRBS BEFORE CONV.
|                         |- PRBS AFTER CONV.
|                         |- NULL TS PACKET
|                         |- NULL PRBS PACKET
|                         |- PRBS BEFORE MAP.
|
|                         HIGH PRIO       LOW PRIO / NONHIERARCHICAL
|- CODE RATE -------------|- 1/2
|                         |- 2/3
|                         |- 3/4
|                         |- 5/6
|                         |- 7/8
|
|- USED BANDWIDTH --------|- 7.607143 MHz (8MHz CHANNEL)
|                         |- 6.656250 MHz (7MHz CHANNEL)
|                         |- 5.705357 MHz (6MHz CHANNEL)
|                         |- EDIT ------------------------------- <wert / value>
|
|- FFT MODE --------------|- 2k
|                         |- 8k
|
|- GUARD INTERVAL --------|- 1/4
|                         |- 1/8
|                         |- 1/16
|                         |- 1/32
|                         |- OFF
|
|- SPECIAL ---------------|- PACKET LENGTH  -- 188 / 204
                          |
                          |- SCRAMBLER --------- ON / OFF
                          |
                          |- SYNC. BYTE INV.  --- ON / OFF
                          |
                          |- REED SOLOMON --- ON / OFF
                          |
                          |- CONV. INTERL. ------ ON / OFF
                          |
                          |- BIT INTERL.  ---------- ON / OFF
                          |
                          |- SYMBOL INTERL. --- ON / OFF
                          |
                          |- TPS ------------------ |- CELL ID (HEX) -------------- <wert / value>
                          |                         |- TPS RES. STATE ---------- OFF / ON
                          |                         |- TPS RES. (HEX)  ----------- <wert / value>
                          |
                          |- EDIT CARRIERS --- |- MOD. DATA CARR.-------- ON / OFF
                                               |- MOD. PILOT CARR. ------- ON / OFF
                                               |- MOD. TPS CARRIERS ---- ON / OFF
                                               |- DATA CARRIERS ---------- ON / OFF
                                               |- PILOT CARRIERS---------- ON / OFF
                                               |- TPS CARRIERS ------------ ON / OFF
                                               |- EQUAL CW CARRIERS -- OFF / ON
                                               |- DISABLE CARRIERS------ <wert / value>
```

A.4.6 ATSC VSB

```
|- INPUT SELECT------------------|- SPI
|                                |- ASI
|                                |- TS PARALLEL
|                                |- SPI EXT.CLOCK
|                                |- ASI EXT. CLOCK
|                                |- SMPTE
|                                |- SMPTE EXT. CLOCK
|
|- INPUT DATA RATE ------------<wert / value>------------------------------- <messwert / measure value >
|
|- USEFUL DATA RATE -------------------------------------------------------- <messwert / measure value >
|
|- SYMBOL RATE -----------------<wert / value>
|
|- MODE -------------------------|- DATA
|                                |- NULL TS PACKET
|                                |- NULL PRBS PACKET
|                                |- SYNC PRBS
|                                |- PRBS BEFORE TRELLIS
|                                |- PRBS AFTER TRELLIS
|
|- ROLL OFF ---------------------|- 0.115
|
|- SPECIAL ----------------------|- RANDOMIZER ------- ON/OFF
                                 |- REED SOLOMON---- ON/OFF
                                 |- INTERLEAVER ------ ON/OFF
                                 |- PILOT ------------------- ON/OFF
                                 |- PILOT VALUE -------- <wert / value>
```

A.4.7 ITU-T J.83/B

```
|- INPUT SELECT------------------|- SPI
|                                |- ASI
|                                |- TS PARALLEL
|                                |- SPI EXT.CLOCK
|                                |- ASI EXT. CLOCK
|
|- INPUT DATA RATE ------------<wert / value>------------------------------- <messwert / measure value >
|
|- USEFUL DATA RATE -------------------------------------------------------- <messwert / measure value >
|
|- SYMBOL RATE -----------------<wert / value>
|
|- MODE -------------------------|- DATA
|                                |- NULL TS PACKET
|                                |- NULL PRBS PACKET
|                                |- SYNC PRBS
|                                |- PRBS BEFORE TRELLIS
|                                |- PRBS AFTER TRELLIS
|
|- ROLL OFF ---------------------|- 0.18     (only 64 QAM)
|                                |- 0.12     (only 256 QAM)
|
|- INTERLEAVER MODE -------------|- (128, 1)  (0001, LEVEL 1+2)
|                                |- (64, 2)   (0011, LEVEL 2)
|                                |- (32, 4)   (0101, LEVEL 2)
|                                |- (16, 8)   (0111, LEVEL 2)
|                                |- (8, 16)   (1001, LEVEL 2)
|                                |- (128, 1)  (0000, LEVEL 1+2)
|                                |- (128, 2)  (0010, LEVEL 2)
|                                |- (128, 3)  (0100, LEVEL 2)
|                                |- (128, 4)  (0110, LEVEL 2)
|                                |- (128, 5)  (1000, LEVEL 2)
|                                |- (128, 6)  (1010, LEVEL 2)
|                                |- (128, 7)  (1100, LEVEL 2)
|                                |- (128, 8)  (1110, LEVEL 2)
|
|- SPECIAL ----------------------|- RANDOMIZER  ------- ON/OFF
                                 |- REED SOLOMON---- ON/OFF
                                 |- INTERLEAVER  ------ ON/OFF
```

A.4.8 ISDB-T BST-OFDM

```
|- INPUT SELECT-------------------|- SPI
|                                 |- ASI
|                                 |- TS PARALLEL + AUX
|
|- INPUT DATA RATE ------------<messwert / measure value >
|
|
|                                   LAYER A    LAYER B    LAYER C
|- USEFUL DATA RATE MAX -----------------------------------------<messwert / measure value >
|
|                                   LAYER A    LAYER B    LAYER C
|- USEFUL DATA RATE MEASURE---------------------------------<messwert / measure value >
|
|                                   LAYER A    LAYER B    LAYER C
|- MODE ------------------------------|- DATA
|                                 |- NULL TS PACKET
|                                 |- NULL PRBS PACKET
|                                 |- SYNC PRBS
|                                 |- PRBS BEFORE TRELLIS
|                                 |- PRBS AFTER TRELLIS
|
|                                   LAYER A    LAYER B    LAYER C
|- CODE RATE-----------------------|- 1/2
|                                 |- 2/3
|                                 |- 3/4
|                                 |- 5/6
|                                 |- 7/8
|
|                                   LAYER A    LAYER B    LAYER C
|- TIME INTERLEAVING ---------|- 0
|                                 |- 1
|                                 |- 2
|                                 |- 4
|                                 |- 8
|                                 |- 16
|
|- ISDB-T MODE  ------------------|- MODE1 (2K)
|                                 |- MODE2 (4K)
|                                 |- MODE3 (8K)
|
|- GUARD INTERVAL  ------------|- 1/4
|                                 |- 1/8
|                                 |- 1/16
|                                 |- 1/32
|                                 |- OFF
|
|- BANDWIDTH  --------------------|- 5.575397 MHz (MODE1)
|                                 |- 5.573413 MHz (MODE2)
|                                 |- 5.572421 MHz (MODE3)
|                                 |
|                                 |- EDIT ----------------------------<wert / value>
|
```

```
|- SPECIAL -------------------------|- SCRAMBLER -------------------------- ON/OFF
                                    |- REED SOLOMON--------------------- ON/OFF
                                    |- BYTE INTERL. ------------------------ ON/OFF
                                    |- BIT INTERL. --------------------------- ON/OFF
                                    |- FREQ. INTERL. ----------------------- ON/OFF
                                    |- ALERT BROADC. F. ----------------- ON/OFF
                                    |- PID PRBS TS PACKET ------------- |- A..C (HEX)----- <wert / value>
                                    |- EDIT CARRIERS ---------------------- |- DATA ------------ ON/OFF
                                    |                                       |- SP --------------- ON/OFF
                                    |                                       |- CP --------------- ON/OFF
                                    |                                       |- TMCC----------- ON/OFF
                                    |                                       |- MOD. DATA --- ON/OFF
                                    |                                       |- AC --------------- ON/OFF
                                    |                                       |- MOD. SP------- ON/OFF
                                    |                                       |- MOD. CP------- ON/OFF
                                    |                                       |- MOD. TMCC -- ON/OFF
                                    |                                       |- MOD. AC------- ON/OFF
                                    |- EDIT SEGMENTS -------------------- |- 0..12 ------------- ON/OFF
                                    |- AC DATA -------------------------------- |- AC1-------------- |- ALL1
                                                                            |                    |- PRBS
                                                                            |- AC2               |- ALL1
                                                                                                 |- PRBS
```

A.5 BASEBAND

```
|- VIDEO ------------------------------|- VIDEO-------------------- |- ON
|                                      |                            |- OFF
|                                      |- DEVIATION------------ <wert / value>
|                                      |- DEVIATION +/- ------- |- "+"
|                                      |                        |- "-"
|                                      |- INPUT SELECT------- |- FRONT  1M
|                                      |                      |- FRONT 75 Ω
|                                      |                      |- REAR1 X30.2        75Ω
|                                      |                      |- REAR2 X30.3        75Ω
|                                      |                      |- AUTOM. VIDEO SWITCH
|                                      |- STANDARD------------ |-PAL
|                                      |                       |-SECAM
|                                      |                       |-NTSC
|                                      |- CLAMPING ------------ |- CLAMPING-- |- ON
|                                      |                       |             |- OFF
|                                      |                       |- CLAMPING-- |- HARD
|                                      |                       |             |- SOFT
|                                      |                       |- SYNC. EXT.- |- ON
|                                      |                                      |- OFF
|                                      |-PREEMPH -------------- |- ON
|                                      |                        |- OFF
|                                      |-LOWPASS-------------- |- ON
|                                      |                       |- OFF
|                                      |- COUPLING ------------ |- AC
|                                                               |- DC          F3 = DC OFFS. CAL
|- ENERGY DISPERSIAL --------|- ENERGY DISP-------- |- ON
|                            |                      |- OFF
|                            |- DEVIATION------------ <wert / value>
|                            |- DEVIATION +/- ------- |-  "+"
|                                                    |-  " -"
|- SUBCARRIER FM --------------|--- 1 --- |- SUBCARRIER--------- |- ON
|                              |    2     |                      |- OFF
|                              |    3     |
|                              |    4     |- RF FREQENCY ------- <wert / value>
|                              |    5     |
|                              |    6     |- RF DEVIATION ------- <wert / value>
|                                         |- AUDIO INPUT --------- |- INTERN.
|                                         |                       |- EXTERN.
|                                         |- AUDIO MODE --------- |- AUDIO- ------- |-ON
|                                         |                       |                 |-OFF
|                                         |                       |- LOWPASS- ..    |-ON
|                                         |                                         |-OFF
|                                         |- AUDIO                 <wert / value>
|                                         |- AUDIO DEVIATION       <wert / value>
|                                         |- PREEMPH. ------------- |- ON
|                                         |                         |- OFF
|                                         |- PREEMPH. ------------- |- 50 µs
|                                                                   |- 75 us
|                                                                   |- J17
```

```
|-SUBCARRIER ADR - -----------|--- 1 --- |- SUBCARRIER-- -------|- ON
|                             |    2     |                      |- OFF
|                             |    3     |
|                             |    4     |- RF FREQUENCY----- <wert / value>
|                             |    .     |
|                             |    .     |- RF DEVIATION ------- <wert / value>
|                             |    .     |
|                             |    10    |- DATA SOURCE ------- |- INTERNAL
|                             |    11    |                      |- EXTERNAL  NORM. CLK
|                             |    12    |                      |  (nur bei SC ungerade / odd SC only)
|                                        |                      |- EXTERNAL  INV. CLK
|                                        |                      |  (nur bei SC ungerade / odd SC only)
|                                        |                      |- PRBS
|                                        |                      |- CW
|                                        |                      |- TEST 1
|                                        |                      |- TEST 2
|                                        |                      |- TEST 3
|                                        |
|                                        |- DATA  MODE----------|- I/Q------|- NORMAL
|                                        |                      |           |- CHANGED
|                                        |                      |
|                                        |                      |- BER----|- ON
|                                        |                      |         |- OFF
|                                        |                      |
|                                        |                      |- BER     <wert / value>
|                                        |
|                                        |-ANCILLARY DATA ----  |- OFF
|                                        |                      |- DATA1
|                                        |                      |- DATA2
|                                        |                      |- DATA3
|                                        |                      |- DATA4
|                                        |
|                                        |-GENERATOR INT. ----  |- SINGLE
|                                        |  MUSICAM MODE        |- DUAL
|                                        |                      |- STEREO
|                                        |
|                                        |- GENERATOR INT.  --  |- AUDIO FREQ. L. ------<wert / value>
|                                           AUDIO DATA          |- VOLUME L. -------------<wert / value>
|                                                               |
|                                                               |- AUDIO L. ----------------|- ON
|                                                               |                           |- OFF
|                                                               |
|         Nicht bei SINGLE: / Not with SINGLE:                  |- AUDIO FREQ. R.------<wert / value>
|         Nicht bei SINGLE: / Not with SINGLE:                  |- VOLUME R. ------------<wert / value>
|                                                               |
|         Nicht bei SINGLE: / Not with SINGLE:                  |- AUDIO R. ---------------|- ON
|                                                               |                          |- OFF
|                                                               |
|                                                               |- PREEMPHASIS -------|- ON
|                                                                                     |- OFF
|
|- NOISE -----------------------------|- NOISE------------------- ON/OFF
|                                     |
|                                     |- C/N----------------------- <wert / value>
|                                     |
|                                     |- C/N SHIFT ------------- <wert / value>
|                                     |
|                                     |- BANDWIDTH---------- <wert / value>
|
|- CW/MODULATION  ------------|- CW (RF 0NLY)
|                             |- MODULATION
```

A.6 SPECIAL

```
|- SWEEP START/STOP        |-START ---------------------------- <wert / value>
|                          |-STOP----------------------------- <wert / value>
|                          |-STEP FREQ. ---------------------- <wert / value>
|                          |-STEP TIME ----------------------- <wert / value>
|                          |-                                           F4: SWEEP  ON/OFF
|- SWEEP SPAN              |-CENTER -------------------------- <wert / value>
|                          |-SPAN----------------------------- <wert / value>
|                          |-STEP FREQ. ---------------------- <wert / value>
|                          |-STEP TIME ----------------------- <wert / value>
|                          |-                                           F4: SWEEP  ON/OFF
|
|
|- BER MEASUREMENT---- |- ON
|                      |- OFF
|- BER---------------------------- <ber>------------------------ <ber gate ratio>
|- BER INPUT ------------------ |- SERIAL-------------------- |- DATA --------- |- NORMAL
|                               |                             |                 |- INVERTED
|                               |                             |- CLOCK ------- |- NORMAL
|                               |                             |                 |- INVERTED
|                               |                             |- ENABLE------ |- ALWAYS
|                               |                             |                 |- ACTIVE HIGH
|                               |                             |                 |- ACTIVE LOW
|                               |- TS PARALLEL (AUX)          |- MODE -------- |- PRBS
|                                                             |                 |- PRBS INVERTED
|                                                             |                 |- NULL PRBS PACKET
|                                                             |          |- PID F. FOR PRBS PACKET
|                                                             |- ENABLE------ |- DVALID
|                                                                               |- ALWAYS
|- BER PRBS SEQUENCE - |- 2^23 - 1
                       |- 2^15 - 1
```

A.7 MEMORY

```
|- STORE INTERNAL.        |- STORE NO. ----------------------1 to 30
|                         |- COMMENT
|                         |- START STORE
|                         |- START DELETE
|- RECALL INTERNAL        |- RECALL NO ----------------------1 to 30
|                         |- START RECALL
|- STORE EXTERNAL.        |- STORE NO. ----------------------1 to 99
|                         |- COMMENT
|                         |- START STORE
|                         |- START DELETE
|- RECALL EXTERNAL        |- RECALL NO ----------------------1 to 99
|                         |- START RECALL
|- SPECIAL FUNCTIONS      |- FORMAT EXTERNAL----------1, 2, 4, 10, 20 MB
|                         |- REPLIC. CALIBRATION
|- SW UPDATE              |- START UPDATE
|- ADR DATA UPDATE        |- START UPDATE DATA1
                          |- START UPDATE DATA2
                          |- START UPDATE DATA3
                          |- START UPDATE DATA4
```

A.8 SETUP

```
|- HARDWARE------------- |- FUNCTION. CIRCUIT - Bild  FUNCTIONAL CIRCUIT
|                        |                      Display of block diagram
|                        |
|                        |- EQUIPMENT------------- Bild  Bestückung, STATUS
|                        |                      Display of equipment list with
|                        |                      STATUS  O.K. / ERROR etc.
|                        |
|                        |- NUMBERS --------------- Bild  Fertigungsnummern ... / Display of Order Nos...
|                        |
|                        |- CSPL CODER INFO --- START SELFTEST         <ergebnis / result>
|                        |                      ERROR DC SUPPLY        <DC Error>
|                        |
|                        |- ISDB-T CODER INFO - ERROR DC SUPPLY        <DC Error>
|                        |                      UNLOCK CAUSE           <Unlock Cause>
|                        |                      NO CLOCK CAUSE         <No Clock Cause>
|                        |                      NO DATA CAUSE          <No Data Cause>
|                        |                      OVERLOW CAUSE          <Overflow Cause>
|                        |                      PID ERROR CAUSE        <PID Error Cause>
|                        |
|                        |- CALIBRATING         |- ALL
|                                               - VCO SYNTHESIS---------<Result> --<Date>
|                                               - RF LEVEL--------------------<Result> --<Date>
|                                               - I/Q MODULATION--------<Result> --<Date>
|                                               - RF ALC LEARN TABLE -<Result> --<Date>
|                                               - CSPL AMPLITUDE -------<Result> --<Date>
|                                               - ISDB-T AMPLITUDE -----<Result> --<Date>
|                                               |- NOISE ALL -----------------<Result> --<Date>
|
|- INFO FIRMWARE---------------------------------------- Versionsnummern / version number
|
|- TIME/DATE/CLOCK--- |-TIME- ------------------------|- 12:59:00
|                     |
|                     |-DATE- ----------------------|- 31.09.1997
|                     |
|                     |-TIME/DATE FORMAT-- |- DD-MM-YYYY / 24 HOURS
|                                          |- MM-DD-YYYY / 12 HOURS
|
|- COMMUNICATION ---- |- BAUDRATE -------------- <wert / value>
|                     |
|                     |- DATABITS---------------- <wert / value>
|                     |
|                     |- STOPBITS---------------- <wert / value>
|                     |
|                     |- PARITY--------------------|- EVEN/ ODD/ZERO/ONE/NONE
|                     |
|                     |- PROTOCOLL ------------|- XON/NONE/ACK
|                     |
|                     |- IEEE ADDRESS -------- <wert / value>
|                     |
|                     |- CHANNEL- ---------------|- IEEE
|                                                - RS232
|                                                - IEEE + RS232
|                                                |- NONE
|
```

SETUP (Fortsetzung / cont'd)

```
                              |- PRESET ------------------ |- LEVEL UNIT- ------------ |- DBM
                                  |- DBUV
                                  |- MV
           - FREQ. RESOLUTION - |- .000 MHZ
                                |- .000 000 MHZ
           - 10 MHZ REFERENCE- |- INTERNAL
                               |- EXTERNAL
           - BEEPER ------------------ |- ON/OFF
           - DIAGNOSTIC------------ |- ON/OFF
           - TS CLOCK EXT. -------- |- BIT CLOCK
                                    |- BYTE CLOCK
           - FADING ------------------- |- SPEED UNIT ------ |- m/s
                                                              |- km/h
                                                              |- mph
                                        |- REFERENCE ----- |- SPEED
                                                            |- DOPPLER FREQUENCY
                                        |- POWER            |- MULTIPATH (default)
                                                            |- MAIN
           - KEYBOARD ------------- |- GERMAN
                                    |- US
           - IFFT SYNC OUTPUT - |- ON/OFF
           - PRBS SEQUENCE ---- |- 2^23 - 1
                                |- 2^15 - 1
```

SETUP (Fortsetzung / cont'd)

```
|- CHANNEL TABLE       |- USER1 --------------------|- CHANNEL
|                      |- USER2                     |- NAME
|                      |- USER3                     |
|                      |- USER4                     |
|                      |- USER5                     |
|
|-FADING PARAMETER     |- USER DEFINED 1------      |- PATH STATE ----------<wert / value[PATH 1..12]>
|                      |- USER DEFINED 2            |
|                      |- USER DEFINED 3            |- PROFILE----------------<wert / value[PATH 1..12]>
|                      |- USER DEFINED 4            |
|                      |- USER DEFINED 5            |- PATH LOSS  -----------<wert / value[PATH 1..12]>
|                      |                            |
|                      |                            |- DELAY-------------------<wert / value[PATH 1..12]>
|                      |                            |
|                      |                            |- SPEED ------------------<wert / value[PATH 1..12]>
|                      |                            |
|                      |                            |- DOPPLER FREQUENCY
|                      |                            |  -----------------------------<wert / value[PATH 1..12]>
|                      |                            |
|                      |                            |- PHASE-------------------<wert / value[PATH 1..12]>
|                      |                            |
|                      |                            |- DESCRET COMPONENT ---- <wert[PATH 1..12]>
|                      |                            |
|                      |                            |- --------------POWER RATIO --- <wert[PATH 1..12]>
|                      |                            |
|                      |                            |- ------ FREQUENCY RATIO --- <wert[PATH 1..12]>
|                      |                            |
|                      |                            |- LOG NORMAL------------------- <wert[PATH 1..12]>
|                      |                            |
|                      |                            |- -------- LOCAL CONSTANT --- <wert[PATH 1..12]>
|                      |                            |
|                      |                            |- ------------ STD DEVIATION --- <wert[PATH 1..12]>
|                      |
|                      |- F4: PRESET -------------  |- DVB --------------------------------  | EASY3
|                                                   |                                        | 0 dB ECHO
|                                                   |                                        | FX ECHO
|                                                   |                                        | PT ECHO
|                                                   |                                        | SFN ECHO
|                                                   |                                        | TU6
|                                                   |                                        | RA6
|                                                   |                                        | RC6 ANX B
|                                                   |                                        | RL6 ANX B
|                                                   |                                        | RED HT100
|                                                   |                                        | ET50
|                                                   |                                        | VALIDATE100
|                                                   |                                        | RC12 ANX B
|                                                   |                                        | RL12 ANX B
|                                                   |                                        | TU3 12PATH
|                                                   |                                        | TU50 12PATH
|                                                   |                                        | HT100 12PATH
|                                                   |
|                                                   |- ATTC ------------------------------  | A APP A
|                                                                                            | B APP A
|                                                                                            | C APP A
|                                                                                            | D APP A
|                                                                                            | E APP A
|                                                                                            | F APP A
|                                                                                            | G APP A
|                                                                                            | 15us APP B
|                                                                                            | 1 APP C
|                                                                                            | 2 APP C
|                                                                                            | 3 APP C
```

SETUP (Fortsetzung / cont'd)

```
|- SERVICE ----------------- |- SOFTWARE OPTIONS
                             |
                             |- DIAGNOSTICS---------- |- ADDRESS ----------------<wert / value>
                             |                        |- POINT ---------------------<wert / value>--<Result>
                             |
                             |- DIVERSITY OFFSET -- |- OFFSET I -----------------<wert / value>
                             |                        |- OFFSET Q ----------------<wert / value>
                             |
                             |- 10 MHz ADJUST--------<wert / value>
                             |
                             |- NOISE C/N CAL.--------<wert / value>
                             |
                             |- PASSWORD-------------<wert / value>
```

Anhang/Annex B Fading Parameter

B.1 DVB-Profile

B.1.1 Übersicht / Overview

Cluster	Name	Erläuterung / Explanation	SCPI	Quelle / Source	Geändert / Modified	Version
DVB	EASY3	MOTIVATE WG: EASY, 3km/h	EASY3	**DVB-T Mobile Profile (SFN)**	**ITIS in Darmstadt**	
DVB	0 dB ECHO	ETSI TR101 290: 0 dB ECHO, Tg/2=112us, 50 km/h	ECHO	**ETSI TR101 290**		**ab 01.22**
DVB	**FX ECHO**	**ETSI TR101 290: ECHO, FIXED RECEPTION**	**FX_echo**	ETSI TR101 290		ab 01.22
DVB	**PT ECHO**	**ETSI TR101 290: ECHO, PORTABLE RECEPTION**	**PT_echo**	ETSI TR101 290		ab 01.22
DVB	**SFN ECHO**	**ETSI TR101 290: ECHO, DENSE SFN**	**SFN_echo**	ETSI TR101 290		ab 01.22
DVB	***REGULAR TU50*** **TU6**	***REGULAR, REDUCED TYPICAL URBAN, 50 km/h*** ETSI TR101 290: TYPICAL URBAN, 50 km/h	***REGular_tu50*** **|| TU6**	***COST 207 (DAB und GSM)*** ETSI TR101 290	**Reduced by R&S**	**bis 01.20** ab 01.22
DVB	***DIFFICULT RA250*** **RA6**	***DIFFICULT, RURAL AREA, 250 km/h*** **ETSI TR101 290:TYPICAL RURAL AREA, 100 km/h**	***DIFFicult_ra*** **|| RA6**	*COST 207 (GSM)* ETSI TR101 290		**bis 01.20** ab 01.22
DVB	RC6 ANX B	EN300744: ANNEX B / RICE 6 PATHS	RC6_anx_b	**EN 300 744, Annex B**		**ab 01.22**
DVB	RL6 ANX B	EN300744: ANNEX B / RAYLEIGH 6 PATHS	RL6_anx_b	**EN 300 744, Annex B**		**ab 01.22**
DVB	RED HT100	COST207: REDUCED HILLY TERRAIN, 100 km/h	RED_ht100	**COST 207 (GSM)**	**Reduced by R&S**	
DVB	**ET50**	**COST207: EQUALIZATION TEST, 50 km/h**	**ET50**	COST 207 (GSM)		
DVB	**VALIDATE100**	**VALIDATE: RECOMMENDATION: 100 km/h**	**VALidate100**	Arbeitsgruppe Validate		
DVB	*RED6 DVB-T*	REDUCED DVB-T ANNEX B, 6 PATHS	***RED6_dvb_t***	***EN 300 744, Annex B***	*Reduced by R&S*	*bis 01.20*
DVB	RC12 ANX B	EN300744: ANNEX B / RICE 12 PATHS	RC12_anx_b	**EN 300 744, Annex B**		**ab 01.22**
DVB	RL12 ANX B	EN300744: ANNEX B / RAYLEIGH 12 PATHS	RL12_anx_b	**EN 300 744, Annex B**		**ab 01.22**
DVB	***RED12 DVB-T***	***REDUCED DVB-T ANNEX B, 12 PATHS***	***RED12_dvb_t***	***EN 300 744, Annex B***	***Reduced by R&S***	***bis 01.20***
DVB	**TU3 12PATHS**	**COST207: TYPICAL URBAN, 3 km/h, 12 PATHS**	**TU3_12path**	COST 207 (GSM)		
DVB	**TU50 12PATHS**	COST207: TYPICAL URBAN, 50 km/h, 12 PATHS	**TU50_12path**	COST 207 (GSM)		
DVB	**HT100 12PATHS**	COST207: HILLY TERRAIN, 100 km/h, 12 PATHS	**HT100_12path**	COST 207 (GSM)		

B.1.2 USER DEFINED 1-5

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.3 EASY3 - MOTIVATE WG: EASY, 3 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: 6

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	P. DOPPLER	P. DOPPLER	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	3.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	28.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	2.8 Hz	2.8 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	-1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

Hinweis Das DELAY von PATH 2 ist bei DVB-T COFDM = ½ * Tg, wobei Tg = GUARD INTERVAL * Tsymbol.
Tsymbol (FFT MODE = 2k) = 224 µs und Tsymbol (FFT MODE = 8k) = 896 µs.

Note: The DELAY of PATH 2 for DVB-T is COFM = ½ x Tg, where Tg = GUARD INTERVAL x Tsymbol.
Tsymbol (FFT MODE = 2k) = 224 µs and Tsymbol (FFT MODE = 8k) = 896 µs.

B.1.4 0 dB ECHO - ETSI TR101 290: 0 dB ECHO, Tg/2=112us, 50 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: **2**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	P. DOPPLER	P. DOPPLER	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	.0,0dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.0 µs	112 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	46.3 Hz	46.3 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0°	0°	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	-1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.5 FX ECHO - ETSI TR101 290: ECHO, FIXED RECEPTION

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	17.8 dB	17.9dB	19.1 dB	20.4 dB	20.6 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.50 µs	1.95 µs	3,25 µs	2.75 µs	0.45 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.6 PT ECHO - ETSI TR101 290: ECHO, PORTABLE RECEPTION

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	7,8dB	7.9 dB	9.1dB	10.4 dB	10.6 dB	11.6 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.50 µs	1.95 µs	3,25 µs	2.75 µs	0.45 µs	0.85 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.7 SFN ECHO - ETSI TR101 290: ECHO, DENSE SFN

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	9.3 dB	5.5dB	16.1 dB	14.5 dB	23.4 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	7.80 µs	11.60 µs	17.50 µs	20.00 µs	23,40 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.8 TU6 - ETSI TR101 290: TYPICAL URBAN, 50 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	3.0 dB	0.0 dB	2.0 dB	6.0 dB	8.0 dB	10.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.20 µs	0.50 µs	1.60 µs	2.30 µs	5.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.9 RA6 - ETSI TR101 290: TYPICAL RURAL AREA, 100 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	RICE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	4.0 dB	8.0 dB	12.0 dB	16.0 dB	20.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.10 µs	0.20 µs	0.30 µs	0.40 µs	0.50 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	92.7 Hz	92.7 Hz	92.7 Hz	92.7 Hz	92.7 Hz	92.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	6,47 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.10RC6 ANX B - EN300744: ANNEX B / RICE 6 PATH

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.4dB	16.2 dB	18.8 dB	16.3 dB	19.0 dB	17.5 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.0 µs	0.50 µs	2.75 µs	1.95 µs	0,45 µs	3.25 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0.0 °	336.0 °	127.0 °	8,8 °	339,7 °	174,9 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.11RL6 ANX B - EN300744: ANNEX B / RAYLEIGH 6 PATH

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	6.2 dB	8.8 dB	6.4 dB	9.0 dB	7.5 dB	10.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.50 µs	2.75 µs	1.95 µs	0,45 µs	3.25 µs	0,85 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	336 0°	127 0°	8,8 °	339,7 °	174,9 °	36 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.12RED HT100 - COST 207: REDUCED HILLY TERRAIN, 100 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	1.5 dB	4.5 dB	7.5 dB	8.0 dB	17.7 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.10 µs	0.30 µs	0.50 µs	15.00 µs	17.20 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.13ET50 - COST 207: EQUALIZATION TEST, 50 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	3.20 µs	6.40 µs	9.60 µs	12.80 µs	16.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.14VALIDATE100 - VALIDATE: RECOMMENDATION, 100 km/h

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	2.8 dB	0.0 dB	3.8 dB	0.1 dB	2.6 dB	1.3 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.05 µs	0.40 µs	1.45 µs	2.30 µs	2.80 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.15RED6 DVB-T - REDUCED DVB-T ANNEX B, 6 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Hinweis: *Nur bis Version 01.20*
Note: Only up to version 01.20

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	3.9 dB	4.0 dB	4.5 dB	5.2 dB	5.3 dB	5.8 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.50 µs	1.95 µs	3.25 µs	2.75 µs	0.45 µs	0.85 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	336.0 °	8.9 °	174.9 °	127.0 °	339.7 °	36.0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.16RC12 ANX B - COST 207: ANNEX B / RICE 12 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **12**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE
PATH LOSS	0.4dB	18.0 dB	20.6 dB	22.0 dB	18.2 dB	20.8 dB	19.3dB	21.8dB	23.1 dB	22.6 dB	23.3 dB	24.9 dB
DELAY	0.0 µs	0.50 µs	2.75 µs	0,60 µs	1.95 µs	0.45 µs	3.25 µs	0.85 µs	0,05 µs	0,90 µs	0.65 µs	3.30 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0.0 °	336.0 °	127.0 °	215.3 °	8.8 °	339.7 °	174.9 °	36.0 °	122.0 °	210.0 °	191.0 °	330.9 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.17RL12 ANX B - COST 207: ANNEX B / RAYLEIGH 12 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **12**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
PROFILE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE	C. PHASE
PATH LOSS	7.9 dB	10,5 dB	11.8 dB	14.8 dB	8.0 dB	10.7 dB	9,2 dB	11,7 dB	13.0 dB	12.5 dB	13.2 dB	11.8 dB
DELAY	0.50 µs	2.75 µs	0.60 µs	3.30 µs	1.95 µs	0.45 µs	3.25 µs	0.85 µs	0,05 µs	0,90 µs	0.65 µs	1,35 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	336.0 °	127.0 °	215.3 °	330.9 °	8.8 °	339.7 °	174.9 °	36.0 °	122.0 °	210.0 °	191.0 °	22.6 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.18RED12 DVB-T - REDUCED DVB-T ANNEX B, 12 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **12**

Hinweis: *Nur bis Version 01.20*
Note: Only up to version 01.20

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST
PATH LOSS	3.9 dB	4.0 dB	4.5 dB	5.2 dB	5.3 dB	5.8 dB	5.9 dB	5.9 dB	6.2 dB	6.5 dB	6.6 dB	7.5 dB
DELAY	0.50 µs	1.95 µs	3.25 µs	2.75 µs	0.45 µs	0.85 µs	1.35 µs	0.60 µs	0.90 µs	0.05 µs	0.65 µs	5.40 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz
PHASE	336.0 °	8.9 °	174.9 °	127.0 °	339.7 °	36.0 °	22.6 °	215.3 °	210.0 °	122.0 °	191.8 °	195.9 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.19TU3 12PATHS - COST 207: TYPICAL URBAN, 3 km/h, 12 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **12**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	4.0 dB	3.0 dB	0.0 dB	2.0 dB	3.0 dB	5.0 dB	7.0 dB	5.0 dB	6.0 dB	9.0 dB	11.0 dB	10.0 dB
DELAY	0.00 µs	0.20 µs	0.40 µs	0.60 µs	0.80 µs	1.20 µs	1.40 µs	1.80 µs	2.40 µs	3.10 µs	3.20 µs	5.00 µs
SPEED	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h	0.8 m/s 3.0 km/h
DOPPLER FREQ	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz	2.8 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.20TU50 12PATHS - COST 207: TYPICAL URBAN, 50 km/h, 12 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **12**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	4.0 dB	3.0 dB	0.0 dB	2.6 dB	3.0 dB	5.0 dB	7.0 dB	5.0 dB	6.5 dB	8.6 dB	11.0 dB	10.0 dB
DELAY	0.00 µs	0.10 µs	0.30 µs	0.50 µs	0.80 µs	1.10 µs	1.30 µs	1.70 µs	2.30 µs	3.10 µs	3.20 µs	5.00 µs
SPEED	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h	13.9 m/s 50.0 km/h
DOPPLER FREQ	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz	46.3 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.1.21HT100 12PATHS - COST 207: HILLY TERRAIN, 100 km/h, 12 PATHS

Erforderliche Anzahl von Pfaden / Necessary number of paths: **12**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 2	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
PROFILE	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	10.0 dB	8.0 dB	6.0 dB	4.0 dB	0.0 dB	0.0 dB	4.0 dB	8.0 dB	9.0 dB	10.0 dB	12.0 dB	14.0 dB
DELAY	0.00 µs	0.10 µs	0.30 µs	0.50 µs	0.70 µs	1.00 µs	1.30 µs	15.00 µs	15.20 µs	15.70 µs	17.20 µs	20.00 µs
SPEED	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h	27.8 m/s 100.0 km/h
DOPPLER FREQ	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz	92,7 Hz
PHASE	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2 ATTC-Profile

B.2.1 Übersicht / Overview

Cluster	Name	Erläuterung / Explanation	SCPI	Quelle / Source	Geändert / Modified	Version
ATTC	**A APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE A**	**AA_Static**	ATTC		ab 01.24
ATTC	**B APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE B**	**AB_Static**	ATTC		ab 01.24
ATTC	**C APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE C**	**AC_Static**	ATTC		ab 01.24
ATTC	**D APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE D**	**AD_Static**	ATTC		ab 01.24
ATTC	**E APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE E**	**AE_Static**	ATTC		ab 01.24
ATTC	**F APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE F**	**AF_Static**	ATTC		ab 01.24
ATTC	**G APP A**	**ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE G**	**AG_Static**	ATTC		ab 01.24
ATTC	**15us APP B**	**ATTC ECHO REJECTION APPENDIX B 15us ECHO**	**B_ECho**	ATTC		ab 01.24
ATTC	**1 APP C**	**ATTC RANDOM APPENDIX C ENSEMBLE 1**	**C1_Random**	ATTC		ab 01.24
ATTC	**2 APP C**	**ATTC RANDOM APPENDIX C ENSEMBLE 2**	**C2_Random**	ATTC		ab 01.24
ATTC	**3 APP C**	**ATTC RANDOM APPENDIX C ENSEMBLE 3**	**C3_Random**	ATTC		ab 01.24

B.2.2 A APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE A

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	20.0 dB	20.0 dB	10.0 dB	14.0 dB	18..0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	1.80 µs	0.00 µs	1.95 µs	3.60 µs	7.50 µs	19.80 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	188 °	260 °	332 °	44 °	116 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.3 B APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE B

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	20.0 dB	20.0 dB	10.0 dB	14.0 dB	18.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	1.75 µs	0.00 µs	1.95 µs	3.60 µs	7.50 µs	19.70 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	208 °	280 °	352 °	64 °	136 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.4 C APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE C

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	18.0 dB	20.0 dB	20.0 dB	10.0 dB	14.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	1.80 µs	0.00 µs	1.95 µs	3.60 µs	7.50 µs	19.80 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	188 °	260 °	332 °	44 °	116 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.5 D APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE D

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	20.0 dB	20.0 dB	18.0 dB	14.0 dB	10.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	1.80 µs	0.00 µs	1.95 µs	3.60 µs	7.50 µs	19.80 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	188 °	260 °	332 °	44 °	116 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.6 E APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE E

Erforderliche Anzahl von Pfaden / Necessary number of paths: 6

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	20.0 dB	14.0 dB	10.0 dB	20.0 dB	18.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	1.80 µs	0.00 µs	1.95 µs	3.60 µs	7.50 µs	19.80 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	188 °	260 °	332 °	44 °	116 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.7 F APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE F

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	20.0 dB	20.0 dB	10.0 dB	14.0 dB	18.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.20 µs	1.90 µs	3.90 µs	8.20 µs	15.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	90 °	0 °	72 °	144 °	216 °	288 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.8 G APP A - ATTC STATIC MULTIPATH APPENDEX A ENSEMBLE G

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	19.0 dB	22.0 dB	17.0 dB	22.0 dB	19.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.20 µs	0.00 µs	0.28 µs	0.35 µs	0.50 µs	0.80 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	75 °	220 °	260 °	330 °	125 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.9 15us APP B - ATTC ECHO REJECTION APPENDIX B 15us ECHO

Erforderliche Anzahl von Pfaden / Necessary number of paths: **2**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	10.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	15.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	340 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.101 APP C - ATTC RANDOM APPENDIX C ENSEMBLE 1

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	2.2 dB	12.1 dB	16.4 dB	9.7 dB	14.6 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.05 µs	0.05 µs	0.05 µs	0.10 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	74 °	321 °	286 °	339 °	331 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.112 APP C - ATTC RANDOM APPENDIX C ENSEMBLE 2

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	5.6 dB	6.1 dB	6.9 dB	14.8 dB	12.2 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.05 µs	0.05 µs	0.10 µs	0.05 µs	0.10 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	326 °	151 °	299 °	298 °	235 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

B.2.123 APP C - ATTC RANDOM APPENDIX C ENSEMBLE 3

Erforderliche Anzahl von Pfaden / Necessary number of paths: **6**

Preset Werte (F4) sind 5% Grau schattiert
Preset values (F4) are 5% grey

	PATH 1	PATH 2	PATH 3	PATH 4	PATH 5	PATH 6	PATH 7	PATH 8	PATH 9	PATH 10	PATH 11	PATH 12
PATH STATE	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
PROFILE	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	PHASE CONST	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH	RAYLEIGH
PATH LOSS	0.0 dB	2.4 dB	10.5 dB	4.7 dB	16.4 dB	7.3 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
DELAY	0.00 µs	0.05 µs	0.05 µs	0.05 µs	0.05 µs	0.10 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs	0.00 µs
SPEED	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h	20 m/s 72 km/h
DOPPLER FREQ	66,7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
PHASE	0 °	118 °	39 °	283 °	16 °	261 °	0 °	0 °	0 °	0 °	0 °	0 °
DESCREET COMP STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
POWER RATIO	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB
FREQ. RATIO	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
LOG NORMAL STATE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
LOCAL CONST	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m	200.0 m
STD DEV	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB	0.0 dB

Annex C SFQ - Z17 Common Interface TS OUT

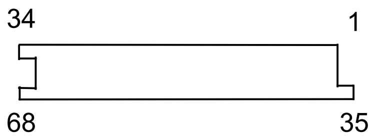
The common interface adapter card SFQ-Z17 (VAR 02) can be inserted into the common interface slot of a set-top box.

At the common interface of the set-top box the MPEG-2 transport stream is available with TTL or LVTTL logic level.

The adapter card converts this logic level to LVDS (low voltage differential signalling) signals. The LVDS signals are then available at a 25-contact sub-D connector (contact assignment: EN 50083-9) via a cable supplied with the adapter card.

The MPEG-2 signal can be applied to the SFQ (BER measurement) or routed to an MPEG-2 decoder, e.g. DVMD, via a standard parallel cable (25-contact sub-D connector/25-contact sub-D connector).

C.1 Counting of Pins (Front view of SFQ - Z17)



C.2 Pin Assignment

COMMON INTERFACE (DVB Document A017) and connected pins of COMMON INTERFACE TS OUT SFQ-Z17:

Common interface				SFQ-Z17			
Pin	**Signal**	**I/O**	**Function**	**Pin**	**Signal**	**I/O**	**Function**
1	GND		Ground	1	GND		Ground
2	D3	I/O	Data bit 3	2	nc		
3	D4	I/O	Data bit 4	3	nc		
4	D5	I/O	Data bit 5	4	nc		
5	D6	I/O	Data bit 6	5	nc		
6	D7	I/O	Data bit 7	6	nc		
7	CE1#	I	Card enable 1	7	nc		
8	A10	I	Address bit 10	8	nc		
9	OE#	I	Output enable	9	nc		
10	A11	I	Address bit 11	10	nc		
11	A9	I	Address bit 9	11	nc		
12	A8	I	Address bit 8	12	nc		
13	A13	I	Address bit 13	13	nc		
14	A14	I	Address bit 14	14	nc		
15	WE#	I	Write enable	15	nc		
16	IREQ#	O	Interrupt request	16	nc		
17	VCC		Vcc	17	VCC	I	Vcard (+5.5 to +3 V)
18	VPP1		Program voltage 1	18	VPP1	I	Vcard (+5.5 to +3 V)
19	MIVAL	I	MP in valid	19	DVALID	I	MPEG2 DVALID
20	MCLKI	I	MPEG2 clock input	20	CLK	I	MPEG2 CLOCK
21	A12	I	Address bit 12	21	nc		
22	A7	I	Address bit 7	22	nc		
23	A6	I	Address bit 6	23	nc		
24	A5	I	Address bit 5	24	nc		
25	A4	I	Address bit 4	25	nc		
26	A3	I	Address bit 3	26	nc		
27	A2	I	Address bit 2	27	nc		
28	A1	I	Address bit 1	28	nc		
29	A0	I	Address bit 0	29	nc		
30	D0	I/O	Data bit 0	30	nc		
31	D1	I/O	Data bit 1	31	nc		
32	D2	I/O	Data bit 2	32	nc		
33	IOIS16#		16-bit I/O (always high)	33	nc		
34	GND		Ground	34	GND		Ground
35	GND		Ground	35	GND		Ground
36	CD1#	O	Card detect 1	36	CD1#	O	Ground card detect 1

Common interface			
Pin	**Signal**	**I/O**	**Function**
37	MDO3	O	MP data out 3
38	MDO4	O	MP data out 4
39	MDO5	O	MP data out 5
40	MDO6	O	MP data out 6
41	MDO7	O	MP data out 7
42	CE2#	I	Card enable 2
43	VS1#	O	Voltage sense 1
44	IORD#	I	I/O read
45	IOWR#	I	I/O write
46	MISTRT	I	MP in start
47	MDI0	I	MP data in 0
48	MDI1	I	MP data in 1
49	MDI2	I	MP data in 2
50	MDI3	I	MP data in 3
51	VCC		Vcc
52	VPP2		Program voltage 2
53	MDI4	I	MP data in 4
54	MDI5	I	MP data in 5
55	MDI6	I	MP data in 6
56	MDI7	I	MP data in 7
57	MCLKO	O	MPEG2 clock output
58	RESET	I	Card reset
59	WAIT#	O	Extend bus cycle
60	INPACK#	O	Input port ack
61	REG#	I	Register select
62	MOVAL	O	MP out valid
63	MOSTRT	O	MP out start
64	MDO0	O	MP data out 0
65	MDO1	O	MP data out 1
66	MDO2	O	MP data out 2
67	CD2#	O	Card detect 2
68	GND		Ground

SFQ-Z17			
Pin	**Signal**	**I/O**	**Function**
37	nc		
38	nc		
39	nc		
40	nc		
41	nc		
42	nc		
43	nc		
44	nc		
45	nc		
46	PSYNC	I	MPEG2 PSYNC
47	D0	I	MPEG2 D0
48	D1	I	MPEG2 D1
49	D2	I	MPEG2 D2
50	D3	I	MPEG2 D3
51	VCC	I	Vcard (+5.5 to +3 V)
52	VPP2	I	Vcard (+5.5 to +3 V)
53	D4	I	MPEG2 D4
54	D5	I	MPEG2 D5
55	D6	I	MPEG2 D6
56	D7	I	MPEG-2 D7
57	nc		
58	nc		
59	nc		
60	nc		
61	nc		
62	nc		
63	nc		
64	nc		
65	nc		
66	nc		
67	CD2#	O	Ground card detect 2
68	GND		Ground

C.2.1 Pin Assignment of 25-Contact Sub-D Connector on the Cable of SFQ-Z17

Pin	Signal line	Pin	Signal line
1	Clock A	14	Clock B
2	System Gnd	15	System Gnd
3	Data 7 A(MSB)	16	Data 7 B
4	Data 6 A	17	Data 6 B
5	Data 5 A	18	Data 5 B
6	Data 4 A	19	Data 4 B
7	Data 3 A	20	Data 3 B
8	Data 2 A	21	Data 2 B
9	Data 1 A	22	Data 1 B
10	Data 0 A	23	Data 0 B
11	DVALID A	24	DVALID B
12	PSYNC A	25	PSYNC B
13	Cable shield		

3 Remote Control

3.1 Introduction

The SFQ is fitted as standard with an IEC/IEEE-bus interface in line with the IEC 625.1/IEEE 488.2 standard. The connector is located on the rear panel. A controller can be connected for remote control. The SFQ supports the SCPI version 1995.0 (Standard Commands for Programmable Instruments). The SCPI standard is based on the IEEE 488.2 standard and its goal is a standardization of the device-specific commands, error handling and status registers (see section 3.5.1).

Basic knowledge of IEC/IEEE-bus programming and operation of the controller is required for a clear understanding of this Chapter. A description of the interface commands is to be taken from the relevant manuals.

The requirements placed by the SCPI standard on the command syntax, error handling and configuration of the status registers are described in detail in the relevant sections. Tables provide a quick overview of the commands implemented in the instrument and the assignment of the bits in the status registers. The tables are supplemented by a detailed description of each command and of the status registers.

3.2 Brief Instructions

The following brief and simple operating instructions allow the instrument to be quickly put into operation and to set the basic functions. It is assumed however that the IEC/IEEE-bus address factory-set to 20 has not been changed.

1. Connect SFQ and controller using the IEC/IEEE-bus cable.

2. Generate and start the following program on the controller:

`CALL IBDEV(0, 28, 12, 0, 0x100a, generator%)`	Open channel to device
`CALL IBPAD(generator%, 28)`	Send device address to controller
`CALL IBWRT(generator%, "*rst;*cls")`	Reset device
`CALL IBWRT(generator%, "sour:freq:chan 2")`	Select user-defined TV channel 2
`CALL IBWRT(generator%, "sour:pow -10 dBm")`	Select output power

A German-standard TV signal on channel 2 is available at the output of the SFQ with an output power of -10 dBm.

3. Return to manual operation: Press [LOCAL] key on the front panel.

3.3 Switchover to Remote Control

On power up, the SFQ is always in the manual control mode (LOCAL state) and can be operated from the front panel. Switchover to remote control (REMOTE state) is effected as soon as the SFQ receives an addressed command from a controller. In the remote-control mode, operation from the front panel is inhibited. The SFQ remains in the REMOTE state until it is switched back to the manual control mode either from the front panel or via the IEC/IEEE bus (see section 3.3.3). Switchover from the manual mode to remote control and vice versa has no effect on the device settings.

3.3.1 Setting the Device Address

The factory-set IEC/IEEE-bus address is 28. The address can be changed either manually in the SETUP menu or via the IEC/IEEE bus. Addresses between 0 and 30 can be selected.

Manually:

- Press [SETUP / INFO] key
- Select COMMUNICATION menu
- Select IEEE ADDRESS
- Press [ENTER] key
- Enter desired address
- Terminate entry with [ENTER] key

Via IEC/IEEE bus:

`CALL IBFIND("DEV1", generator%)`	Open channel to device
`CALL IBPAD(generator%, 28)`	Send old address to controller
`CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 17")`	Set device to new address
`CALL IBPAD(generator%, 17)`	Send new address to controller

3.3.2 Displays in Remote-Control Mode

The remote-control status is indicated on the front panel by the LEDs labelled REMOTE and LLO. In the REMOTE status a REMOTE message is indicated on the display and the REMOTE LED lights. The LLO LED lights if the instrument is in the local lockout state and does not respond to the [LOCAL] key.

Note: *If the main parameters and the display of special messages should be updated on the display with each remote-control command, command SYSTem:DISPlay:UPDate[:STATe] ON has to be entered first.*

3.3.3 Return to Manual Control

Return to manual control can be made via the front panel or via the IEC/IEEE bus.

Manually: ➢Press the [LOCAL] key

Note:

– Prior to the switchover the commands must have been fully processed since otherwise remote control is immediately switched on again.

– The [LOCAL] key can be locked by the universal command `LLO` (see Appendix A3) in order to prevent inadvertent switchover. It is then only possible to switch to manual control via the IEC/IEEE bus.

– Locking of the [LOCAL] key can be cancelled by deactivating the "REN" line of the IEC/IEEE bus (see Appendix A3).

Via IEC/IEEE bus:...

`CALL IBLOC(generator%)`	Set instrument to manual control
...	

3.4 IEC/IEEE-Bus Messages

The messages transmitted on the data lines of the IEC/IEEE bus (see Appendix A3) can be subdivided into two groups:

- **interface messages** and
- **device-dependent messages.**

3.4.1 Interface Messages

Interface messages are transmitted on the data lines of the IEC/IEEE bus, with the control line "ATN" being active. They are used for communication between the controller and the instrument and can only be sent by a controller with controller function on the IEC/IEEE bus.
There are two groups of interface messages:

- **common commands** and
- **addressed commands**.

Common commands affect all devices connected to the IEC/IEEE bus without any addressing being required, whereas addressed commands only affect devices addressed as a listener. The relevant interface messages are listed in Appendix A3.

3.4.2 Device-Dependent Messages (Commands and Responses)

The device-dependent messages are transmitted on the data lines of the IEC/IEEE bus, with the control line "ATN" being not active. The ASCII code is used for data transmission. Device-dependent messages are differentiated according to the direction in which they are sent via the IEC/IEEE bus:

- **Commands** are messages sent by the controller to the device. They control the device functions and request information.
  The commands are differentiated according to two criteria:

  1. According to the effect they have on the device:

     Setting commands trigger device settings, eg resetting of the instrument or setting the output level to 1 Volt.

     Queries cause data to be provided for output via the IEC/IEEE bus, eg for device identification or query of the active input.

  2. According to their definition in the IEEE 488.2 standard:

     Common Commands are precisely defined in their function and notation in the IEEE 488.2 standard. They refer to functions as for instance the management of the standardized status registers, resetting and selftest.

     Device-specific commands refer to functions that depend on the device characteristics, such as frequency setting. A large number of these commands has also been standardized by the SCPI Consortium (see section 3.5.1).

- **Responses** are messages sent by the device to the controller following a query. They may contain results, device settings or information about the device status (see section 3.5.4).

Structure and syntax of the device-dependent messages are described in Section 3.5. The commands are listed and explained in Section 3.6.

3.5 Structure and Syntax of Device-Dependent Messages

3.5.1 SCPI Introduction

SCPI (Standard Commands for Programmable Instruments) describes a standardized command set for the programming of devices regardless of the type of instrument or manufacturer. The goal of the SCPI Consortium is to standardize device-specific commands to a large extent. For this purpose an instrument model has been developed which defines identical functions within an instrument or of different instruments. Command systems have been generated and assigned to these functions so that it is possible to address identical functions by the same commands. The command systems have a hierarchical structure. Fig. 3-1 shows this tree structure, using a detail from the SOURce command system for controlling the signal sources of the instrument. The other examples of syntax and structure of the commands are mainly taken from this command system.

SCPI is based on the IEEE 488.2 standard, ie it uses the same syntax elements as well as the "common commands" defined therein. The syntax of the responses is partly subjected to stricter rules than laid down in the IEEE 488.2 standard (see section 3.5.4, Responses to Queries).

3.5.2 Command Structure

The commands consist of a so-called header and usually one or several parameters. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, eg space = 32 decimal). The headers may be composed of several keywords. The query form is generated by appending a question mark directly to the header.

Common Commands

Common commands consist of an a header to which an asterisk "*" is prefixed and one or several parameters.

Example:

`*RST`	RESET, resets the device.
`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the Event Status Enable Register.
`*ESR?`	EVENT STATUS QUERY, queries the contents of the Event Status Register.

Device-specific commands

Hierarchy:

Device-specific commands have a hierarchical structure (see Fig. 3-1). The various levels are represented by compound headers. Headers of the highest level (root level) have one keyword only. This keyword stands for a whole command system.

Example: `SOURce` This keyword denotes the command system `SOURce`.

For lower-level commands the full path has to be specified, starting with the highest level in the left-most position. The individual keywords are separated by a colon ":".

Example: `SOURce:MODulator:STATe OFF`

This command is at the third level of the SOURce system.
It switches the RF output off.

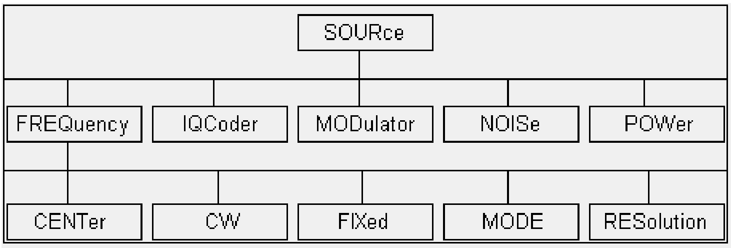


Fig. 3-1 Tree structure of SCPI command system, SOURce being shown as an example

Optional keywords: In some command systems it is possible to insert or to omit certain keywords. These keywords are shown in the instrument manual in square brackets. For reasons of compatibility with the SCPI standard, the instrument must be able to recognize the full command length. Some of the commands become considerably shorter when the optional keywords are omitted.

Example: `SOURce:MODulator[:STATe] ON`

The following command has the same effect:

`SOURce:MODulator ON`

Note:	*An optional keyword may not be omitted if its effect is specified in more detail by a numeric suffix.*

Long and short form: The keywords have a long and a short form. The keyword may be entered in short or in long form, other abbreviations are not allowed.

Example: `STATus:QUEStionable:ENABle 1= STAT:QUES:ENAB 1`

Note:	*The short form uses uppercase characters, the long form gives the whole keyword. Uppercase and lowercase letters are only used for identification in the instrument manual, the instrument itself does not differentiate between uppercase and lowercase characters.*

Parameter: The parameter must be separated from the header by a "white space". If a command contains several parameters, these have to be separated by a comma ",". Some of the queries allow the specification of the parameters MINimum, MAXimum and DEFault. For a description of the various types of parameter see section 3.5.5.

Example: `SOURce:POWer:LEVel? MINimum`

Response: `-9,900000e+01`

This query returns the maximum value for the attenuation.

Numeric suffix: If an instrument has several identical functions or features, eg inputs, the desired function can be selected by a suffix to the command. Commands given without suffix are interpreted as having suffix 1.

Example: `SOURce:FM:SUBCarrier:FM1:PREemphasis:STATe ON`
This command switches on the preemphasis of FM subcarrier 1.

3.5.3 Structure of a Command Line

A command line may contain one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. QuickBASIC automatically generates an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:
```
CALL IBWRT(generator%,"SOURce:POWer MAXimum;
:OUTPut:STATe ON")
```

This command line contains two commands. The first command belongs to the SOURce system and is used to set the output line to maximum value. The second command belongs to the OUTPut system and through-connects the output signal to the output connector.

If the successive commands belong to the same system and therefore have one or several common levels, the command line may be shortened. The second command following the semicolon then starts at the level that is below the common levels (see also Fig. 3-1). The colon after the semicolon has to be omitted.

Example:
```
CALL IBWRT(generator%, "SOURce:IQCoder:QPSK:RATE R3_4;
:SOURce:IQCoder:QPSK:ROLLoff 0.35")
```

This command line is shown in full length and contains two commands separated by a semicolon. Both commands belong to the SOURce command system, IQCoder:QPSK subsystem, ie they have two common levels.
In the shortened command line the second command starts at the level below SOURce: IQCoder:QPSK. The colon after the semicolon has to be omitted.

The shortened form of the command line is:

```
CALL IBWRT(generator%," SOURce:IQCoder:QPSK:RATE R3_4; ROLLoff 0.35")
```

A new command line always starts with the full path however.

Example:
```
CALL IBWRT(generator%,  "SOURce:IQCoder:QPSK:RATE R3_4")
CALL IBWRT(generator%,  "SOURce:IQCoder:QPSK:ROLLoff 0.35")
```

3.5.4 Responses to Queries

Unless otherwise expressly specified, a query is defined for each setting command. The query is generated by appending a question mark to the associated setting command. The SCPI rules imposed on the query responses are somewhat stricter than those of the IEEE 488.2 standard:

1. The required parameter is sent without header.

   Example: `SYSTem:FREQency:RESolution?` Response: `LOW`

2. Maximum and minimum values as well as all further quantities requested by a special text parameter are returned as numeric values.

Example: `SOURCe:FREQuency? MAX` Response: `3.300000e+09`

2. Maximum and minimum values as well as all further quantities requested by a special text parameter are returned as numeric values.

   Example: `SOURce:FREQuency?` Response: `1.000000e+07` for 10 MHz

4. Boolean values are returned as 0 (for OFF) and 1 (for ON).

   Example: `SOURce:POWer:STATe?` Response: `1`

5. Character data are returned in short form (see also section 3.5.5).

   Example: `ROUTe:REFerence:CLOCk?` Response: `INT`

3.5.5 Parameters

Most commands require the specification of a parameter. The parameters must be separated from the header by a "white space". Parameters may be specified as numeric values, Boolean parameters, character data, character strings and block data. The type of parameter required for the specific command as well as the permitted range of values are described together with the commands (see section 3.6).

Numeric values

Numeric values may be entered in any customary form, ie with sign, decimal point and exponent. If the values exceed the resolution of the instrument, they will be rounded off. The mantissa may comprise up to 255 characters, the exponent must be in the range between -32 000 and 32 000. The exponent is denoted by an "E" or "e". The exponent alone must not be used. Physical quantities may be stated with the unit. Permissible prefixes for the unit are E (Exa), P (Peta), T (Tera), G (Giga), MA (Mega, MOHM and MHZ are also allowed), K (Kilo), M (Milli), not with OHM and HZ, where M means Mega), U (Micro), N (Nano), P (Pico), F (Femto) and A (Atto). If no unit is specified, the basic unit will be used. No prefix is allowed for the units DBM and DB. For voltages, additional logarithmic units in the form of dB<prefix>V are supported.

As a rule, numeric values are inadmissible for queries of the SFQ. This does not apply however to the special numeric values described below.

Example:
`SOURce:FREQuency 1.5 kHz = SOURce:FREQuency 1.5E3`

Special numeric values

The parameters MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numeric values. MINimum and MAXimum are allowed for all device-specific commands, DEFault, UP and DOWN for a few only (see command description).

Upon a query, the numeric value will be returned.

Example: Setting command: `SOURce:POWer:LEVel MINimum`
Query: `SOURce:POWer:LEVel?`
Response: `-9.900000e+01`

MIN/MAX: MINimum and MAXimum denote the minimum and maximum value.

DEF: DEFault denotes a preset value stored in the EPROM. This value coincides with the basic setting called up by the *RST command.

UP/DOWN UP, DOWN increments or decrements the numeric value by one step. The step size can be adjusted for each parameter set via UP, DOWN with the aid of the associated step command (see List of Commands, Appendix C3).

Boolean parameters Boolean parameters represent two states. The ON state (true condition) is represented by ON or a nonzero numeric value.
The OFF state (false condition) is represented by OFF or the value of 0.
Queries always return 0 or 1.

Example: Setting command: `SOURce:POWer:STATe ON`
Query: `SOURce:POWer:STATe?` Response: `1`

Text Character data follow the syntax rules for keywords, ie they also have a short and a long form. Like any other parameters, they must be separated from the header by a 'white space'. A query returns the short form of the character data.

Example: Setting command: `SOURce:SIDeband UPPer`
Query: `SOURce:SIDeband?` Response: `UPP`

Character data Strings must always be given in single or double quotes.

Example: `"character string"` or
`'character string'`

Block data Block data is a format suitable for the transmission of large data volumes. A command with a block data parameter has the following structure:

Example: `HEADer:HEADer #45168xxxxxxxx`

The ASCII character # denotes the beginning of the data block. The next number specifies the number of subsequent digits defining the length of the data block. In the example above, the four digits specify a length of 5168 bytes. The data bytes follow next. During the transmission of these data bytes all terminators and other control characters are ignored until all bytes have been transmitted. In case of data elements comprising more than one byte, the byte defined by the SCPI command "`FORMat:BORDer`" will be transmitted first.

3.5.6 Overview of Syntax Elements

The following list provides an overview of the syntax elements.

:	The colon separates the keywords of a command. In a command line, the colon following a semicolon identifies the highest command level.
;	The semicolon separates two commands in a command line. It does not change the path.
,	The comman separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk identifies a common command.
"	Quotation marks denote the beginning of a character string and terminate it.
#	The double cross denotes the beginning of block data.
	A "white space" (ASCII code 0 to 9, 11 to 32 decimal,eg space) separates header and parameters.

3.6 Description of Commands

3.6.1 Notation

In the following sections, all commands implemented in the SFQ are tabulated according to the command system and described in detail. The notation is largely in line with the SCPI standard. The SCPI conformity information is given in a table in Appendix C3.

Command table

Command: In the command column the table shows an overview of the commands and their hierarchical relationships (see indentations).

Parameter: In the parameter column the required parameters and their range of values are stated.

Unit: The unit column shows the basic unit of the physical parameters.

Notes: In the notes column it is stated
- whether the command has a query form,
- whether the command is only in the form of a query and
- whether this command is implemented in a certain instrument option only.

In the individual command description the hierarchy is represented accordingly. This means that for each command all keywords above up to the left-most position have to be considered too. An example is given at the end of the individual description for each command.

Upper/lower case Uppercase/lowercase characters are used to differentiate between the long form and the short form of the keywords of a command in the command description (see section 3.5.2). The instrument itself does not differentiate between uppercase and lowercase letters.

Special characters **|** For some commands there is a choice of keywords having the same effect. These keywords are stated in the same line and separated by a vertical bar. Only one of these keywords need to be stated in the header of the command. The effect of the command is independent of the keyword selected.

Example:
```
SOURce
:FREQuency
    :CW|:FIXed
```

The following two commands having the same effect can be generated. They both set the frequency of continuous-wave signal to 10 MHz:

`SOURce:FREQuency:CW 1E7 = SOURce:FREQuency:FIXed 1E7`

A vertical bar in the notation of the parameters is used to separate alternative options and is to be seen as "or". The effect of the command differs according to the parameter stated.

Example: Selection of parameters for the command
`SOURce:FREQency:RESolution HIGH | LOW`

[ ] Keywords in square brackets may be omitted in compound headers (see section 3.5.2, optional keywords). For reasons of compatibility with the SCPI standard, the instrument must be able to recognize the full length of the command.
Parameters in square brackets may also be optionally inserted into the command or omitted.

{ } Parameters in curly brackets may be included in the command zero, one or more times.

3.6.2 Common Commands

Die Common Commands sind der Norm IEEE 488.2 (IEC 625.2) entnommen. Gleiche Befehle haben in unterschiedlichen Geräten gleiche Wirkung. Die Header dieser Befehle bestehen aus einem Stern"*", dem drei Buchstaben folgen. Viele Common Commands betreffen das Status-Reporting-System, das in Abschnitt 3.8 ausführlich beschrieben ist.	The common commands are based on the IEEE 488.2 (IEC 625.2) standard. A specific command has the same effect in different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system described in detail in section 3.8.

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
***CLS**			keine Abfrage no query
***ESE**	0 bis / to 255		
***ESR?**			nur Abfrage query only
***IDN?**			nur Abfrage query only
***IST?**			nur Abfrage query only
***OPC**			
***OPT?**			nur Abfrage query only
***PRE**	0 bis / to 255		
***PSC**	0 | 1		
***RST**			keine Abfrage no query
***SRE**	0 bis / to 255		
***STB?**			nur Abfrage query only
***TST?**			nur Abfrage query only
***WAI**			
***RCL**	1 bis / to 30 101 bis / to 199		keine Abfrage no query
***SAV**	1 bis / to 30 101 bis / to 199		keine Abfrage no query

***CLS** **CLEAR STATUS**

setzt das Status Byte (STB), das Standard-Event-Register (ESR) und den EVENt-Teil des QUEStionable- und des OPERation-Registers auf Null. Der Befehl verändert die Masken- und Transition-Teile der Register nicht. Er löscht den Ausgabepuffer.	Sets the status byte (STB), the Standard Event Register (ESR) and the EVENt part of the QUEStionable and of the OPERation Register to zero. The command has no effect on the mask and transition parts of the register. The output buffer is cleared.

***ESE** 0...255 **EVENT STATUS ENABLE**

setzt das Event-Status-Enable-Register auf den angegebenen Wert. Der Abfragebefehl *ESE? gibt den Inhalt des Event-Status-Enable-Registers in dezimaler Form zurück.	Sets the Event Status Enable Register to the defined value. The query *ESE? returns the contents of the Event Status Enable Register in decimal form.

***ESR?** **STANDARD EVENT STATUS QUERY**

gibt den Inhalt des Event-Status-Registers in dezimaler Form zurück (0...255) und setzt danach das Register auf Null.	Returns the contents of the Event Status Register in decimal form (0 to 255) and then clears the register.

***IDN?** **IDENTIFICATION QUERY**

fragt die Gerätekennung ab. Die Geräteantwort lautet zum Beispiel: "ROHDE&SCHWARZ,SFQ,123456/123,01.02" 123456/123 = Seriennummer 01.02 = Firmware-Versionsnummer	For identification of the instrument. The response is for example: " ROHDE&SCHWARZ,SFQ,123456/123,01.02" 123456/123 = serial number 01.02 = firmware version

***IST?** **INDIVIDUAL STATUS QUERY**

gibt den Inhalt des IST-Flags in dezimaler Form zurück (0 | 1). Das IST-Flag ist das Status-Bit, das während einer Parallel-Poll-Abfrage gesendet wird (siehe Abschnitt 3.8.3.2).	Returns the contents of the IST flag in decimal form (0 | 1). The IST flag is the status bit sent during a parallel poll (see section 3.8.3.2).

***OPC** **OPERATION COMPLETE**

setzt das Bit 0 im Event-Status-Register, wenn alle vorausgegangenen Befehle abgearbeitet sind. Dieses Bit kann zur Auslösung eines Service Requests benutzt werden (siehe Abschnitt 3.7).	Sets bit 0 in the Event Status Register if all preceding commands have been executed. This bit may be used to assert a service request (see section 3.7).

***OPC?** **OPERATION COMPLETE QUERY**

schreibt die Nachricht "1" in den Ausgabepuffer, sobald alle vorangegangenen Befehle ausgeführt sind (siehe Abschnitt 3.7).	Places an ASCII character 1 into the output buffer as soon as all preceding commands have been executed (see section 3.7).

***OPT?** **OPTION IDENTIFICATION QUERY**

fragt die im Gerät enthaltenen Optionen gemäß SFQ Datenblatt ab. Beispiel für eine Geräteantwort: "SFQ-B5,SFQ-B6,SFQ-B8,SFQ-B9,SFQ-10, SFQ-B11,SFQ-B12,SFQ-B13,SFQ-B15, SFQ-B16,SFQ-B17"	Requests identification of the device options according to SFQ data sheet. Example of a device response: "SFQ-B5,SFQ-B6,SFQ-B8,SFQ-B9,SFQ-10, SFQ-B11,SFQ-B12,SFQ-B13,SFQ-B15, SFQ-B16,SFQ-B17"

***PRE** 0...255 **PARALLEL POLL REGISTER ENABLE**

setzt das Parallel-Poll-Enable-Register auf den angegeben Wert. Der Abfragebefehl *PRE? gibt den Inhalt des Parallel-Poll-Enable-Registers in dezimaler Form zurück.	Sets the Parallel Poll Enable Register to the defined value. The query *PRE? returns the contents of the Parallel Poll Enable Register in decimal form.

***PSC** 0 | 1 **POWER ON STATUS CLEAR**

legt fest, ob beim Einschalten der Inhalt der ENABle-Register erhalten bleibt oder zurückgesetzt wird. *PSC = 0 bewirkt, dass der Inhalt der Statusregister erhalten bleibt. Damit kann bei entsprechender Konfiguration der Statusregister ESE und SRE beim Einschalten ein Service Request ausgelöst werden, *PSC = 1 setzt die Register zurück Der Abfragebefehl *PSC? liest den Inhalt des Power-on-Status-Clear-Flags aus. Die Antwort kann 0 oder 1 sein.	Determines whether on power up the contents of the ENABle Register is retained or cleared. *PSC = 0 causes the status register to retain its contents. With a corresponding configuration of the status registers ESE and SRE, a service request may be asserted upon power up, *PSC = 1 clears the register. The query *PSC? reads out the contents of the power-on-status-clear flags. The response may be 0 or 1.

***RST** **RESET**

versetzt das Gerät in einen definierten Grundzustand. Anhang C3 enthält die Resetwerte.	Sets the device to a defined default state. Appendix C3 contains the reset values.

***SRE** 0...255 **SERVICE REQUEST ENABLE**

setzt das Service-Request-Enable-Register auf den angegebenen Wert. Bit 6 (MSS-Maskenbit) bleibt 0. Dieser Befehl bestimmt, unter welchen Bedingungen ein Service Request ausgelöst wird. Der Abfragebefehl *SRE? liest den Inhalt des Service-Request-Enable-Registers in dezimaler Form aus. Bit 6 ist immer 0.	Sets the Service Request Enable Register to the defined value. Bit 6 (MSS mask bit) remains 0. This command determines the conditions under which a service request will be asserted. The query *SRE? outputs the contents of the Service Request Enable Register in decimal form. Bit 6 is always 0.

***STB?** **READ STATUS BYTE QUERY**

liest den Inhalt des Status-Bytes in dezimaler Form aus.	Outputs the contents of the status byte in decimal form.

***TST?** **SELF TEST QUERY**

löst alle im SFQ implementierten Selbsttests aus und gibt einen Fehlercode in dezimaler Form aus.	Triggers all selftests implemented in the SFQ and outputs an error code in decimal form.

***WAI** **WAIT-to-CONTINUE**

erlaubt die Abarbeitung der nachfolgenden Befehle erst, nachdem alle vorhergehenden Befehle durchgeführt und alle Signale eingeschwungen sind (siehe auch Abschnitt 3.7 und "*OPC").	Allows processing of commands only after all preceding commands have been executed and all signals are settled (see also section 3.7 and *OPC).

***RCL** **RECALL**

wiederaufrufen von internen (1...30) und externen (101...199) Geräteeinstellungen, dies entspricht den Menü-Befehlen **RECALL INTERN** bzw. **RECALL EXTERN**.	Recalls internal (1 to 30) and external (101 to 199) instrument settings, corresponds to commands **RECALL INTERNAL** and **RECALL EXTERNAL**.

***SAV** **SAVE**

speichern von internen (1...30) und externen (101...199) Geräteeinstellungen, dies entspricht den Menü-Befehlen **STORE INTERN** bzw. **STORE EXTERN**.	Stores internal (1 to 30) and external (101 to 199) instrument settings, corresponds to commands **STORE INTERNAL** and **STORE EXTERNAL.**

3.6.3 CALIBRATE Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
CALibrate:DC:OFFSet:INTern			
CALibrate:DC:OFFSet:EXTern			
CALibrate:ALL			RF_Level MODulation SYNThesis CSPL ISDBt NOISe:ALL
CALibrate:RF_Level			
CALibrate:RF_Level:DATE			
CALibrate:MODulation			All modulation modes / Alle Modulationen
CALibrate:MODulation:DATE			
CALibrate:MODulation:ONCE			Only modulation mode currently set / Nur für die eingestellte Modulation
CALibrate:SYNThesis			
CALibrate:SYNThesis:DATE			
CALibrate:CSPL			
CALibrate:CSPL:DATE			
CALibrate:ISDBt			
CALibrate:ISDBt:DATE			
CALibrate:NOISe			
CALibrate:NOISe:ALL			
CALibrate:NOISe:ALL:DATE			

Diese Befehle bewirken alle eine Kalibration. Im Einzelnen haben die Befehle folgende Wirkung:	These commands cause a calibration. The individual commands have the following effect:

CALibrate:DC:OFFSet:INTern

Kalibrierung des DC Offset bei FM Modulation	Calibrates the DC offset for FM modulation

CALibrate:DC:OFFSet:EXTern

Kalibrierung des DC Offset bei FM Modulation bei externer Einspeisung	Calibrates the DC offset for FM modulation with external feed

CALibrate:RF_Level

Kalibrierung des RF_LEVEL. Die Abfrage liefert PASS oder FAIL	Calibrates the RF_LEVEL. PASS or FAIL is returned in response to a query.

CALibrate:RF_Level:DATE

Abfrage des Datums der letzten RF Level Kalibrierung.	Queries the date of the last RF level calibration.

CALibrate:MODulation

Kalibrierung aller I/Q Modulationen. Die Abfrage liefert PASS oder FAIL	Calibrates all I/Q modulation modes. PASS or FAIL is returned in response to a query.

CALibrate:MODulation:DATE

Abfrage des Datums der letzten Modulations-Kalibrierung.	Queries the date of the last modulation calibration.

CALibrate:MODulation:ONCE

Kalibrierung der eingestellten Modulation	Calibrates the modulation mode currently set.

CALibrate:SYNThesis

Kalibrierung des VCO Synthesizer. Die Abfrage liefert PASS oder FAIL	Calibrates the VCO synthesizer. PASS or FAIL is returned in response to a query.

CALibrate:SYNThesis:DATE

Abfrage des Datums der letzten Synthesizer-Kalibrierung.	Queries the date of the last synthesizer calibration.

CALibrate:CSPL

Kalibrierung des CSPL Coders. Die Abfrage liefert PASS oder FAIL	Calibrates the CSPL coder. PASS or FAIL is returned in response to a query.

CALibrate:CSPL:DATE

Abfrage des Datums der letzten CSPL Coder-Kalibrierung.	Queries the date of the last CSPL coder calibration.

CALibrate:ISDBt

Kalibrierung des ISDB-T Coders. Die Abfrage liefert PASS oder FAIL	Calibrates the ISDB-T coder. PASS or FAIL is returned in response to a query.

CALibrate:ISDBt:DATE

Abfrage des Datums der letzten ISDB-T Coder-Kalibrierung.	Queries the date of the last ISDB-T coder calibration.

CALibrate:NOISe

Kalibrierung der Rauschgeneratoren 2 oder 3 für die aktuell eingestellte Modulation. Die Abfrage liefert PASS oder FAIL	Calibrates the noise generator 2. PASS or FAIL is returned in response to a query.

CALibrate:NOISe:ALL

Kalibrierung der Rauschgeneratoren 2 oder 3 für alle im jeweiligen SFQ möglichen internen digitalen Modulationen. Die Abfrage liefert PASS oder FAIL	Calibrates the noise generators 2 or 3 for all internal digital modulation modes possible in the SFQ. PASS or FAIL is returned in response to a query.

CALibrate:NOISe:ALL:DATE

Abfrage des Datums, wann der Rauschgenerator zuletzt für alle internen digitalen Modulationen kalibriert wurde.	Queries the date of the last calibration of the noise generator for all internal digital modulation modes.

3.6.4 DIAGNOSTIC Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
DIAGnostic:CARDs[:STATe]			nur Abfrage query only
DIAGnostic:POSition	<Wert / value> | MINimum | MAXimum, <Wert / value> | MINimum | MAXimum		nur Abfrage 1.Param.: Adresse 2.Param.: Punkt query only 1st parameter: address 2nd parameter: test point
DIAGnostic:CSPL	<string>		Nur mit / only with CSPL Coder
DIAGnostic:CSPL:ERROR	<string>		Nur mit / only with CSPL Coder nur Abfrage query only

Das Subsystem DIAGNOSTIC dient zur Diagnose innerhalb des Geräts.	The DIAGNOSTIC subsystem is used for a diagnosis within the unit.

DIAGnostic:CARDs[:STATe]

Dieser Befehl ist für den Service bestimmt.	This command is used in servicing.

DIAGnostic:POSition

Mit diesem Befehl wird eine Spannung an einem bestimmten Messpunkt einer Baugruppe ermittelt. Mit dem ersten Parameter wird die Adresse der Baugruppe und mit dem zweiten Parameter Messpunkt innerhalb der Baugruppe ausgewählt. Dieser Befehl ist für den Service bestimmt.	This command determines a voltage at a specific test point of a module. The first parameter selects the module address the second the test point within the module. This command is used in servicing.

DIAGnostic:CSPL

Mit diesem Befehl wird der Selbstest des CSPL Coders gestartet. Eine Abfrage lioefert das Ergebnis.	This command starts the selftest of the CSPL coder. The result is returned in response to a query.

DIAGnostic:CSPL:ERRor

Abfrage von Fehlern bei der DC Versorgung des CSPL Coders.	Queries the errors occurring in respect of the DC supply of the CSPL coder.

3.6.5 OUTPUT Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
OUTPut[:STATe]	<Wert / value> | OFF | ON		

Das Subsystem OUTPUT dient zum Schalten des RF Ausgangs.	The OUTPUT is used to switch off the RF output.

OUTPut[:STATE]

schaltet das Ausgangssignal des Geräts ein und aus.	Switches the output signal of the instrument on and off.

3.6.6 READ Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
READ:FM[:BASeband]:DEViation?			nur Abfrage query only
READ:FM[:BASeband]:ENERgy[:DISPersal]: DOUBle[:STATe]?			nur Abfrage query only
READ:IQCoder:DATarate?			nur Abfrage query only
READ:IQCoder:SYMBols[:RATE]?			nur Abfrage query only
READ:IQCoder:USEFul[:RATE]?			nur Abfrage query only
READ:IQCoder:PACKetlength?			nur Abfrage query only
READ:IQCoder:COFDm:Input:DATarate[:LOW]?			nur Abfrage query only
READ:IQCoder:COFDm:Input:DATarate:HIGH?			nur Abfrage query only
READ:IQCoder:COFDm:USEFul[:RATE][:LOW]?			nur Abfrage query only
READ:IQCoder:COFDm:USEFul[:RATE]:HIGH?			nur Abfrage query only
READ:IQCoder:ISDBt:Input:DATarate?			nur Abfrage query only
READ:IQCoder:ISDBt:USEFul[:RATE]:A?	[MAXimum]		nur Abfrage query only
READ:IQCoder:ISDBt:USEFul[:RATE]:B?	[MAXimum]		nur Abfrage query only
READ:IQCoder:ISDBt:USEFul[:RATE]:C?	[MAXimum]		nur Abfrage query only
READ:BER?			nur Abfrage query only
READ:BER:ALL?			nur Abfrage query only
READ:BER:GATE[:RATio]?			nur Abfrage query only
READ:BER:STATe?	BER_LOCKED | NO_BER_CLOCK | NO_BER_DATA | NO_BER_SYNC		nur Abfrage query only

Das Subsystem READ dient zum Abfragen von Werten, die der SFQ selbst errechnet bzw. generiert.	The READ subsystem is used to query values calculated or generated by the SFQ.

READ:FM[:BASeband]:DEViation

Mit diesem Befehl wird das Ergebnis des Summenhubs ermittelt.	This command determines the sum deviation.

READ:FM[:BASeband]:ENERgy[:DISPersal]:DOUBle[:STATe]

Mit diesem Befehl wird ermittelt, ob für FM Basisband der Störhub, Deviation verdoppelt ist. Die Abfrage liefert 1 für Verdoppelung und 0 für Normalbetrieb zurück.	This command is used to determine whether the deviation is doubled for the FM baseband. 1 is returned for doubling and 0 for normal operation.

READ:IQCoder:DATarate

Mit diesem Befehl wird der Messwert der eingespeisten Datenrate bei DVB-C, SATELLITE, VSB oder J.83/B abgefragt.	This command queries the measured data rate for DVB-C, SATELLITE, VSB or J.83/B.

READ:IQCoder:SYMBols[:RATE]

Abfrage der Symbolrate, die sich aus der Messung des externen ASI bzw. SPI Taktes bei DVB-C, SATELLITE, VSB oder J.83/B ergibt. Hierzu ist die Option Input Interface erforderlich.	Queries the symbol rate which results from the measurement of the external ASI or SPI clock in case of DVB-C, SATELLITE, VSB or J.83/B. Only possible if the optional Input Interface is fitted.

READ:IQCoder:USEFul[:RATE]

Abfrage der bei DVB-C, SATELLITE, VSB oder J.83/B im eingespeisten Transportstrom enthaltenen Programmdaten. Hierzu ist die Option Input Interface erforderlich.	Queries the program data contained in the applied transport stream in case of DVB-C, SATELLITE, VSB or J.83/B. Only possible if the optional Input Interface is fitted.

READ:IQCoder:PACKetlength

Abfrage der Packetlänge, des bei DVB-C bzw. SATELLITE im über ASI oder SPI eingespeisten Transportstroms. Hierzu ist die Option Input Interface erforderlich.	Queries the packet length of the transport stream applied via ASI or SPI in case of DVB-C or SATELLITE. Only possible if the optional Input Interface is fitted.

READ:IQCoder:COFDm:INPut:DATarate[:LOW]

Mit diesem Befehl wird der Messwert der eingespeisten Datenrate bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation abgefragt.	Queries the measured value of the fed-in data rate for non-hierarchical constellation or of the low-priority path for hierarchical COFDM modulation.

READ:IQCoder:COFDm:INPut:DATarate:HIGH

Mit diesem Befehl wird der Messwert der eingespeisten Datenrate des High Priority Zweigs bei hierarchischer COFDM-Modulation abgefragt.	Queries the measured value of the fed-in data rate of the high-priority path for hierarchical COFDM modulation.

READ:IQCoder:COFDm:USEFul[:RATE][:LOW]

Abfrage der im eingespeisten Transportstrom enthaltenen Programmdaten bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation. Hierzu ist die Option Input Interface erforderlich.	Queries the program data contained in the fed-in transport stream for non-hierarchical constellation or of the low-priority path for hierarchical COFDM modulation. Option input interface is required.

READ:IQCoder:COFDm:USEFul[:RATE]:HIGH

Abfrage der im eingespeisten Transportstrom enthaltenen Programmdaten des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Queries the program data of the high-priority path for hierachical COFDM modulation. The program data is contained in the fed-in transport stream.

READ:IQCoder:ISDBt:INPut:DATarate?

Abfrage der eingespeisten Datenrate bei ISDB-T Modulation	Queries the fed-in data rate for ISDB-T modulation.

READ:IQCoder:ISDBt:USEFul[:RATE]:A?

Abfrage der im eingespeisten Transportstrom enthaltenen Programmdaten für Layer A bei ISDB-T-Modulation.	Queries the layer A program data contained in the fed-in transport stream for ISDB-T modulation.

READ:IQCoder:ISDBt:USEFul[:RATE]:A? MAXimum

Abfrage der maximal möglichen Nutzdatenmenge, die bei ISDB-T-Modulation bei den derzeitigen Einstellungen in Layer A übertragen werden kann.	Queries the maximum possible useful data rate for transmission in layer A for the current coder settings for ISDB-T modulation.

READ:IQCoder:ISDBt:USEFul[:RATE]:B?

Abfrage der im eingespeisten Transportstrom enthaltenen Programmdaten für Layer B bei ISDB-T-Modulation.	Queries the layer B program data contained in the fed-in transport stream for ISDB-T modulation.

READ:IQCoder:ISDBt:USEFul[:RATE]:B? MAXimum

Abfrage der maximal möglichen Nutzdatenmenge, die bei ISDB-T-Modulation bei den derzeitigen Einstellungen in Layer B übertragen werden kann.	Queries the maximum possible useful data rate for transmission in layer B for the current coder settings for ISDB-T modulation.

READ:IQCoder:ISDBt:USEFul[:RATE]:C?

Abfrage der im eingespeisten Transportstrom enthaltenen Programmdaten für Layer A bei ISDB-T-Modulation.	Queries the layer C program data contained in the fed-in transport stream for ISDB-T modulation.

READ:IQCoder:ISDBt:USEFul[:RATE]:C? MAXimum

Abfrage der maximal möglichen Nutzdatenmenge, die bei ISDB-T-Modulation bei den derzeitigen Einstellungen in Layer C übertragen werden kann.	Queries the maximum possible useful data rate for transmission in layer C for the current coder settings for ISDB-T modulation.

READ:BER?

Abfrage der Bit Error Ratio. Beispiel: "5.00E-01"	Query of bit error ratio. Example: "5.00E-01"

READ:BER:ALL?

Abfrage Bit Error Ratio, des Verhältnisses der tatsächlichen zu den zur Bit Error Ratio Messung benötigten Bits und Zustandes der Bit Error Ratio Messung. Die Antwort ist eine Kombination der Befehle READ:BER?, READ:BER:GATE? und READ:BER:STATe? Beispiel: "5.00E-01","(0 / 100)",NO_BER_CLOCK	Query of bit error ratio, of ratio of actual bits to bits required for bit error ratio measurement and of state of BER measurement. The response is a combination of the queries READ:BER?, READ:BER:GATE? and READ:BER:STATe? Example: "5.00E-01","(0 / 100)",NO_BER_CLOCK

READ:BER:GATE[:RATio]?

Abfrage des Verhältnisses der tatsächlichen zu den zur Bit Error Ratio Messung benötigten Bits. Beispiel: "(0 / 100)"	Queries the ratio of the actual bits to the bits required for bit error ratio measurement Example: "(0 / 100)"

READ:BER:STATe?

Abfrage des Zustandes der Bit Error Ratio Messung	Queries the state of the bit error ratio measurement

3.6.7 ROUTE Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
ROUTe:FM[:BASeband]:VIDeo:INPut	FR1M | FR75 | RE1 | RE2 | AUTO | FRONt1m | FRONt75 | REAR1 | REAR2		
ROUTe:MONitor	INTernal | EXTernal		
ROUTe:REFerence:CLOCk	INTernal | EXTernal		
ROUTe:REFerence:STATe			nur Abfrage query only

Das Subsystem ROUTE dient zum Aufbau logischer und elektrischer Verbindungen innerhalb des Geräts.	The ROUTE subsystem is provided to establish logical and electrical connections within the instrument.

ROUTe:FM[:BASeband]:VIDeo:INPut

Auswahl der Eingangsbuchse für FM Basisband, Video. Mögliche Einstellungen sind Front mit 1 MΩ, Front mit 75 Ω, Rear X30.2 oder Rear X30.3.	Selects the input socket for the video signal. Selectable inputs: 1 MΩ/75 Ω input at the front, X30.2 or X30.3 at the rear.

ROUTe:MONitor

Auswahl des Monitor-Anschlusses INTERN / EXTERN	Selects the monitor connector INTERNAL / EXTERNAL

ROUTe:REFerence:CLOCk

Mit diesem Kommando wird festgelegt, mit welchem Referenztakt das Gerät arbeitet. Möglich sind der interne Referenztakt (INTernal) oder ein von außen zugeführter Referenztakt (EXTernal).	This command defines the reference clock of the instrument. An internal (INTernal) or an external reference clock (EXTernal) may be used.

ROUTe:REFerence:STATe

Mit diesem Kommando wird abgefragt, ob der 10 MHz Referenztakt anliegt. Dies ist bei der Verwendung einer externen Referenz erforderlich. 0 entspricht keine Referenz vorhanden und 1 entspricht Referenz vorhanden	This command queries whether the 10 MHz reference clock is present. This is necessray when an external reference is used. 0 = reference clock not present and 1 = reference clock present

3.6.8 SENSE Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
SENSe:BER:MEASurement	<numeric> | OFF | ON		
SENSe:BER[:INPut][:SELect]	SERial | PARallel		
SENSe:BER[:INPut]:SERial:DATA	NORMal | INVerted		
SENSe:BER[:INPut]:SERial:CLOCk	NORMal | INVerted		
SENSe:BER[:INPut]:SERial:ENABle	ALWays | HIGH | LOW		
SENSe:BER[:INPut]:PARallel[:MODE]	NORMal | INVerted | NULL | PID		
SENSe:BER:PRBS[:SEQuence]	P23_1 | P15_1		

Das Subsystem SENSE dient zum Einstellen der Messeingänge des Geräts.	The SENSE subsystem is used for setting the test inputs of the instrument.

SENSe:BER:MEASurement

Ein- bzw. Ausschalten der BER Messung	Switches BER measurment on or off.

SENSe:BER[:INPut][:SELect]

Umschaltung zwischen seriellen und parallelen Eingang für die BER Messung	Selects serial or parallel input for the BER measurement.

SENSe:BER[:INPut]:SERial:DATA

Ein- bzw. Ausschalten der Invertierung des seriellen Daten-Eingangs für die BER Messung	Switches the inversion of the serial data input for the BER measurement on or off.

SENSe:BER[:INPut]:SERial:CLOCk

Ein- bzw. Ausschalten der Invertierung des seriellen Takt-Eingangs für die BER Messung	Switches the inversion of the serial clock input for the BER measurement on or off.

SENSe:BER[:INPut]:SERial:ENABle

Auswahl der Funktion des Enable Signals bei der BER Messung mit seriellen Eingängen	Selects the function of the enable signal for the BER measurement with serial inputs.

SENSe:BER[:INPut]:PARallel[:MODE]

Auswahl der Betriebsart bei der BER Messung mit parallelem Eingang	Selects the operating mode for the BER measurement with parallel input.

SENSe:BER:PRBS[:SEQuence]

Umschaltung der Länge der PRBS Sequenz für die BER Messung	Switches the length of the PRBS sequence for the BER measurement.

3.6.9 SOURCE Subsystem

3.6.9.1 SOURce:DM Subsystem

<table>
<tr><th>Befehl / Command</th><th>Parameter</th><th>Einheit
Unit</th><th>Bemerkung
Notes</th></tr>
<tr><td>[SOURce]:DM:CW:STATe</td><td><Wert/ value> | OFF | ON</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:FORMat</td><td>S4 | (QPSK |)*
S8 |
S16 |
S4T |
S8T |
C16 | (QAM16 |)*
C32 | (QAM32 |)*
C64 | (QAM64 |)*
C128 | (QAM128 |)*
C256 | (QAM256 |)*
T4 | (COFDmqpsk |)*
T16 | (COFDm16qam |)*
T64 | (COFDm64qam |)*
T161 | (COFDm16qam1 |)*
T162 | (COFDm16qam2 |)*
T164 | (COFDm16qam4 |)*
T641 | (COFDm64qam1 |)*
T642 | (COFDm64qam2 |)*
T644 | (COFDm64qam4 |)*
J83B64 |
J83B256 |
VSB8 |
IPDD |
IPDC |
IPCC |
IDDD |
IDDC |
IDCC |
ICCC
(* veraltet / obsolete, legacy code)</td><td></td><td>Satellite DVB-S QPSK
Satellite DVB-S 8PSK
Satellite DVB-S 16QAM
Satellite QPSK Turbo
Satellite 8PSK Turbo
DVB-C 16QAM
DVB-C 32QAM
DVB-C 64QAM
DVB-C 128QAM
DVB-C 256QAM
DVB-T QPSK
DVB-T 16QAM
DVB-T 64QAM
DVB-T 16QAM α=1
DVB-T 16QAM α=2
DVB-T 16QAM α=4
DVB-T 64QAM α=1
DVB-T 64QAM α=2
DVB-T 64QAM α=4
ITU-T J.83/B 64QAM
ITU-T J.83/B 256QAM
ATSC 8VSB
ISDB-T Part Diff Diff
ISDB-T Part Diff Cohe
ISDB-T Part Cohe Cohe
ISDB-T Diff Diff Diff
ISDB-T Diff Diff Cohe
ISDB-T Diff Cohe Cohe
ISDB-T Cohe Cohe Cohe</td></tr>
<tr><td>[SOURce]:DM:IQRatio[:MAGNitude]</td><td><Wert/ value> [ONE | PCT] | MINimum | MAXimum</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:MODulation:OFFSet</td><td><Wert/ value> [ONE | PCT] | MINimum | MAXimum</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:POLarity[:ALL]</td><td>NORMal | INVerted</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:QUADrature:ANGLe</td><td><Wert/ value> [DEG] | MINimum | MAXimum</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:SOURce</td><td>EXTernal | INTernal</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:STATe</td><td><Wert/ value> | OFF | ON</td><td></td><td></td></tr>
<tr><td>[SOURce]:DM:IQEXternal:INPut:CORRection</td><td><Wert/ value> [DB] | MINimum | MAXimum</td><td>DB</td><td></td></tr>
<tr><td>[SOURce]:DM:IQEXternal:INPut:SIGNal</td><td>NOM | DVBT</td><td></td><td>?: | MODIFIED</td></tr>
</table>

Das Subsystem SOURCE:DM enthält die Befehle zur Digitalen Modulation. Unter Digitaler Modulation wird QPSK, QAM, COFDM, VSB und externe I/Q Einspeisung verstanden.	The SOURCE:DM subsystem provides the commands for digital modulation. Digital modulation includes QPSK, QAM, COFDM, VSB and the externally applied I/Q signal.

[SOURce]:DM:CW:STATe

Ein-/Ausschalten der digitalen Modulation (continuous wave).	Switches digital modulation (continuous wave) on and off.

[SOURce]:DM:FORMat

Auswahl der Modulationsart.	Selects the type of modulation.

[SOURce]:DM:IQRatio[:MAGNitude]

Modulation IQ Unbalance in Prozent in der aktuell gewählten digitalen Modulationsart.	Sets the I/Q modulation imbalance in percent for the currently selected digital modulation mode.

[SOURce]:DM:MODulation:OFFSet

Modulation Residual Carrier in Prozent in der aktuell gewählten digitalen Modulationsart.	Sets the residual carrier in percent for the currently selected digital modulation mode.

[SOURce]:DM:POLarity[:ALL]

Auswahl des Modulation IQ (normal / changed) in aktuell gewählter digitaler Modulationsart.	Selects the I/Q modulation (normal / changed) for the currently selected digital modulation mode.

[SOURce]:DM:QUADrature:ANGLe

Modulation, Quadratur Offset in aktuell gewählter digitaler Modulationsart.	Sets the quadrature offset for the currently selected digital modulation mode.

[SOURce]:DM:SOURce

Umschaltung zwischen EXTerner / INTerner digitaler Modulationsquelle.	Switches between EXTernal / INTernal digital modulation source.

[SOURce]:DM:STATe

Ein-/Ausschalten der digitalen Modulation (QPSK, QAM, IQ External). Beim Einschalten wird auf die zuletzt verwendete digitale Modulation geschaltet. Beim Ausschalten wird auf die zuletzt verwendete FM-Modulation geschaltet. (siehe auch [SOURce]:FM:STATe).	This command switches digital modulation (QPSK, QAM, I/Q external) on and off. On power-up the digital modulation used last is selected. Upon switch-off, the FM modulation used last is selected. See also [SOURce]:FM:STATe.

[SOURce]:DM:IQEXternal:INPut:CORRection

Individuelle Wahl des I/Q Pegelkorrekturfaktors bei externer I/Q Einspeisung. Eine individueller Pegelkorrekturfaktor führt bei DM:IQEX:INP:SIGN? zu MODIFIED.	Individual selection of I/Q level correction factor with external I/Q signals. An individual level correction factor returns MODIFIED upon the query DM:IQEX:INP:SIGN?

[SOURce]:DM:IQEXternal:INPut:SIGNal

Wahl der I/Q Pegelkorrektur bei externer I/Q Einspeisung eines nominalen I/Q Signals oder eines DVB-T Signals in einen externen SFQ (z.B. für Diversity Betrieb)	Selection of I/Q level correction with external nominal I/Q signal fed in or DVB-T signal applied to an external SFQ (e.g. for diversity operation).

3.6.9.2 SOURce:FM Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:FM:EXTernal:COUPling	AC | DC		
[SOURce]:FM:EXTernal:DEViation	<Wert / value> | MAXimum | MINimum	[HZPP]	
[SOURce]:FM:EXTernal:POLarity	NORMal | INVerted		
[SOURce]:FM:EXTernal:IMPedance	<Wert / value> | MAXimum | MINimum	[Ω]	
[SOURce]:FM: EXTernal:STATe	<Wert / value > | OFF | ON		
[SOURce]:FM:SOURce	EXTernal | INTernal		
[SOURce]:FM:STATe	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:CW[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:ENERgy [:DISPersal]:DEViation	<Wert / value> | MAXimum | MINimum	[HZPP]	
[SOURce]:FM[:BASeband]:ENERgy [:DISPersal]:POLarity	NORMal | INVerted		
[SOURce]:FM[:BASeband]:ENERgy [:DISPersal][:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR [1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT:FREQuency	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FM[:BASeband]:SUBCarrier:ADR [1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT:VOLume	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT [:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio: PREemphasis[:STATe]	<Wert / value> | OFF | ON		

Das Subsystem SOURCE:FM enthält die Befehle zur Frequenz-Modulation.	The SOURCE:FM subsystem provides the commands for frequency modulation.

[SOURce]:FM:EXTernal:COUPling

Kopplung des Modulationssignals bei FM-Modulation mit externer Einspeisung.	Coupling of the modulation signal for FM modulation with external feed.

[SOURce]:FM:EXTernal:DEViation

Hub bei FM-Modulation mit externer Einspeisung.	Sets the deviation of the external signal for FM.

[SOURce]:FM:EXTernal:POLarity

Polarität des Hubs bei FM-Modulation mit externer Einspeisung.	Selects the deviation polarity of the external signal for FM.

[SOURce]:FM:EXTernal:IMPedance

Impedance des Eingangs bei FM-Modulation mit externer Einspeisung (50 Ω, 75 Ω oder 10 kΩ).	Input impedance for FM with external source (50 Ω, 75 Ω or 10 kΩ).

[SOURce]:FM:EXTernal:STATe

Ein-/Ausschalten der externen Signalquelle bei FM-Modulation mit externer Einspeisung.	Switches the external signal for FM on and off.

[SOURce]:FM:SOURce

Umschaltung zwischen EXTerner / INTerner digitaler Modulationsquelle.	Switches between EXTernal / INTernal digital modulation signal source.

[SOURce]:FM:STATe

Ein-/Ausschalten der FM-Modulation (FM, FM External). Beim Einschalten wird auf die zuletzt verwendete FM-Modulation geschaltet. Beim Ausschalten wird auf die zuletzt verwendete digitale Modulation geschaltet. Siehe auch [SOURce]:DM:STATe.	Switches frequency modulation (FM, FM external) on and off. Upon power-up, the FM used last is selected. When the instrument is switched off, the digital modulation used last is selected. See also [SOURce]:DM:STATe.

[SOURce]:FM[:BASeband]:CW[:STATe]

Ein-/Ausschalten der digitalen Modulation (continuous wave).	Switches digital modulation (continuous wave) on and off.

[SOURce]:FM[:BASeband]:ENERgy[:DISPersal]:DEViation

Hub des Energieverwischungssignals bei FM-Modulation.	Sets the deviation of the energy dispersal signal for FM.

[SOURce]:FM[:BASeband]:ENERgy[:DISPersal]:POLarity

Polarität des Energieverwischungs-Hubs bei FM-Modulation.	Selects the deviation polarity of the energy dispersal signal for FM.

[SOURce]:FM[:BASeband]:ENERgy[:DISPersal][:STATe]

Ein-/Ausschalten des Energieverwischungssignals bei FM-Modulation.	Switches the energy dispersal signal for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT:FREQuency

Frequenz des linken Audiokanals eines ADR-Unterträgers bei FM-Modulation.	Sets the frequency of the left audio channel of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT:VOLume

Pegel des linken Audiokanals eines ADR-Unterträgers bei FM-Modulation.	Sets the level of the left audio channel of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT[:STATe]

Ein-/Ausschalten des linken Audiokanals eines ADR-Unterträgers bei FM-Modulation.	Switches the left audio channel of an ADR subcarrier for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:PREemphasis [:STATe]

Ein-/Ausschalten der Preemphase der Audio-signale eines ADR-Unterträgers bei FM-Modulation.	Switches the preemphasis of the audio signals of an ADR subcarrier for FM on and off.

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt:FREQuency	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt:VOLume	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio[:MODE]	SINGle | DUAL | STEReo		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:RF:DEViation	<Wert / value> | MAXimum | MINimum	[HZPP]	
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:RF:FREQuency	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:STATe	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:ANCillary	OFF | DAT1 | DAT2 | DAT3 | DAT4		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:BER:RATE	<Wert / value> | MAXimum | MINimum		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:BER[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:POLarity	NORMal | INVerted		
[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:SOURce	INTernal | EXTN | EXTI | PRBS | CW | TST1 | TST2 | TST3		

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt:FREQuency

Frequenz des rechten Audiokanals eines ADR-Unterträgers bei FM-Modulation.	Sets the frequency of the right audio channel of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt:VOLume

Pegel des rechten Audiokanals eines ADR-Unterträgers bei FM-Modulation.	Sets the level of the right audio channel of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt[:STATe]

Ein-/Ausschalten des rechten Audiokanals eines ADR-Unterträgers bei FM-Modulation.	Switches the right audio channel of an ADR subcarrier for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio[:MODE]

Audio Mode des MUSICAM Signals eines ADR-Unterträgers bei FM-Modulation.	Selects the audio mode of the MUSICAM signal of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:RF:DEViation

Hub eines ADR-Unterträgers bei FM-Modulation	Sets the deviation of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:RF:FREQuency

Frequenz eines ADR-Unterträgers bei FM-Modulation.	Sets the frequency of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:STATe

Ein-/Ausschalten eines ADR-Unterträgers bei FM-Modulation	Switches an ADR subcarrier for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:ANCillary

Zusatzdaten des MUSICAM Signals eines ADR-Unterträgers bei FM-Modulation.	Selects ancillary data for the MUSICAM signal of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:BER:RATE

Fehlerrate des MUSICAM Signals eines ADR-Unterträgers bei FM-Modulation.	Sets the bit error rate (BER) of the MUSICAM signal of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:BER[:STATe]

Ein-/Ausschalten der Fehlerrate des MUSICAM Signals eines ADR-Unterträgers bei FM-Modulation.	Switches the BER of the MUSICAM signal of an ADR subcarrier for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:POLarity

Normale/vertauschte Zuordnung der I und Q Signale eines ADR-Unterträgers bei FM-Modulation.	Assigns the polarity (normal / inverted) of the I and Q signals of an ADR subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:SOURce

Datenquelle des MUSICAM Signals eines ADR-Unterträgers bei FM-Modulation.	Selects the data source of the MUSICAM signal of an ADR subcarrier for FM.

<table>
<tr><th>Befehl / Command</th><th>Parameter</th><th>Einheit
Unit</th><th>Bemerkung
Notes</th></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:AUDio:DEViation</td><td><Wert / value> | MAXimum | MINimum</td><td>[HZPP]</td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:AUDio:FREQuency</td><td><Wert / value> | MAXimum | MINimum</td><td>[HZ]</td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:AUDio:LPASs[:STATe]</td><td><Wert / value> | OFF | ON</td><td></td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:AUDio:SOURce</td><td>EXTernal | INTernal</td><td></td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:AUDio[:STATe]</td><td><Wert / value> | OFF | ON</td><td></td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:PREemphasis:TIME</td><td>US50 | US75 | J17</td><td></td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:PREemphasis[:STATe]</td><td><Wert / value> | OFF | ON</td><td></td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:RF:DEViation</td><td><Wert / value> | MAXimum | MINimum</td><td>[HZPP]</td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6]:RF:FREQuency</td><td><Wert / value> | MAXimum | MINimum</td><td>[HZ]</td><td></td></tr>
<tr><td>[SOURce]:FM[:BASeband]:SUBCarrier:FM
[1|2|3|4|5|6][:STATe]</td><td><Wert / value> | OFF | ON</td><td></td><td></td></tr>
</table>

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:DEViation

Frequenzhub der FM-Audio-Modulation eines FM-Unterträgers bei FM-Modulation.	Sets the frequency deviation of the audio modulation signal of an FM subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:FREQuency

Frequenz des Audiosignals eines FM-Unterträgers bei FM-Modulation.	Sets the audio signal frequency of an FM subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:LPASs[:STATe]

EIN-/AUS-Schalten des Tiefpasses eines FM-Unterträgers bei FM-Modulation.	Switches the lowpass filter of an FM subcarrier for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:SOURce

Interne oder externe Audioquelle zur Modulation eines FM-Unterträgers bei FM-Modulation.	Selects the audio signal source (internal or external) for FM subcarrier modulation for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio[:STATe]

Ein-/Ausschalten des Audiosignals eines FM-Unterträgers bei FM-Modulation.	Switches the audio signal of an FM subcarrier for FM on and off

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:PREemphasis:TIME

Art der Preemphasis des Audiosignals eines FM-Unterträgers bei FM-Modulation.	Selects the preemphasis of the audio signal of an FM subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:PREemphasis[:STATe]

Ein-/Ausschalten der Preemphasis des Audiosignals eines FM-Unterträgers bei FM-Modulation.	Switches the preemphasis of the audio signal of an FM subcarrier for FM on and off.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:RF:DEViation

Frequenzhub des FM-Unterträgers bei FM-Modulation.	Sets the frequency deviation of the FM subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:RF:FREQuency

Frequenz eines FM-Unterträgers bei FM-Modulation.	Sets the frequency of an FM subcarrier for FM.

[SOURce]:FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6][:STATe]

Ein-/Ausschalten eines FM-Unterträgers bei FM-Modulation.	Switches the FM subcarrier for FM on and off.

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:FM[:BASeband]:VIDeo:COUPling	<Wert / value> | AC | DC		
[SOURce]:FM[:BASeband]:VIDeo:CLAMping: SYNC	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:VIDeo:CLAMping: TYPE	HARD | SOFT		
[SOURce]:FM[:BASeband]:VIDeo:CLAMping[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:VIDeo:DEViation	<Wert / value> | MAXimum | MINimum	[HZPP]	
[SOURce]:FM[:BASeband]:VIDeo:LPASs [:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:VIDeo:POLarity	NORMal | INVerted		
[SOURce]:FM[:BASeband]:VIDeo:PREemphasis[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:FM[:BASeband]:VIDeo:STANdard	PAL | SECam | NTSC		
[SOURce]:FM[:BASeband]:VIDeo[:STATe]	<Wert / value> | OFF | ON		

[SOURce]:FM[:BASeband]:VIDeo:COUPling

Kopplung des Videosignals bei FM-Modulation (AD / DC).	Coupling of the video signal for FM modulation (AD / DC).

[SOURce]:FM[:BASeband]:VIDeo:CLAMping:SYNC

Ein-/Ausschalten der Klemmung auf ein externes Synchronisationssignal bei FM-Modulation.	Switches clamping to an external sync signal for FM on and off.

[SOURce]:FM[:BASeband]:VIDeo:CLAMping:TYPE

Art der Klemmung des Videosignals (HARD oder SOFT) bei FM-Modulation.	Selects clamping of the video signal (HARD or SOFT) for FM.

[SOURce]:FM[:BASeband]:VIDeo:CLAMping[:STATe]

Ein-/Ausschalten der Klemmung des Videosignals bei FM-Modulation.	Switches clamping of the video signal for FM on and off.

[SOURce]:FM[:BASeband]:VIDeo:DEViation

Frequenzhub des Basisband-Video-Signals bei FM-Modulation.	Sets the frequency deviation of the baseband video signal for FM.

[SOURce]:FM[:BASeband]:VIDeo:LPASs[:STATe]

Ein-/Ausschalten des entzerrten Tiefpass für das Videosignals bei FM-Modulation.	Switches the corrected lowpass filter for the video signal for FM on and off.

[SOURce]:FM[:BASeband]:VIDeo:POLarity

Ein-/Ausschalten des entzerrten Tiefpass für das Videosignals bei FM-Modulation.	Switches the corrected lowpass filter for the video signal for FM on and off.

[SOURce]:FM[:BASeband]:VIDeo:PREemphasis[:STATe]

Ein-/Ausschalten der Preemphase für das Videosignals bei FM-Modulation.	Switches preemphasis of the video signal for FM on and off.

[SOURce]:FM[:BASeband]:VIDeo:STANdard

Videostandard (PAL, SECAM und NTSC).	Selects the video standard (PAL, SECAM and NTSC).

[SOURce]:FM[:BASeband]:VIDeo[:STATe]

Ein-/Ausschalten des Videosignals bei FM-Modulation.	Switches the video signal for FM on and off.

3.6.9.3 SOURce:FREQuency Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:FREQuency:CENTer	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:CHANnel	<Wert / value> | MAXimum | MINimum | UP | DOWN		
[SOURce]:FREQuency:CHANnel:TABLe	NONE | USR1 | USR2 | USR3 | USR4 | USR5 | USER1 | USER2 | USER3 | USER4 | USER5		
[SOURce]:FREQuency[:CW]	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:FIXed	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:MODE	CW | FIXed | SWEep		
[SOURce]:FREQuency:RESolution	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:SHIFt	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:SPAN	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:STARt	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:STOP	<Wert / value> | MAXimum | MINimum	[HZ]	
[SOURce]:FREQuency:ACTual:CENTer	<Wert / value>	[HZ]	nur bei VSB at VSB only
[SOURce]:FREQuency:NOMinal:CENTer	<Wert / value>	[HZ]	nur bei VSB at VSB only
[SOURce]:FREQuency:OOC[:STATe]?	<Wert / value> | OFF | ON		nur bei VSB at VSB only

Das Subsystem SOURCE:FREQUENCY enthält die Befehle zur Frequenzeinstellung.	The SOURCE:FREQUENCY subsystem provides commands for setting the frequency.

[SOURce]:FREQuency:CENTer

Mittenfrequenz bei Wobbelbetrieb.	Sets the center frequency for a sweep.

[SOURce]:FREQuency:CHANnel

Kanal innerhalb einer eingestellten und vorher selbstdefinierten Kanaltabellen.	Selects the channel from a selected, user-defined channel table.

[SOURce]:FREQuency:CHANnel:TABLe

Mit diesem Kommando kann man selbstdefinierte Kanaltabellen verwenden. Es können fünf Tabellen angelegt werden, deren Namen vom Anwender vergeben werden.	This command selects a user-defined channel table. The user can generate up to five tables and assign a name to them.

[SOURce]:FREQuency[:CW]
[SOURce]:FREQuency:FIXed

Die beiden Kommandos sind gleichbedeutend und dienen zur Einstellung einer festen Trägerfrequenz.	These two commands have the same function. They set a fixed carrier frequency.

[SOURce]:FREQuency:MODE

Unterscheidung des Frequenz-Modes zwischen Normalbetrieb (CW bzw. FIXed) und Wobbelbetrieb (SWEep).	Selects the frequency mode for normal (CW or FIXed) and sweep operation (SWEep).

[SOURce]:FREQuency:RESolution

Schrittweite der Frequenz bei Wobbelbetrieb (SWEEP).	Sets the frequency steps for a sweep.

[SOURce]:FREQuency:SHIFt

Verschiebung der Ausgangsfrequenz an der Buchse	Shifts the output frequency at the connector.

[SOURce]:FREQuency:SPAN

Gesamtes Frequenzintervall bei Wobbelbetrieb.	Sets the frequency range for a sweep.

[SOURce]:FREQuency:STARt

Startfrequenz bei Wobbelbetrieb.	Sets the start frequency for a sweep.

[SOURce]:FREQuency:STOP

Stopfrequenz bei Wobbelbetrieb.	Sets the stop frequency for a sweep.

[SOURce]:FREQuency:ACTual:Center

Einstellung der Mittenfrequenz des VSB RF Spektrums unter Berücksichtigung der zum Einstellzeitpunkt aktuellen Symbolrate.	Sets the center frequency of the VSB RF spectrum taking into account the current symbol rate.

[SOURce]:FREQuency:NOMinal:Center

Einstellung der Mittenfrequenz des VSB RF Spektrums unter Annahme einer normgerechten Bandbreite, resultierend aus der Normsymbolrate von 10.7622377622 MSymb/s.	Sets the center frequency of the VSB RF spectrum assuming a standard-conformal bandwidth resulting from the standard symbol rate of 10.7622377622 Msymb/s.

[SOURce]:FREQuency:OOC[:STATe]?

Abfrage des Zustandes der Out of Center Überwachung. Hierbei wird geprüft, ob das erzeugte Ausgangsspektrum tatsächlich mittig zur eingestellen Mittenfrequenz ist.	Queries the status of the out-of-center monitoring. The generated output spectrum is checked for being symmetrical about the set center frequency.

3.6.9.4 SOURce:CHANnel Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:CHANnel:TABLe:SET	USR1 | USR2 | USR3 | USR4 | USR5, <numeric>, <numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ]	[HZ]	Table set Channel Number Channel Frequency
[SOURce]:CHANnel:TABLe:ASSign	USR1 | USR2 | USR3 | USR4 | USR5, <string>		Table set Table set name

[SOURce] :CHANnel:TABLe:SET

Weist einer Kanaltabelle einen neuen Kanal zu. Parameter 1: Kanaltabelle Parameter 2: Kanal (1..100) Parameter 3: Frequenz (0 löscht den Eintrag) Bei der Abfrage sind die ersten zwei Parameter erforderlich	Assigns a new channel to a channel table. Parameter 1: channel table Parameter 2: channel (1 to 100) Parameter 3: frequency (0 clears entry) The first two parameters are needed for a query.

[SOURce] :CHANnel:TABLe:ASSign

Zuweisen eines Namens zu einer Kanaltabelle Parameter 1: Kanaltabelle Parameter 2: Name (max. 12 Zeichen) Bei der Abfrage ist der erste Parameter erforderlich	Assigns a name to a channel table. Parameter 1: channel table Parameter 2: name (max. 12 characters) The first parameter is needed for a query.

3.6.9.5 SOURce:IQCoder Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:DVBC:DATarate (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:DATarate)	<Wert / value> [MB] | MAXimum | MINimum		CSPL Coder: nur Abfrage query only
[SOURce]:IQCoder:DVBC:INPut (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:INPut)	TSP | ASI | SPI | ASX | SPX |		TS PARALLEL ASI SPI ASI EXT. CLOCK SPI EXT. CLOCK
[SOURce]:IQCoder:DVBC:MODE (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:MODE)	DATA | AUTO |(nur/only I/Q Coder, CSPL Coder:erzwingt/forces DATA) PRBS | NTSP | PTSP		DATA I/Q Coder: AUTO CSPL Coder: DATA PRBS NULL TS PACKET NULL PRBS PACK.
[SOURce]:IQCoder:DVBC:PACKetlength (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:PACKetlength)	P188 | P204		
[SOURce]:IQCoder:DVBC:SYMBols[:RATe] (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:SYMBols[:RATe])			
[SOURce]:IQCoder:DVBC:LOCKed? (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:LOCKed?)	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL | ERROR | NOREF | CABER		LOCKED UNLOCKED NO CLOCK NO DATA FRAME ERROR OVERFLOW UNDERFLOW WRONG CLOCK DC ERROR NO REFERENCE CABLE ERROR nur Abfrage query only
[SOURce]:IQCoder:DVBC:ROLLoff (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM:ROLLoff)	<Wert / value> | MAXimum | MINimum		
[SOURce]:IQCoder:DVBC[:SPECial]: INTerleave (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM[:SPECial]:INTerleave)	<Wert / value> | OFF | ON		
SOURce]:IQCoder:DVBC[:SPECial]: REEDsolomon (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM[:SPECial]:REEDsolomon)	<Wert / value> | OFF | ON		
[SOURce]:IQCoder:DVBC[:SPECial]: SCRamble (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QAM[:SPECial]:SCRamble)	<Wert / value> | OFF | ON		

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:DVBC[:SPECial]: SYNC[:BYTE]:INVersion	<Wert / value> | OFF | ON		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:DVBC[:SPECial]:PLL:INT	REF10 | TCXO | VCXO		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:DVBC [:SPECial]:PLL:DATA	FIFO | TS		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:DVBC:UNLock:CAUSe	<string>		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:SAT:DATarate (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:DATarate)	<Wert / value> [MB] | MAXimum | MINimum		CSPL Coder: nur Abfrage query only
[SOURce]:IQCoder:SAT:INPut (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:INPut)	TSP | ASI | SPI | ASX | SPX |		TS PARALLEL ASI SPI ASI EXT. CLOCK SPI EXT. CLOCK
[SOURce]:IQCoder:SAT:MODE (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:MODE)	DATA | AUTO |(nur/only I/Q Coder, CSPL Coder:erzwingt/forces DATA) PRBS | NTSP | PTSP		DATA I/Q Coder: AUTO CSPL Coder: DATA PRBS NULL TS PACKET NULL PRBS PACK.
[SOURce]:IQCoder:SAT:PACKetlength (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:PACKetlength)	P188 | P204		
[SOURce]:IQCoder:SAT:SYMBols[:RATe] (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:SYMBols[:RATe])			
[SOURce]:IQCoder:SAT:LOCKed? (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:LOCKed?)	LOCK | UNL | NOCL | NOD | FRER | OVERFL| UNDERFL | WICL | ERROR | NOREF | CABER		LOCKED UNLOCKED NO CLOCK NO DATA FRAME ERROR OVERFLOW UNDERFLOW WRONG CLOCK DC ERROR NO REFERENCE CABLE ERROR nur Abfrage query only
[SOURce]:IQCoder:SAT:RATE (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:RATE)	R1_2 | R2_3 | R3_4 | R5_6 | R7_8 | R8_9 | R1_3		
[SOURce]:IQCoder:SAT:ROLLoff (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK:ROLLoff)	<Wert / value> | MAXimum | MINimum		

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:SAT[:SPECial]: INTerleave (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK[:SPECial]:INTerleave)	<Wert / value> | OFF | ON		
[SOURce]:IQCoder:SAT[:SPECial]: REEDsolomon (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK[:SPECial]:REEDsolomon)	<Wert / value> | OFF | ON		
[SOURce]:IQCoder:SAT[:SPECial]: SCRamble (veraltet / obsolete, legacy code: [SOURce]:IQCoder:QPSK[:SPECial]:SCRamble)	<Wert / value> | OFF | ON		
[SOURce]:IQCoder:SAT[:SPECial]: SYNC[:BYTE]:INVersion	<Wert / value> | OFF | ON		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:SAT[:SPECial]:PLL:INT	REF10 | TCXO | VCXO		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:SAT: [:SPECial]:PLL:DATA	FIFO | TS		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:SAT:UNLock:CAUSe	<string>		Nur mit / only with CSPL Coder
[SOURce]:IQCoder:COFDm:INPut[:LOW]	TSP | ASI | SPI | ASX | SPX | SPIAUX TSPAUX		TS PARALLEL ASI SPI ASI EXT. CLOCK SPI EXT. CLOCK SPI AUX Input TSP AUX Input
[SOURce]:IQCoder:COFDm:INPut:HIGH	TSP | ASI | SPI | ASX | SPX | SPIAUX TSPAUX		TS PARALLEL ASI SPI ASI EXT. CLOCK SPI EXT. CLOCK SPI AUX Input TSP AUX Input
[SOURce]:IQCoder:COFDm:INPut:DATarate [:LOW]	<numeric> [MB] | MAXimum | MINimum		
[SOURce]:IQCoder:COFDm:INPut:DATarate: HIGH	<numeric> [MB] | MAXimum | MINimum		
[SOURce]:IQCoder:COFDm:USED [:BANDwidth]	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum		
[SOURce]:IQCoder:COFDm:CHANnel [:BANDwidth]	BW_8 | BW_7 | BW_6		?: | MODIFIED
[SOURce]:IQCoder:COFDm:PACKetlength [:LOW]	P188 | P204		
[SOURce]:IQCoder:COFDm:PACKetlength :HIGH	P188 | P204		

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:COFDM:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL		LOCKED UNLOCKED NO CLOCK NO DATA FRAME ERROR OVERFLOW UNDERFLOW WRONG CLOCK nur Abfrage query only
[SOURce]:IQCoder:COFDM:LOCKed:LOW?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL		nur Abfrage query only
[SOURce]:IQCoder:COFDM:LOCKed:HIGH?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL		nur Abfrage query only
[SOURce]:IQCoder:COFDm:PACKetlength [:LOW]	P188 | P204		
[SOURce]:IQCoder:COFDm:PACKetlength: HIGH	P188 | P204		
[SOURce]:IQCoder:COFDm:MODE[:LOW]	DATA | PBEC | PAFC | NTSP | PTSP | PBEM		DATA PRBS BEF. CONV. PRBS AFTER CONV. NULL TS PACKET NULL PRBS PACKET PRBS BEFORE MAP.
[SOURce]:IQCoder:COFDm:MODE:HIGH	DATA | PBEC | PAFC | NTSP | PTSP | PBEM		DATA PRBS BEFORE CONV. PRBS AFTER CONV. NULL TS PACKET NULL PRBS PACKET PRBS BEFORE MAP.
[SOURce]:IQCoder:COFDm:DATA	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:DATA:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:PILot	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:PILot:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:TPS	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:TPS:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:EQUal [:CARRiers]	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:GUARd	G1_4 | G1_8 | G1_16 | G1_32 | OFF		
[SOURce]:IQCoder:COFDm:FFT:MODE	M2K | M8K		
[SOURce]:IQCoder:COFDm:RATE[:LOW]	R1_2 | R2_3 | R3_4 | R5_6 | R7_8		
[SOURce]:IQCoder:COFDm:RATE:HIGH	R1_2 | R2_3 | R3_4 | R5_6 | R7_8		
[SOURce]:IQCoder:COFDm[:SPECial]: SCRamble[:LOW]	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: SCRamble:HIGH	<numeric> | OFF | ON		

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:COFDm[:SPECial]: CONV[:INTerleaver][:LOW]	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: CONV[:INTerleaver]:HIGH	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]:BIT [:INTerleaver]	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: SYMBol[:INTerleaver]	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: CELL:ID	<numeric>		MIN: "#0000" MAX: "#FFFF"
[SOURce]:IQCoder:COFDm[:SPECial]: TPSReserved:STATe	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: TPSReserved:VALue	<numeric>		MIN: "#00" MAX: "#3F"
[SOURce]:IQCoder:COFDm[:SPECial]: SYNC[:BYTE]:INVersion[:LOW]	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: SYNC[:BYTE]:INVersion:HIGH	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: REEDsolomon:HIGH	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: REEDsolomon:HIGH	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm[:SPECial]: REEDsolomon:HIGH	<numeric> | OFF | ON		
[SOURce]:IQCoder:COFDm:DISable: CARRiers	<string>		
[SOURce]:IQCoder:COFDm:IFFT:SYNC[:OUTPut]	<numeric> | OFF | ON		
[SOURce:]IQCoder:VSB:DATarate	<numeric> [MB] | MAXimum | MINimum		
[SOURce:]IQCoder:VSB:INPut	TSP | ASI | SPI | ASX | SPX | SMPTe | SMX		TS PARALLEL ASI SPI ASI EXT. CLOCK SPI EXT. CLOCK SMPTE SMPTE EXT. CLOCK
[SOURce:]IQCoder:VSB:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL		LOCKED UNLOCKED NO CLOCK NO DATA FRAME ERROR OVERFLOW nur Abfrage query only
[SOURce:]IQCoder:VSB:MODE	PRBS | DATA | NTSP | PTSP | PBET | PAFT | SYNC		PRBS DATA PRBS BEF. TRELLIS PRBS AFT. TRELLIS NULL TS PACKET NULL PRBS PACK. SYNC PRBS

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce:]IQCoder:VSB:ROLLoff	<numeric> | MAXimum | MINimum		
[SOURce:]IQCoder:VSB:SYMBols[:RATE]	<numeric> | MAXimum | MINimum		
[SOURce:]IQCoder:VSB [:SPECial]:RANDomizer	<numeric> | OFF | ON		
[SOURce:]IQCoder:VSB [:SPECial]:INTerleave	<numeric> | OFF | ON		
[SOURce:]IQCoder:VSB [:SPECial]: PILot[:STATe]	<numeric> | OFF | ON		
[SOURce:]IQCoder:VSB [:SPECial]:PILot:VALue	<numeric> | MAXimum | MINimum		
[SOURce:]IQCoder:J83B:DATarate	<numeric> [MB] | MAXimum | MINimum		
[SOURce:]IQCoder:J83B:INPut	TSP | ASI | SPI | ASX | SPX |		TS PARALLEL ASI SPI ASI EXT. CLOCK SPI EXT. CLOCK
SOURce:]IQCoder:J83B:INTerleaver:MODE	<numeric>		
[SOURce:]IQCoder:J83B:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | CABER		LOCKED UNLOCKED NO CLOCK NO DATA FRAME ERROR OVERFLOW CABLE ERROR nur Abfrage query only
[SOURce:]IQCoder:J83B:MODE	PRBS | DATA | NTSP | PTSP | PBET | PAFT | SYNC		PRBS DATA PRBS BEF. TRELLIS PRBS AFT. TRELLIS NULL TS PACKET NULL PRBS PACK. SYNC PRBS
[SOURce:]IQCoder:J83B:ROLLoff	<numeric> | MAXimum | MINimum		
[SOURce:]IQCoder:J83B:SYMBols[:RATE]	<numeric> | MAXimum | MINimum		
[SOURce:]IQCoder:J83B [:SPECial]:RANDomizer	<numeric> | OFF | ON		
[SOURce:]IQCoder:J83B [:SPECial]:INTerleaver	<numeric> | OFF | ON		
[SOURce:]IQCoder:J83B [:SPECial]:REEDsolomon	<numeric> | OFF | ON		
[SOURce:]IQCoder:PRBS[:SEQuence]	P23_1 | P15_1		
[SOURce]:IQCoder:ISDBt:AC	<numeric> | OFF | ON		

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:ISDBt:AC:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:ACData[1|2]	ALL1 | PRBS		
[SOURce]:IQCoder:ISDBt:BANDwidth	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum		
[SOURce]:IQCoder:ISDBt:CONStel:A	C_DQpsk | C_QPsk | C_16qam | C_64qam		
[SOURce]:IQCoder:ISDBt:CONStel:B	C_DQpsk | C_QPsk | C_16qam | C_64qam		
[SOURce]:IQCoder:ISDBt:CONStel:C	C_DQpsk | C_QPsk | C_16qam | C_64qam		
[SOURce]:IQCoder:ISDBt:CP	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:CP:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:DATA	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:DATA:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:FFT:MODE	M1_2K | M2_4K | M3_8K		
[SOURce]:IQCoder:ISDBt:GUARd	G1_4 | G1_8 | G1_16 | G1_32 | OFF		
[SOURce]:IQCoder:ISDBt:INPut	ASI | SPI | TSPaux		ASI SPI TS PARALLEL + AUX
[SOURce]:IQCoder:ISDBt:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL | ERROR | PIDER		LOCKED UNLOCKED NO CLOCK NO DATA FRAME ERROR OVERFLOW UNDERFLOW WRONG CLOCK DC ERROR PID ERROR nur Abfrage query only
[SOURce]:IQCoder:ISDBt:MODE:A	DATA | NTSP | PTSP | PBEC | PAFC		DATA NULL TS PACKET PRBS TS PACKET PRBS BEF. CONV. PRBS AFT. CONV.
[SOURce]:IQCoder:ISDBt:MODE:B	DATA | NTSP | PTSP | PBEC | PAFC		DATA NULL TS PACKET PRBS TS PACKET PRBS BEF. CONV. PRBS AFT. CONV.
[SOURce]:IQCoder:ISDBt:MODE:C	DATA | NTSP | PTSP | PBEC | PAFC		DATA NULL TS PACKET PRBS TS PACKET PRBS BEF. CONV. PRBS AFT. CONV.
[SOURce]:IQCoder:ISDBt:RATE:A	R1_2 | R2_3 | R3_4 | R5_6 | R7_8		
[SOURce]:IQCoder:ISDBt:RATE:B	R1_2 | R2_3 | R3_4 | R5_6 | R7_8		
[SOURce]:IQCoder:ISDBt:RATE:C	R1_2 | R2_3 | R3_4 | R5_6 | R7_8		
[SOURce]:IQCoder:ISDBt:SEGMents:A	<numeric>		

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:IQCoder:ISDBt:SEGMents:B	<numeric>		
[SOURce]:IQCoder:ISDBt:SEGMents:C	<numeric>		
[SOURce]:IQCoder:ISDBt:SEGMents[:STATe]	<numeric>, <numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:SP	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:SP:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:A	<numeric>		
[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:B	<numeric>		
[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:C	<numeric>		
[SOURce]:IQCoder:ISDBt:TMCC	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt:TMCC:MOD	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:ALERt[:BROadcast]	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:BIT[:INTerleaver]	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:BYTE[:INTerleaver]	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:FREQuency[:INTerleaver]	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:PID:A	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:PID:B	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:PID:C	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:REEDsolomon	<numeric> | OFF | ON		
[SOURce]:IQCoder:ISDBt[:SPECial]:SCRambler	<numeric> | OFF | ON		

Das Subsystem SOURCE:IQCODER enthält die Befehle zur den I/Q Modulationen.	The SOURCE:IQCODER subsystem provides commands for I/Q modulation.

[SOURce]:IQCoder:DVBC:DATarate ([SOURce]:IQCoder:QAM:DATarate)

Eingestellte Datenrate bei DVB-C Modulation. Bei Verwendung eine CSPL Coders ist nur die Abfrage möglich	Sets the data rate for DVB-C.

[SOURce]:IQCoder:DVBC:INPut ([SOURce]:IQCoder:QAM:INPut)

Eingangsinterface bei DVB-C-Modulation. Für alle Eingänge außer TS-Parallel ist die Option Input Interface nötig.	Selects the input interface for DVB-C. The input interface option is required for all inputs except TS PARALLEL.

[SOURce]:IQCoder:DVBC:LOCKed? ([SOURce]:IQCoder:QAM:LOCKed?)

Abfrage des Synchronisationszustandes des I/Q Coders auf den eingespeisten Datenstrom bei DVB-C-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten und FRER (frame error) für Rahmenfehler. Darüber hinaus liefert ein vorhandenes Input Interface bei einer Unvereinbarkeit von Eingangsbitrate und Ausgangssymbolrate die Meldung OVERFL (Overflow).	Queries the synchronisation of the I/Q coder to the applied data stream for DVB-C. The following states are possible: LOCK for locked, UNL for unlocked, NOCL for no clock signal present, NOD for no data received and FRER for frame error. Moreover, a built-in input interface issues the message OVERFL (overflow) if the input bit rate and the output symbol rate do not match.

[SOURce]:IQCoder:DVBC:MODE ([SOURce]:IQCoder:QAM:MODE)

Mode des vom I/Q Coder erzeugten Dateninhalts bei DVB-C-Modulation.	Selects the mode for the data generated by the I/Q coder for DVB-C.

[SOURce]:IQCoder:DVBC:PACKetlength ([SOURce]:IQCoder:QAM:PACKetlength)

Länge des Datenpaketes bei DVB-C-Modulation.	Selects the data packet length for DVB-C.

[SOURce]:IQCoder:DVBC:SYMBols[:RATe] ([SOURce]:IQCoder:QAM:SYMBols[:RATe])

Abfrage der Symbolrate bei DVB-C-Modulation.	Queries the symbol rate for DVB-C.

[SOURce]:IQCoder:DVBC:ROLLoff ([SOURce]:IQCoder:QAM:ROLLoff)

Rolloff-Faktor der Wurzel-Kosinus Bandpassfilterung bei DVB-C-Modulation.	Sets the roll-off factor for root raised cosine bandpass filtering for DVB-C.

[SOURce]:IQCoder:DVBC[:SPECial]:INTerleave ([SOURce]:IQCoder:QAM[:SPECial]:INTerleave)

Ein-/Ausschalten des Convolutional Interleaver bei DVB-C-Modulation.	Switches the convolutional interleaver for DVB-Con and off.

[SOURce]:IQCoder:DVBC[:SPECial]:REEDsolomon ([SOURce]:IQCoder:QAM[:SPECial]:REEDsolomon

Ein-/Ausschalten des Reed-Solomon Encoders bei DVB-C-Modulation.	Switches the Reed-Solomon encoder for DVB-Con and off.

[SOURce]:IQCoder:DVBC[:SPECial]:SCRambler [(SOURce]:IQCoder:QAM[:SPECial]:SCRambler)

Ein-/Ausschalten des Scramblers bei DVB-C-Modulation.	Switches the scrambler for DVB-Con and off.

[SOURce]:IQCoder:SAT:DATarate **([SOURce]:IQCoder:QPSK:DATarate)**

Eingestellte Datenrate bei SATELLITE Modulation.	Sets the data rate for SATELLITE.

[SOURce]:IQCoder:SAT:INPut **([SOURce]:IQCoder:QPSK:INPut)**

Eingangsinterface bei SATELLITE-Modulation. Für alle Eingänge außer TS-Parallel ist die Option Input Interface nötig.	Selects the input interface for SATELLITE. The input interface option is required for all inputs except TS PARALLEL.

[SOURce]:IQCoder:SAT:LOCKed? **([SOURce]:IQCoder:QPSK:LOCKed?)**

Abfrage des Synchronisationszustandes des I/Q Coders auf den eingespeisten Datenstrom bei SATELLITE-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten und FRER (frame error) für Rahmenfehler. Darüber hinaus liefert ein vorhandenes Input Interface bei einer Unvereinbarkeit von Eingangsbitrate und Ausgangssymbolrate die Meldung OVERFL (Overflow).	Queries synchronization of the I/Q coder to the applied data stream for SATELLITE. The following states are possible: LOCK for locked, UNL for unlocked, NOCL for no clock received, NOD for no data received and FRER for frame error. Moreover, a built-in input interface issues the message OVERFL (Overflow) if the input bit rate and the output symbol rate do not match.

[SOURce]:IQCoder:SAT:MODE **([SOURce]:IQCoder:QPSK:MODE)**

Mode des vom I/Q Coder erzeugten Dateninhalts bei SATELLITE-Modulation.	Selects the mode for the data generated by the I/Q coder for SATELLITE.

[SOURce]:IQCoder:SAT:RATE **([SOURce]:IQCoder:QPSK:RATE)**

Punktierungsrate bei SATELLITE-Modulation.	Puncturing rate for SATELLITE.

[SOURce]:IQCoder:SAT:PACKetlength ([SOURce]:IQCoder:QPSK:PACKetlength)

Länge des Datenpaketes bei SATELLITE-Modulation.	Selects the data packet length for SATELLITE.

[SOURce]:IQCoder:SAT:SYMBols[:RATe] **([SOURce]:IQCoder:QPSK:SYMBols[:RATe])**

Abfrage der Symbolrate bei SATELLITE-Modulation.	Queries the symbol rate for SATELLITE.

[SOURce]:IQCoder:SAT:ROLLoff **([SOURce]:IQCoder:QPSK:ROLLoff)**

Rolloff-Faktor der Wurzel-Kosinus Bandpassfilterung bei SATELLITE-Modulation.	Sets the roll-off factor for square root cosine bandpass filtering for SATELLITE.

[SOURce]:IQCoder:SAT[:SPECial]:INTerleave **([SOURce]:IQCoder:QPSK[:SPECial]:INTerleave)**

Ein-/Ausschalten des Convolutional Interleavers bei SATELLITE-Modulation.	Switches the convolutional interleaver for SATELLITEon and off.

[SOURce]:IQCoder:SAT[:SPECial]:REEDsolomon **([SOURce]:IQCoder:QPSK[:SPECial]:REEDsolomon)**

Ein-/Ausschalten des Reed-Solomon Encoders bei SATELLITE-Modulation.	Switches the Reed-Solomon encoders for SATELLITEon and off.

[SOURce]:IQCoder:SAT[:SPECial]:SCRamble **([SOURce]:IQCoder:QPSK[:SPECial]:SCRamble)**

Ein-/Ausschalten des Scramblers bei SATELLITE-Modulation.	Switches the scrambler for SATELLITEon and off.

[SOURce]:IQCoder:COFDm:INPut[:LOW]

Eingangsinterface bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation. Für alle Eingänge außer TS-Parallel ist die Option Input Interface nötig.	Input interface for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation. Option input interface is required for all inputs except TS PARALLEL.

[SOURce]:IQCoder:COFDm:INPut:HIGH

Eingangsinterface des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Input interface of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:INPut:DATarate[:LOW]

Eingangsinterface bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Input interface for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:INPut:DATarate:HIGH

Eingangsdatenrate des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Input data rate of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:USED[:BANDwidth]

Nutzbandbreite bei COFDM-Modulation. Eine individuelle Nutbandbreite führt bei IQCoder:COFDm:CHAN? zu MODIFIED.	Useful bandwidth for COFDM modulation.

[SOURce]:IQCoder:COFDm:CHANnel[:BANDwidth]

Kanalbandbreite bei COFDM-Modulation.	Channel bandwidth for COFDM modulation.

[SOURce]:IQCoder:COFDm:PACKetlength:[LOW]

Länge des Datenpaketes bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Length of data packet for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:PACKetlength:HIGH

Länge des Datenpaketes des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Length of data packet of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDM:LOCKed?

Abfrage des Synchronisationszustandes des DVB-T Coders auf den eingespeisten Datenstrom bei nichthierarchischer oder hierarchischer COFDM-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, WICL (wrong input clock) für Taktabweichungen NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten, FRER (frame error) für Rahmenfehler, OVERFL (overflow) für FIFO Überlauf und UNDERFL (underflow) für zu wenig FIFO Daten .	Queries the synchronization of the DVB-T coder to the applied data stream for non-hierarchical or hierarchical COFDM modulation. The following states are possible: LOCK for locked, UNL for unlocked, WICL for wrong input clock NOCL for no clock, NOD for no data, FRER for frame error, OVERFL for FIFO overflow UNDERFL for FIFO underflow.

[SOURce]:IQCoder:COFDM:LOCKed:LOW?

Abfrage des Synchronisationszustandes des Low Priority Zweigs bei hierarchischer COFDM-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, WICL (wrong input clock) für Taktabweichungen NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten, FRER (frame error) für Rahmenfehler, OVERFL (overflow) für FIFO Überlauf und UNDERFL (underflow) für zu wenig FIFO Daten .	Queries the synchronization of low-priority path for hierarchical COFDM modulation. The following states are possible: LOCK for locked, UNL for unlocked, WICL for wrong input clock NOCL for no clock, NOD for no data, FRER for frame error, OVERFL for FIFO overflow UNDERFL for FIFO underflow.

[SOURce]:IQCoder:COFDM:LOCKed:HIGH?

Abfrage des Synchronisationszustandes des High Priority Zweigs bei hierarchischer COFDM-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, WICL (wrong input clock) für Taktabweichungen NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten, FRER (frame error) für Rahmenfehler, OVERFL (overflow) für FIFO Überlauf und UNDERFL (underflow) für zu wenig FIFO Daten .	Queries the synchronization of high-priority path for hierarchical COFDM modulation. The following states are possible: LOCK for locked, UNL for unlocked, WICL for wrong input clock NOCL for no clock, NOD for no data, FRER for frame error, OVERFL for FIFO overflow UNDERFL for FIFO underflow.

[SOURce]:IQCoder:COFDm:PACKetlength[:LOW]

Länge des Datenpaketes bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Length of data packet for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:PACKetlength:HIGH

Länge des Datenpaketes des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Length of data packet of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:MODE[:LOW]

Mode des vom DVB-T Coder erzeugten Dateninhalts bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Mode of data content generated by the DVB-T coder for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:MODE:HIGH

Mode des vom DVB-T Coder erzeugten Dateninhalts des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Mode of data content (generated by the DVB-T coder) of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:DATA

Abschaltung aller Datenträger bei COFDM-Modulation.	Switch-off of all data carriers for COFDM modulation.

[SOURce]:IQCoder:COFDm:DATA:MOD

Abschaltung der Modulation der Datenträger bei COFDM-Modulation.	Switch-off of modulation of data carriers for COFDM modulation.

[SOURce]:IQCoder:COFDm:PILot

Abschaltung aller Piloten bei COFDM-Modulation.	Switch-off of all pilots for COFDM modulation.

[SOURce]:IQCoder:COFDm:PILot:MOD

Abschaltung der Modulation der Piloten bei COFDM- Modulation.	Switch-off of modulation of pilots for COFDM modulation.

[SOURce]:IQCoder:COFDm:TPS

Abschaltung aller TPS (Transmission Parameter Signalling) - Träger bei COFDM-Modulation.	Switch-off of all TPS (Transmission Parameter Signalling) carriers for COFDM modulation.

[SOURce]:IQCoder:COFDm:TPS:MOD

Abschaltung der Modulation der TPS (Transmission Parameter Signalling) - Träger bei COFDM-Modulation.	Switch-off of modulation of TPS (Transmission Parameter Signalling) carriers for COFDM modulation.

[SOURce]:IQCoder:COFDm:EQUal[:CARRiers]

Einschalten der Erzeugung von unmodulierten CW Trägern mit gleichem Pegel bei COFDM-Modulation.	Activating the generation of unmodulated CW carriers with identical level in the case of COFDM modulation.

[SOURce]:IQCoder:COFDm:GUARd

Wahl des Guard Intervalls bei COFDM-Modulation.	Selection of guard interval for COFDM modulation.

[SOURce]:IQCoder:COFDm:FFT:MODE

Umschaltung zwischen 2K und 8K FFT Mode bei COFDM-Modulation.	Switchover between 2K and 8K FFT mode for COFDM modulation.

[SOURce]:IQCoder:COFDm:RATE[:LOW]

Wahl der Coderate bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Selection of code rate for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:RATE:HIGH

Wahl der Coderate des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Selection of code rate of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:SCRamble[:LOW]

Ein-/Ausschalten der Energieverwischung bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of enery dispersal for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:SCRamble:HIGH

Ein-/Ausschalten der Energieverwischung des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of energy dispersal of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:CONV[:INTerleaver][:LOW]

Ein-/Ausschalten des Convolutional Interleavers bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of convolutional interleaver for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:CONV[:INTerleaver]:HIGH

Ein-/Ausschalten des Convolutional Interleavers des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of convolutional interleaver of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:BIT[:INTerleaver]

Ein-/Ausschalten des Bitinterleavers bei COFDM-Modulation.	Switch-on/off of bit interleaver for COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:SYMBol[:INTerleaver]

Ein-/Ausschalten des Symbolinterleavers bei COFDM-Modulation.	Switch-on/off of symbol interleaver for COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:CELL:ID

Wahl des Inhalts der Cell Identification bei COFDM-Modulation.	Selection of contents of cell identification for COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:TPSReserved:STATe

Ein-/Ausschalten von TPS Reserved Bits bei COFDM-Modulation.	Switch-on/off of TPS reserved bits for COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:TPSReserved:VALue

Wahl des Inhalts der TPS Reserved Bits bei COFDM-Modulation.	Selection of contents of TPS reserved bits for COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:SYNC[:BYTE]:INVersion[:LOW]

Ein-/Ausschalten der Sync. Byte Invertierung bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of sync byte inversion for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:SYNC[:BYTE]:INVersion:HIGH

Ein-/Ausschalten der Sync. Byte Invertierung des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of sync byte inversion of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:REEDsolomon[:LOW]

Ein-/Ausschalten des Reed-Solomon Encoders bei nichthierarchischer Constellation oder des Low Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of Reed-Solomon encoder for non-hierarchical constellation or of low-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm[:SPECial]:REEDsolomon:HIGH

Ein-/Ausschalten des Reed-Solomon Encoders des High Priority Zweigs bei hierarchischer COFDM-Modulation.	Switch-on/off of Reed-Solomon encoder of high-priority path for hierarchical COFDM modulation.

[SOURce]:IQCoder:COFDm:DISable:CARRiers

Abschalten einzelner Träger bei COFDM-Modulation. Träger können im Bereich von 0-8191 im 8K FFT Mode und 0-2047 im 2K FFT Mode gewählt werden. Trägerbereiche werden durch Bindestrich angegeben. Einzelträger und Trägerbereiche werden durch Punkt oder Komma getrennt. Beispiel: ”100,200,300-400” Die beschreibende Zeichenkette darf maximal 40 Zeichen lang sein.	Switch-off of individual carriers for COFDM modulation. Carriers can be selected from 0 to 8191 (0-8191) in the 8K FFT mode and from 0 to 2047 (0-2047) in the 2K FFT mode. Carrier ranges are indicated with a hyphen. Individual carriers and carrier ranges are separated by a decimal point or comma. Example: ”100,200,300-400” The character string may not exceed 40 characters.

[SOURce]:IQCoder:COFDm:IFFT:SYNC[:OUTPut]

IFFT Synchronisationssignals des DVB-T Coders auf die Ausgangsbuchse schalten	Switches IFFT synchronization signal of DVB-T coder to output connector.

[SOURce]:IQCoder:VSB:DATarate

Eingestellte Datenrate bei VSB Modulation abfragen.	Queries the data rate for VSB modulation.

[SOURce]:IQCoder:VSB:INPut

Eingangsinterface bei VSB-Modulation. Für alle Eingänge außer TS-Parallel ist die Option Input Interface nötig.	Input interface for VSB modulation. The optional input interface is required for all inputs except TS PARALLEL.

[SOURce]:IQCoder:VSB:LOCKed?

Abfrage des Synchronisationszustandes des I/Q Coders auf den eingespeisten Datenstrom bei VSB-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten und FRER (frame error) für Rahmenfehler. Darüber hinaus liefert ein vorhandenes Input Interface bei einer Unvereinbarkeit von Eingangsbitrate und Ausgangssymbolrate die Meldung OVERFL (Overflow).	Queries the synchronization of the I/Q coder to the applied data stream for VSB modulation. The following states are possible: LOCK for locked, UNL for unlocked, NOCL for no clock, NOD for no data and FRER for frame error. Moreover, a built-in input interface outputs the message OVERFL (overflow) if the input bit rate and the output symbol rate do not match.

[SOURce]:IQCoder:VSB:MODE

Mode des vom I/Q Coder erzeugten Dateninhalts bei VSB-Modulation.	Mode of data contents generated by I/Q coder for VSB modulation.

[SOURce]:IQCoder:VSB:PACKetlength

Länge des Datenpaketes bei VSB-Modulation.	Length of data packet for VSB modulation.

[SOURce]:IQCoder:VSB:SYMBols[:RATe]

Abfrage der Symbolrate bei VSB-Modulation.	Query of symbol rate for VSB modulation.

[SOURce]:IQCoder: VSB:ROLLoff

Rolloff-Faktor der Wurzel-Kosinus Bandpass-filterung bei VSB-Modulation.	Roll-off factor of root raised cosine bandpass filtering for VSB modulation.

[SOURce]:IQCoder:VSB[:SPECial]:INTerleave

Ein-/Ausschalten des Convolutional Interleavers bei VSB-Modulation.	Switch-on/off of convolutional interleavers for VSB modulation.

[SOURce]:IQCoder:VSB[:SPECial]:REEDsolomon

Ein-/Ausschalten des Reed-Solomon Encoders bei VSB-Modulation.	Switch-on/off of Reed-Solomon encoder for VSB modulation.

[SOURce]:IQCoder:VSB[:SPECial]:PILot[:STATe]

Ein-/Ausschalten des Pilot Trägers bei VSB-Modulation.	Switch-on/off of pilot carrier for VSB modulation.

[SOURce]:IQCoder:VSB[:SPECial]:PILot:Value

Pegel des Pilot Trägers bei VSB-Modulation.	Level of pilot carrier for VSB modulation.

[SOURce]:IQCoder:J83B:DATarate

Eingestellte Datenrate bei J.83/B Modulation abfragen.	Queries the data rate for J.83/B modulation.

[SOURce]:IQCoder:J83B:INPut

Eingangsinterface bei J.83/B-Modulation. Für alle Eingänge außer TS-Parallel ist die Option Input Interface nötig.	Input interface for J.83/B modulation. The optional input interface is required for all inputs except TS PARALLEL.

[SOURce]:IQCoder:J83B:INTerleaver:MODE

Interleaver Mode bei J.83/B-Modulation.	Interleaver mode for J.83/B modulation.

[SOURce]:IQCoder:J83B:LOCKed?

Abfrage des Synchronisationszustandes des Coders auf den eingespeisten Datenstrom bei J.83/B-Modulation. Folgende Zustände sind möglich. LOCK (locked) für eingerastet, UNL (unlocked) für nicht eingerastet, NOCL (no clock) für fehlenden Takt, NOD (no data) für fehlende Daten und FRER (frame error) für Rahmenfehler. Darüber hinaus liefert ein vorhandenes Input Interface bei einer Unvereinbarkeit von Eingangsbitrate und Ausgangssymbolrate die Meldung OVERFL (Overflow).	Queries the synchronization of the coder to the applied data stream for J.83/B modulation. The following states are possible: LOCK for locked, UNL for unlocked, NOCL for no clock, NOD for no data and FRER for frame error. Moreover, a built-in input interface outputs the message OVERFL (overflow) if the input bit rate and the output symbol rate do not match.

[SOURce]:IQCoder:J83B:MODE

Mode des vom Coder erzeugten Dateninhalts bei J.83/B-Modulation.	Mode of data contents generated by coder for J.83/B modulation.

[SOURce]:IQCoder:J83B:PACKetlength

Länge des Datenpaketes bei J.83/B-Modulation.	Length of data packet for J.83/B modulation.

[SOURce]:IQCoder:J83B:SYMBols[:RATe]

Abfrage der Symbolrate bei J.83/B-Modulation.	Query of symbol rate for J.83/B modulation.

[SOURce]:IQCoder: J83B:ROLLoff

Rolloff-Faktor der Wurzel-Kosinus Bandpass-filterung bei J.83/B-Modulation.	Roll-off factor of root raised cosine bandpass filtering for J.83/B modulation.

[SOURce]:IQCoder:J83B:SPECial:INTerleaver

Ein-/Ausschalten des Convolutional Interleavers bei J.83/B-Modulation.	Switch-on/off of convolutional interleavers for J.83/B modulation.

[SOURce]:IQCoder:J83B[:SPECial]:REEDsolomon

Ein-/Ausschalten des Reed-Solomon Encoders bei J.83/B-Modulation.	Switch-on/off of Reed-Solomon encoder for J.83/B modulation.

[SOURce]:IQCoder:ISDBt:AC

Alle *Auxiliary Channel* Träger bei ISDB-T werden ein-/ausgeschaltet (I = 0, Q = 0).	Switch-on/off of all *auxiliary channel* carriers for ISDB-T (I = 0, Q = 0).

[SOURce]:IQCoder:ISDBt:AC:MOD

Die Modulation aller *Auxiliary Channel* Träger bei ISDB-T wird ein-/ausgeschaltet.	Switch-on/off of modulation of all *auxiliary channel* carriers for ISDB-T.

[SOURce]:IQCoder:ISDBt:ACData[1|2]

Wahl des Dateninhalts des Auxiliary Transmission Channels AC bei ISDB-T	Selection of data contents of auxiliary transmission channel (AC) for ISDB-T.

[SOURce]:IQCoder:ISDBt:BANDwidth

Einstellung der Bandbreite (Bandwidth) des ISDB-T Spektrums	Setting of bandwidth of ISDB-T spectrum.

[SOURce]:IQCoder:ISDBt:CONStel:A

Einstellung der Konstellationen für Layer A bei ISDB-T	Setting of constellations for layer A for ISDB-T.

[SOURce]:IQCoder:ISDBt:CONStel:B

Einstellung der Konstellationen für Layer B bei ISDB-T	Setting of constellations for layer B for ISDB-T.

[SOURce]:IQCoder:ISDBt:CONStel:C

Einstellung der Konstellationen für Layer C bei ISDB-T	Setting of constellations for layer C for ISDB-T.

[SOURce]:IQCoder:ISDBt:CP

Alle *Continual Pilots* bei ISDB-T werden ein-/ausgeschaltet (I = 0, Q = 0).	Switch-on/off of all *continual pilots* for ISDB-T (I = 0, Q = 0).

[SOURce]:IQCoder:ISDBt:CP:MOD

Die Modulation aller *Continual Pilots* bei ISDB-T wird ein-/ausgeschaltet.	Switch-on/off of modulation of all *continual pilots* for ISDB-T.

[SOURce]:IQCoder:ISDBt:DATA

Alle Datenträger bei ISDB-T werden ein-/ausgeschaltet (I = 0, Q = 0).	Switch-on/off of all data carriers for ISDB-T (I = 0, Q = 0).

[SOURce]:IQCoder:ISDBt:DATA:MOD

Die Modulation aller Datenträger bei ISDB-T wird ein-/ausgeschaltet.	Switch-on/off of modulation of all data carriers for ISDB-T.

[SOURce]:IQCoder:ISDBt:FFT:MODE

Einstellung des ISDB-T Modes (2K, 4K, oder 8K)	Setting of ISDB-T mode (2K, 4K or 8K)

[SOURce]:IQCoder:ISDBt:GUARd

Einstellung des Guard Intervalls der Übertragung bei ISDB-T	Setting of guard interval for transmission for ISDB-T.

[SOURce]:IQCoder:ISDBt:INPut

Eingangsinterface bei ISDB-T-Modulation. Für den Eingang ASI ist die Option Input Interface nötig.	Selection of input interface for ISDB-T modulation. The optional input interface is required for the ASI input.

[SOURce]:IQCoder:ISDBt:LOCKed?

Abfrage des Synchronisationszustandes des I/Q Coders auf den eingespeisten Datenstrom bei ISTB-T-Modulation.	Queries the synchronization of the I/Q coder to the applied data stream for ISDB-T modulation.

[SOURce]:IQCoder:ISDBt:MODE:A

Art der zu übertragenden Daten für Layer A bei ISDB-T	Type of data to be transmitted in layer A for ISDB-T.

[SOURce]:IQCoder:ISDBt:MODE:B

Art der zu übertragenden Daten für Layer B bei ISDB-T	Type of data to be transmitted in layer B for ISDB-T.

[SOURce]:IQCoder:ISDBt:MODE:C

Art der zu übertragenden Daten für Layer C bei ISDB-T	Type of data to be transmitted in layer C for ISDB-T.

[SOURce]:IQCoder:ISDBt:RATE:A

Einstellung der Coderate des Convolutional Coder des Layers A bei ISDB-T	Setting of code rate of convolutional coder for layer A for ISDB-T.

[SOURce]:IQCoder:ISDBt:RATE:B

Einstellung der Coderate des Convolutional Coder des Layers B bei ISDB-T	Setting of code rate of convolutional coder for layer B for ISDB-T.

[SOURce]:IQCoder:ISDBt:RATE:C

Einstellung der Coderate des Convolutional Coder des Layers C bei ISDB-T	Setting of code rate of convolutional coder for layer C for ISDB-T.

[SOURce]:IQCoder:ISDBt:SEGMents:A

Einstellung der Anzahl der Segmente, die bei ISDB-T Modulation für Layer A verwendet werden.	Setting of number of segments to be used for layer A for ISDB-T modulation.

[SOURce]:IQCoder:ISDBt:SEGMents:B

Einstellung der Anzahl der Segmente, die bei ISDB-T Modulation für Layer A verwendet werden.	Setting of number of segments to be used for layer B for ISDB-T modulation.

[SOURce]:IQCoder:ISDBt:SEGMents:C

Einstellung der Anzahl der Segmente, die bei ISDB-T Modulation für Layer A verwendet werden.	Setting of number of segments to be used for layer C for ISDB-T modulation.

[SOURce]:IQCoder:ISDBt:SEGMents[:STATe]

OFDM-Segmente bei ISDB-T Modulation ein-/ausschalten	Switch-on/off of OFDM segments for ISDB-T modulation.

[SOURce]:IQCoder:ISDBt:SP

Alle *Scattered Pilots* werden ein-/ausgeschaltet (I = 0, Q = 0).	Switch-on/off of all *scattered pilots* (I = 0, Q = 0).

[SOURce]:IQCoder:ISDBt:SP:MOD

Die Modulation aller *Scattered Pilots* wird ein-/ausgeschaltet.	Switch-on/off of modulation of all *scattered pilots* (I = 0, Q = 0).

[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:A

Länge des Time Interleavings von Layer A	Setting of length of time interleaving of layer A.

[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:B

Länge des Time Interleavings von Layer B	Setting of length of time interleaving of layer B.

[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:C

Länge des Time Interleavings von Layer C	Setting of length of time interleaving of layer C.

[SOURce]:IQCoder:ISDBt:TMCC

Alle TMCC Träger werden ein-/ausgeschaltet (I = 0, Q = 0).	Switch-on/off of all TMCC carriers (I = 0, Q = 0).

[SOURce]:IQCoder:ISDBt:TMCC:MOD

Die Modulation aller TMCC Träger wird ein-/ausgeschaltet.	Switch-on/off of modulation of all TMCC carriers.

[SOURce]:IQCoder:ISDBt[:SPECial]:ALERt[:BROadcast]

Ein-/Ausschalten des Alert Broadcasting Flag in den TMCC Daten	Switch-on/off of alert broadcasting flag in TMCC data.

[SOURce]:IQCoder:ISDBt[:SPECial]:BIT[:INTerleaver]

Ein-/Ausschalten des Bit Interleavers	Switch-on/off of bit interleaver.

[SOURce]:IQCoder:ISDBt[:SPECial]:BYTE[:INTerleaver]

Ein-/Ausschalten des Byte Interleavers	Switch-on/off of byte interleaver.

[SOURce]:IQCoder:ISDBt[:SPECial]:FREQuency[:INTerleaver]

Ein-/Ausschalten des Frequency Interleavers	Switch-on/off of frequency interleaver.

[SOURce]:IQCoder:ISDBt[:SPECial]:PID:A

PID von PRBS TS PACKETs für Layer C bei ISDB-T	Setting of PID of PRBS TS PACKETs for layer A for ISDB-T.

[SOURce]:IQCoder:ISDBt[:SPECial]:PID:B

PID von PRBS TS PACKETs für Layer C bei ISDB-T	Setting of PID of PRBS TS PACKETs for layer B for ISDB-T.

[SOURce]:IQCoder:ISDBt[:SPECial]:PID:C

PID von PRBS TS PACKETs für Layer C bei ISDB-T	Setting of PID of PRBS TS PACKETs for layer C for ISDB-T.

[SOURce]:IQCoder:ISDBt[:SPECial]:REEDsolomon

Reed-Solomon Coder bei ISDB-T ein-/ausschalten	Switch-on/off of Reed-Solomon encoder for ISDB-T.

[SOURce]:IQCoder:ISDBt[:SPECial]:SCRambler

Energy Dispersal in der Kanalkodierung bei ISDB-T ein-/ausschalten	Switch-on/off of energy dispersal in channel coding for ISDB-T.

[SOURce]:IQCoder:PRBS[:SEQuence]

Umschaltung der Länge der PRBS Sequenz für die Betriebszustände alle Coder.	Selects length of PRBS sequence for the operating states of all coders.

3.6.9.6 SOURce:MODulator Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:MODulator[:STATe]	<Wert / value> | OFF | ON		

Das Subsystem SOURCE:MODULATOR enthält den Befehl zum Schalten der Modulation.	The SOURCE:MODULATOR subsystem provides the command for switching the modulation on and off.

[SOURce]:MODulator[:STATe]

Ein-/Ausschalten der gesamten Modulation.	Switches the whole modulation on and off.

3.6.9.7 SOURce:NOISe Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:NOISe[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:NOISe:CN	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:DVBS:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:DVBC:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:DVBT:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:ISDBt:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:VSB:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:J83B:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:IQEXternal:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:FM:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:FMEXternal:CN:SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
[SOURce]:NOISe:COUPling	<Wert / value> | OFF | ON		
[SOURce]:NOISe:BANDwidth	<Wert / value> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum		
[SOURce]:NOISe:PULSe[:STATe]	<Wert / value> | OFF | ON		
[SOURce]:NOISe:PULSE:CN	<Wert / value> [DB] | MAXimum | MINimum		

Das Subsystem SOURCE:MODULATOR enthält den Befehl zur Bedienung des Rauschgenerators.	The SOURCE:MODULATOR subsystem provides the control commands for the noise generator.

[SOURce]:NOISe[:STATe]

Ein-/Ausschalten des Rauschgenerators.	Switches the noise generator on and off.

[SOURce]:NOISe:CN

Verhältnis Träger zu Rauschen des Rauschgenerators.	Sets the C/N ratio of the noise generator.

[SOURce]:NOISe:DVBS:CN:SHIFT

[SOURce]:NOISe:DVBC:CN:SHIFT

[SOURce]:NOISe:DVBT:CN:SHIFT

[SOURce]:NOISe:ISDBt:CN:SHIFT

[SOURce]:NOISe:VSB:CN:SHIFT

[SOURce]:NOISe:J83B:CN:SHIFT

[SOURce]:NOISe:IQEXternal:CN:SHIFT

[SOURce]:NOISe:FM:CN:SHIFT

[SOURce]:NOISe:FMEXternal:CN:SHIFT

Verschiebung des Verhältnis Träger zu Rauschen des Rauschgenerators für bestimmte Modulationen.	Shifts the C/N ratio of the noise generator for specific types of modulation.

[SOURce]:NOISe:COUPling

Kopplung der Bandbreite des Rauschgenerators an die Spektrumbreite des I/Q codierten Signals	Couples the noise generator bandwidth to the spectrum width of the I/Q-coded signal.

[SOURce]:NOISe:BANDwidth

Bandbreite des Rauschgenerators.	Sets the noise generator bandwidth.

[SOURce]:NOISe:PULSe[:STATe]

Ein-/Ausschalten von Impulstive Noise	Switch-on/off of impulsive noise.

[SOURce]:NOISe:CN

Verhältnis Träger zu Rauschen für Impulsive Noise	Setting of carrier-to-noise (C/N) ratio for impulsive noise.

3.6.9.8 SOURce:FSIM Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
SOURce:FSIM:SELECT [?]	1 | 2 | 3 | 4 | 5		
SOURce:FSIM:PRESET[1|2|3|4|5]	EASY3 | ECHO | FX_echo | T_echo | SFN_echo | TU6 | RA6 | RC6_anx_b | RL6_anx_b | RED_ht100 | ET50 | VALidate100 | RC12_anx_b | RL12_anx_b | TU3_12path | TU50_12path | HT100_12path		Keine Abfrage no query
[SOURce]:FSIMulator[:STATe]	<numeric> | OFF | ON		
[SOURce]:FSIMulator:SPEed:UNIT	MPS | KMPH | MPH		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:SPEed	<numeric> [NOUNT | MPS | KMH | MPH] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:STATe	<numeric> | OFF | ON		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:PROFile	RICE | PDOPpler | RAYLeigh | CONStphase		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:STATe	<numeric> | OFF | ON		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:PRATio	<numeric> [DB] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:FRATio	<numeric> | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:FDOPpler	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOSS	<numeric> [DB] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DELay	<numeric> [S | AS | FS | PS | NS | US | MS | KS | MAS | GS | TS | PES | EXS] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:STATe	<numeric> | OFF | ON		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:LCONstant	<numeric> [M] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:CSTD	<numeric> [DB] | MAXimum | MINimum		
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:PHASe	<numeric> [DEG] | MAXimum | MINimum		
[SOURce]:FSIMulator:SPEed:REFerence	SPEed | FDOP		
[SOURce]:FSIMulator:POWer[:LEVel]:MODE	MULTipath | MAIN		

Das Subsystem SOURCE:FSIMULATOR enthält Befehle zur Einstellung des Fading Simulators	The SOURCE:FSIMULATOR subsystem comprises commands for setting the fading simulator

[SOURce]:FSIMulator:SELECT

Auswahl des auszusendenden Parameter Sets des Fading Simulators.	Selection of fading simulator parameter set to be sent.

[SOURce]:FSIMulator:PRESET[1|2|3|4|5]

Vorbelegung von Parameter Sets des Fading Simulators.	Presetting of fading simulator parameter set.

[SOURce]:FSIMulator[:STATe]

Ein-/Ausschalten des Fading Simulators.	Switch-on/off of fading simulator.

[SOURce]:FSIMulator:SPEed:UNIT

Umschalten der Geschwindigkeitseinheit zwischen m/s, km/h und mph	Selection of speed units m/s, km/h and mph

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:SPEed

Geschwindigkeit eines einzelnen Pfads des Fading Simulators.	Speed of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:STATe

Ein-/Ausschalten eines einzelnen Pfads des Fading Simulators.	Switch-on/off of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:PROFile

Wahl des Fading-Profils für einen einzelnen Pfad des Fading-Simulators.	Selection of fading profile for a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:STATe

Zustand der diskreten Komponente eines einzelnen Pfads des Fading Simulators.	State of the discrete component of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:PRATio

Leistungsverhältnis der diskreten Komponente eines einzelnen Pfad des Fading Simulators.	Power ratio of the discrete component of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:FRATio

Verhältnis der Dopplerfrequenzverschiebung der diskreten Komponente einen einzelnen Pfad des Fading Simulators.	Doppler frequency shift ratio of the discrete component of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:FDOPpler

Dopplerfrequenzverschiebung für einen einzelnen Pfad des Fading Simulators.	Doppler frequency shift of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOSS

Dämpfung eines einzelnen Pfads des Fading Simulators.	Attenuation of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DELay

Signalverzögerung für einen einzelnen Pfad des Fading Simulators.	Signal delay of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:STATe

Ein-/Ausschalten des Log-Normal-Fading für einen einzelnen Pfad des Fading Simulators.	Switch-on/off of log-normal fading of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:LCONstant

Geländekonstante für Log-Normal-Fading eines einzelnen Pfads des Fading Simulators.	Terrain constant for log-normal fading of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:CSTD

Standardabweichung für Log-Normal-Fading eines einzelnen Pfads des Fading Simulators.	Standard deviation for log-normal fading of a fading simulator path.

[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:PHASe

Konstante Phase für einen einzelnen Pfad des Fading Simulators.	Constant phase of the fading simulator path.

[SOURce]:FSIMulator:SPEed:REFerence

Eistellung des Parameters (Speed oder Dopplerfrequenz), welcher bei Variation der RF-Frequenz konstant gehalten wird	Selection of parameter (speed or Doppler frequency) to be held constant while RF frequency is varied.

[SOURce]:FSIMulator:POWer[:LEVel]:MODE

Umschaltung der Betrachtung des angezeigte RF-Level zwischen Summenleistung aller am Ausgangssignal beteiligten Fading-Pfade (Multipath) oder nur der Leistung des Hauptpfades (Pfad mit niedrigstem Path Loss / Main)	Switchover of RF level display between sum power of all fading paths contributing to the output signal (multipath display) and power of main path (path with lowest loss).

3.6.9.9 SOURce:POWer Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:POWer[:LEVel]:MODE	NORMal | CONTinuous		
[SOURce]:POWer[:LEVel][:IMMediate] [:AMPLitude]	<Wert / value> [DBM] | MAXimum | MINimum		
[SOURce]:POWer[:LEVel][:IMMediate]: SHIFt	<Wert / value> [DB] | MAXimum | MINimum		
SOURce:POWer:ALC:MODE	OFF | ON | AUTO		
SOURce:POWer:ALC:OFFMode	TABLe | HOLD		
SOURce:POWer:ALC:SEARch			
SOURce:POWer:ALC:LEARn			

Das Subsystem SOURCE:POWER enthält Befehle zur Einstellung von Leistungen sowohl am Ausgang als auch im Inneren des Geräts.	The SOURCE:POWER subsystem provides commands for setting the power at the output and within the instrument.

[SOURce]:POWer[:LEVel]:MODE

Einstellung der Betriebsweise der Eichleitung. Im NORMal-Betrieb schaltet die Eichleitung bei beliebigen Pegeln um die gewünschte Pegeleinstellung zu erreichen . Im CONTinuous-Betrieb wird die Eichleitung so eingestellt, dass der Pegel ausgehend vom aktuellen Wert um mindestens 15 dB abgesenkt werden kann, ohne dass dabei ein Schalten der Eichleitung nötig ist. Bei jeder Umschaltung von NORMal- auf CONTinuous-Betrieb wird der maximale Pegel des kontinuierlichen Einstellbereichs auf den aktuellen Pegel gesetzt.	Selects the attenuator-operating mode. In the NORMal mode attenuator switches at any level to obtain the desired level setting. In the CONTinuous mode the attenuator is set so that the level can be reduced by up to 15 dB below the current value without any switching procedure being required. Each time the mode is switched from NORMal to CONTinuous, the current level is set as the maximum for the continuous level range.

[SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]

Nominaler Ausgangspegel. **Hinweis:** *Pegel an der Buchse = nominaler Pegel + Pegelverschiebung.*	Sets the nominal output level. **Note:** *Level at connector = nominal level + level shift.*

[SOURce]:POWer[:LEVel][:IMMediate]:SHIFt

Verschiebung des Ausgangspegels. **Hinweis:** *Level an der Buchse = Level + Level Shift.*	Shift of output level. **Note:** *Level at connector = level + level shift.*

[SOURce]:POWer:ALC:MODE

Ein/Ausschalten der automatischen Pegelregelung. Im AUTO-Mode ist während QPSK, QAM und I/Q External Modulation ALC ausgeschaltet. Bei FM und FM External ist die ALC eingeschaltet.	Switches ALC on and off. In the AUTO mode ALC is switched off during QPSK, QAM and I/Q external modulation. ALC is on with FM and FM external modulation.

[SOURce]:POWer:ALC:OFFMode

Bei ausgeschalteter ALC können die exakte Pegel-einstellungen wahlweise durch vorübergehendes Einschalten der ALC (SAMPLE&HOLD) oder durch Verwendung einer vorher ermittelten Korrektur-tabelle (Table) erreicht werden.	With ALC switched off, set level values can be obtained either by a temporary switch-on of ALC (sample & hold) or by using a previously determined correction table (Table).

[SOURce]:POWer:ALC:SEARCH

Manuelles SAMPLE&HOLD zur optimalen Pegel-einstellung bei der aktuellen Einstellung.	Selects manual sample & hold for optimum level adjustment at current setting.

[SOURce]:POWer:ALC:LEARn

Starten einer neuen Ermittlung der ALC Tabelle für die aktuellen Umgebungsbedingungen.	Starts generation of a new ALC table for current ambient conditions.

3.6.9.10 SOURce:SWEep Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:SWEep:STEP	<Wert / value> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum		
[SOURce]:SWEep:DWELL	<Wert / value> [S | AS | FS | PS | NS | US | MS | KS | MAS | GS | TS | PES | EXS] | MAXimum | MINimum		

[SOURce]:SWEep:STEP

Frequenz-Schrittweite bei Wobbelbetrieb.	Sets frequency steps for sweep operation.

[SOURce]:SWEep:DWELL

Zeit pro Frequenzschritt bei Wobbelbetrieb.	Sets the time for a frequency step for sweep operation.

3.6.9.11 SOURce:VOLTage Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
[SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude]	<Wert / value> [DBM | AV | FV | PV | NV | UV | MV | V | KV | MAV | GV | TV | PEV | EXV | DBAV | DBFV | DBPV | DBNV | DBUV | DBMV | DBV | DBKV | DBMAV | DBGV | DBTV | DBPEV | DBEXV] | MAXimum | MINimum		

Das Subsystem SOURCE:VOLTAGE besteht nur aus dem Befehl.	The SOURCE:VOLTAGE subsystem provides one command only.

[SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude]

Ausgangpegel. Bei der Abfrage erfolgt die Ausgabe des Pegels in der über UNIT:VOLTage eingestellten Einheit.	Sets the output level. When queried the level is output with the unit set with UNIT:VOLTage.

3.6.10 STATUS Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
STATus:OPERation[:EVENt]?			nur Abfrage query only
STATus:OPERation:CONDition?			nur Abfrage query only
STATus:OPERation:ENABle	0 to 32767		
STATus:PRESet			keine Abfrage no query
STATus:QUEStionable [:EVENt]?			nur Abfrage query only
STATus:QUEStionable:CONDition?			nur Abfrage query only
STATus:QUEStionable:ENABle	0 to 32767		
STATus:QUEue[:NEXT]?			nur Abfrage query only

Das Subsystem STATUS beinhaltet die SCPI Statusverwaltung (siehe hierzu auch Kapitel 3.8).	The STATUS subsystem comprises the SCPI-defined status reporting system. See also section 3.8.

STATus:OPERation[:EVENt]?

liest den Inhalt des Event-Teils des STATus:OPERation-Registers.	Reads the contents of the event register of the STATus:OPERation Register.

STATus:OPERation:CONDition?

liest den Inhalt des Condition-Teils des STATus:OPERation-Registers.	Reads the contents of the condition register of the STATus:OPERation Register.

STATus:OPERation:ENABle

schreibt bzw. liest den Inhalt des Enable-Teils des STATus:OPERation-Registers.	Writes or reads the contents of the enable register of the STATus:OPERation Register.

STATus:PRESet

setzt die SCPI - Statusverwaltung teilweise zurück.	Partly resets the SCPI status.

STATus:QUEStionable [:EVENt]?

liest den Inhalt des Event-Teils des STATus:QUEStionable-Registers.	Reads the contents of the event register of the STATus:QUEStionable Register.

STATus:QUEStionable:CONDition?

liest den Inhalt des Condition-Teils des STATus:QUEStionable-Registers.	Reads the contents of the condition register of the STATus:QUEStionable Register.

STATus:QUEStionable:ENABle

schreibt bzw. liest den Inhalt des Enable-Teils des STATus:QUEStionable-Registers.	Writes or reads the contents of the enable register of the STATus:QUEStionable Register.

STATus:QUEue[:NEXT]?

liest den ältesten Eintrag aus der Error Queue aus und löscht diesen. **Hinweis:** *Status Operation-Register und Status Questionable-Register sind nicht belegt.*	Reads out and clears the first-in entry from the error queue. **Note:** *Status Operation Register and Status Questionable Register are not yet assigned.*

3.6.11 SYSTEM Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
SYSTem:BASeband:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:PRESet			
SYSTem:BASeband:ENERgy[:DISPersal]:PRESet			
SYSTem:BASeband:FM[1|2|3|4|5|6]:PRESet			
SYSTem:BASeband:PRESet			nur Abfrage query only
SYSTem:BASeband:VIDeo:PRESet			
SYSTem:BEEPer:STATe	<Wert / value> | OFF | ON		
SYSTem:CODer:PRESet			
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	<Wert / value> | MAXimum | MINimum		
SYSTem:COMMunicate:REMote	OFF | GPIB | SERial | BOTH		
SYSTem:COMMunicate:SERial[:RECeive]:BAUD	<Wert> | MAXimum | MINimum		
SYSTem:COMMunicate:SERial[:RECeive]:BITS	<Wert / value> | MAXimum | MINimum		
SYSTem:COMMunicate:SERial[:RECeive]:PACE	NONE | XON | ACK		
SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE]	ODD | EVEN | ZERO | ONE | NONE		
SYSTem:COMMunicate:SERial[:RECeive]:SBITs	<Wert / value> | MAXimum | MINimum		
SYSTem:DATE	<Wert / value> | MAXimum | MINimum, <Wert / value> | MAXimum | MINimum, <Wert / value> | MAXimum | MINimum		
SYSTem:DISPlay:UPDate[:STATe]	<Wert / value> | OFF | ON		
SYSTem:ERRor			nur Abfrage query only
SYSTem:FREQuency:RESolution	LOW | HIGH		
SYSTem:INFormation			nur Abfrage query only
SYSTem:MODulation:PRESet			
SYSTem:TIME	<Wert / value> | MAXimum | MINimum, <Wert / value> | MAXimum | MINimum, <Wert / value> | MAXimum | MINimum		
SYSTem:VERSion			nur Abfrage query only

SYSTem:BASeband:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:PRESet

stellt die Preset-Werte für die Parameter des Menüs eines ADR SUBCARRIER ein (siehe Menübedienung).	Sets the preset values for the parameters of the ADR SUBCARRIER menu (see Menu Operation).

SYSTem:BASeband:ENERgy[:DISPersal]:PRESet

stellt die Preset-Wert für die Parameter des ENERGY DISPERSAL Menüs ein. (siehe Menübedienung)	Sets the preset values for the parameters of the ENERGY DISPERSAL menu (see Menu Operation).

SYSTem:BASeband:FM[1|2|3|4|5|6]:PRESet

stellt die Preset-Werte für die Parameter des Menüs eines FM SUBCARRIER ein. (siehe Menübedienung)	Sets the preset values for the parameters of the FM SUBCARRIER menu (see Menu Operation).

SYSTem:BASeband:PRESet

stellt die Preset-Werte für die Parameter des gesamten Baseband Menüs ein (siehe Menübedienung).	Sets the preset values for the parameters of the complete baseband menu (see Menu Operation).

SYSTem:BASeband:VIDeo:PRESet

stellt die Preset-Werte für die Parameter des Video Menüs ein (siehe Menübedienung).	Sets the preset values for the parameters of the VIDEO menu (see Menu Operation).

SYSTem:BEEPer:STATe

schaltet den Lautsprecher ein und aus.	Switches the loudspeaker on and off.

SYSTem:CODer:PRESet

stellt die Preset-Werte für die Parameter des Coder Menüs zur aktuellen Modulation ein (siehe Menübedienung).	Sets the preset values for the parameters of the CODER menu for the currently selected modulation (see Menu Operation).

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess

stellt die Adresse des Geräts am IEEE 488 Bus ein.	Sets the device address on the IEEE 488 bus.

SYSTem:COMMunicate:REMote

stellt den aktiven Fernsteuerkanal ein. Mit OFF wird die Fernbedienung ausgeschaltet, mit GPIB wird der IEEE 488 Bus aktiviert, mit SERial die RS 232 Schnittstelle. Der Wert BOTH ermöglicht die Kommunikation sowohl über IEEE 488, als auch über RS 232.	Sets the active remote-control channel. The remote control is switched off by OFF, the IEEE 488 bus activated by GPIB and the RS-232 interface by SERial. BOTH enables communication via the IEEE 488 bus and the RS-232 interface.

SYSTem:COMMunicate:SERial[:RECeive]:BAUD

stellt die Baudrate für die Fernbedienung über serielle Schnittstelle ein.	Sets the baud rate for remote control via serial interface.

SYSTem:COMMunicate:SERial[:RECeive]:BITS

stellt die Zahl der Datenbits pro Byte für die Fernbedienung über serielle Schnittstelle ein.	Sets the number of data bits per byte for remote control via serial interface.

SYSTem:COMMunicate:SERial[:RECeive]:PACE

stellt den Handshake für die Fernbedienung über serielle Schnittstelle ein. OFF bedeutet kein Handshake, XON bedeutet Handshake mit XON und XOFF, ACK bedeutet Handshake mit den Handshake Leitungen RTS und CTS.	Sets the handshake for remote control via serial interface. OFF means no handshake, XON means handshake with XON and XOFF, ACK means handshake with the handshake lines RTS and CTS.

SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE]

stellt die Art des Parity Bits ein. NONE bedeutet, dass kein Parity Bit übertragen wird. Mit ZERO bzw. ONE bekommt das Parity Bit einen konstanten Wert, nämlich 0 bzw. 1. EVEN bzw. ODD bedeutet gerade bzw. ungerade Parität.	Sets the parity bit. NONE means that no parity bit is transmitted, ZERO or ONE assigns a constant value to the parity bit, i.e. 0 or 1. EVEN or ODD means even or odd parity.

SYSTem:COMMunicate:SERial[:RECeive]:SBITs

stellt die Zahl der Stopbits ein.	Sets the number of stop bits.

SYSTem:DATE

stellt das Datum ein. Die erste Zahl ist die Jahreszahl, die zweite der Monat und die dritte der Tag.	Sets the date. The first number represents the year, the second the month and the third the day.

SYSTem:DISPlay:UPDate[:STATe]

aktiviert, bzw. deaktiviert die Statusleiste am Bildschirm. **Hinweis:** *Mit aktivierter Statusleiste sinkt die Verarbeitungsgeschwindigkeit.*	Activates or deactivates the status bar on the screen. **Note:** *When the status bar is active, the processing speed is reduced.*

SYSTem:ERRor?

liest den ältesten Eintrag aus der Error Queue aus und löscht diesen. Die Wirkung ist identisch mit :STATus:QUEue[:NEXT].	Reads out and clears the first-in entry from the error queue. The effect is the same as of :STATus:QUEue[:NEXT].

SYSTem:FREQuency:RESolution?

Damit lässt sich die Auflösung der Frequenz in der Darstellung der Frontbedienung verändern. HIGH bedeutet eine Auflösung von 1 Hz, LOW bedeutet 1 kHz	Permits the frequency resolution in the display for front-panel operation to be changed. HIGH means a resolution of 1 Hz, LOW of 1 kHz.

SYSTem:INFormation?

Abfrage der installierten Hardware. Zurückgegeben wird ein variabler String, der folgendermaßen formatiert ist: ”MAIN:<MAIN-version>.<MAIN-Subversion>, <MAIN-Jahr>,<MAIN-Monat>,<MAIN-Tag>, BIOS:<BIOS-version>.<BIOS-Subversion>, <BIOS-Jahr>,<BIOS-Monat>,<BIOS-Tag>, FMSUB:<FMSUB-Version>.<FMSUB-Subversion>, <FMSUB- Jahr>,<FMSUB- Monat>,<FMSUB- Tag>, ADRSUB:<ADRSUB-Version>.<ADRSUB-Subversion>, <ADRSUB-Jahr>,<ADRSUB-Monat>,<ADRSUB-Tag>,”, ”CODER:<CODER-Version>.<CODER-Subversion>, <CODER-Jahr>,<CODER-Monat>,<CODER-Tag>, CSPL CODER:<CSPLVersion>.<CSPL-Subversion>, <CSPL-Jahr>,<CSPL-Monat>,<CSPL-Tag>, DVB-T CODER:<**DVB-T**-Version>.<DVB-T-Subversion>, <DVB-T-Jahr>,<DVB-T- Monat>,<DVB-T- Tag>, US CODER:<US C.-Version>.<US C.-Subversion>, <US C.-Jahr>,<US C.-Monat>,<US C.-Tag>, ISDB-T CODER:<ISDB-T-Version>.<ISDB-T-Subversion>, <ISDB-T-Jahr >,<ISDB-T-Monat>,<ISDB-T-Tag >, INPUT:<Input I.-Version>.<Input I.-Subversion>, <Input I.-Jahr>< Input I.-Monat>,<Input I.-Tag>”, PCCARD INTERNAL:<Speicherkapazität der internen PC Card in ganzen MB>MB”, <Baugruppenname>,”<Identnummer der Baugruppe>”, <Baugruppenvariante>,<Baugruppencode> {,<Baugruppenname>,”<Identnummer der Baugruppe>”, <Baugruppenvariante>,<Baugruppencode>}* Die Versionen und Subversionen werden mit jeweils zweistellig mit führenden Nullen angegeben. (z.B. MAIN:01.10,BIOS:...)	Query of installed hardware. A variable string formatted as follows is returned: ”MAIN:<MAIN version>.<MAIN subversion>, <MAIN year>,<MAIN month>,<MAIN day>, BIOS:<BIOS version>.<BIOS subversion>, <BIOS year>,<BIOS month>,<BIOS day>, FMSUB:<FMSUB version>.<FMSUB subversion>, <FMSUB year>,<FMSUB month>,<FMSUB day>, ADRSUB:<ADRSUB version>.<ADRSUB subversion>, <ADRSUB year>,<ADRSUB month>,<ADRSUB day>,”, ”CODER:<CODER version>.<CODER subversion>, <CODER year>,<CODER month>,<CODER day>, CSPL CODER:< CSPL version>.< CSPL subversion>, < CSPL year>,< CSPL day>,< CSPL day>, DVB-T CODER:<DVB-T version>.<DVB-T subversion>, <DVB-T year>,<DVB-T day>,<DVB-T day>, US CODER:<US C. version>.<US C.subversion>, <US C. year>,<US C. month>,<US C. day>, ISDB-T CODER:<ISDB-T version>.<ISDB-T subversion>, <ISDB-T year>,<ISDB-T month >,<ISDB-T day>, INPUT:<Input I. version>.<Input I. subversion>, <Input I. year>< Input I. month>,<Input I. day>”, PCCARD INTERNAL:<Storage capacity of internal PC card in integer MB>MB”, <Module name>,”<Order number of module>”, <Model of module>,<Code of module> {,<Module name>,”<Order number of module>”, <Model of module>,<Code of module>}* The versions and subversions are indicated in two digits with leading zeros. (e.g. MAIN:01.10,BIOS:...)
Folgende Abkürzungen stehen für die Baugruppen-namen: CTRL Controller MB Motherboard COD IQ Coder für DVB-S und DVB-C CSPL CSPL Coder für Satellite und DVB-C DVBT DVB-T Coder USC US Coder ISDBT ISDB-T Coder IQC IQ Converter IQM IQ Modulator SYN Synthesizer BAS Baseband FM... FM-Subcarrier ... AD... ADR-Subcarrier ... NGEN BBFM / Noise INP Input Interface ATT Eichleitung FSIM... Fading Simulator ... *: Die Anzahl der Baugruppennamen ist von der tatsächlichen Bestückung abhängig. Beispiel für Firmwareinformationen: MAIN:01.10,1998,07,14 Beispiel für Baugruppeninformationen: COD:2072.7404,02,0	The following abbreviations are used for the modules: CTRL Controller MB Motherboard COD IQ Coder for DVB-S and DVB-C CSPL CSPL Coder for Satellite and DVB-C DVBT DVB-T Coder USC US Coder ISDBT ISDB-T Coder IQC IQ Converter IQM IQ Modulator SYN Synthesizer BAS Baseband FM... FM Subcarrier ... AD... ADR Subcarrier ... NGEN BBFM / Noise INP Input Interface ATT Attenuator FSIM... Fading Simulator ... *: The number of module names depends on the number of built-in modules. Example firmware information: MAIN:01.10,1998,07,14 Example module information: COD:2072.7404,02,0

SYSTem:MODulation:PRESet

stellt die Preset-Werte für die Parameter des Modulation-Menüs ein (siehe Menübedienung).	Sets the preset values for parameters of the MODULATION menu (see Menu Operation).

SYSTem:TIME

stellt die Uhrzeit ein. Die erste Zahl ist die Stunde (24-Stunden-Zählung), die zweite die Minute und die dritte die Sekunde.	Sets the time. The first number is the hour (24-hour clock), the second the minute, the third the second.

SYSTem:VERSion?

fragt die verwendete SCPI-Version ab.	Queries the SCPI version used.

3.6.12 UNIT Subsystem

Befehl / Command	Parameter	Einheit Unit	Bemerkung Notes
UNIT:VOLTage	AV | FV | PV | NV | UV | MV | V | KV | MAV | GV | TV | PEV | EV | DBAV | DBFV | DBPV | DBNV | DBUV | DBMV | DBV | DBKV | DBMAv | DBGV | DBTV | DBPEv | DBEV		

Das Subsystem UNIT besteht nur aus dem Befehl.	The UNIT subsystem consists of a single command only.

UNIT:VOLTage

stellt die Default-Einheit für Spannungen ein. Die Default-Einheit legt fest, in welcher Einheit Abfragekommandos für Spannungen beantwortet werden und welche Einheit bei Einstellbefehlen für Spannungen verwendet wird, wenn keine Einheit angegeben wurde. Die Voreinstellung für die Standardeinheit ist V.	Sets the default unit for voltages. The default unit defines the unit to be used in responses to voltage queries and the unit to be used in voltage setting commands when no particular unit is specified. The default unit is V.

3.7 Device Model and Command Processing

The device model shown in Fig. 3.7-1 has been configured under the aspect of processing IEC/IEEE-bus commands. The individual components operate independently of each other and simultaneously. They communicate with each other by means of so-called messages.

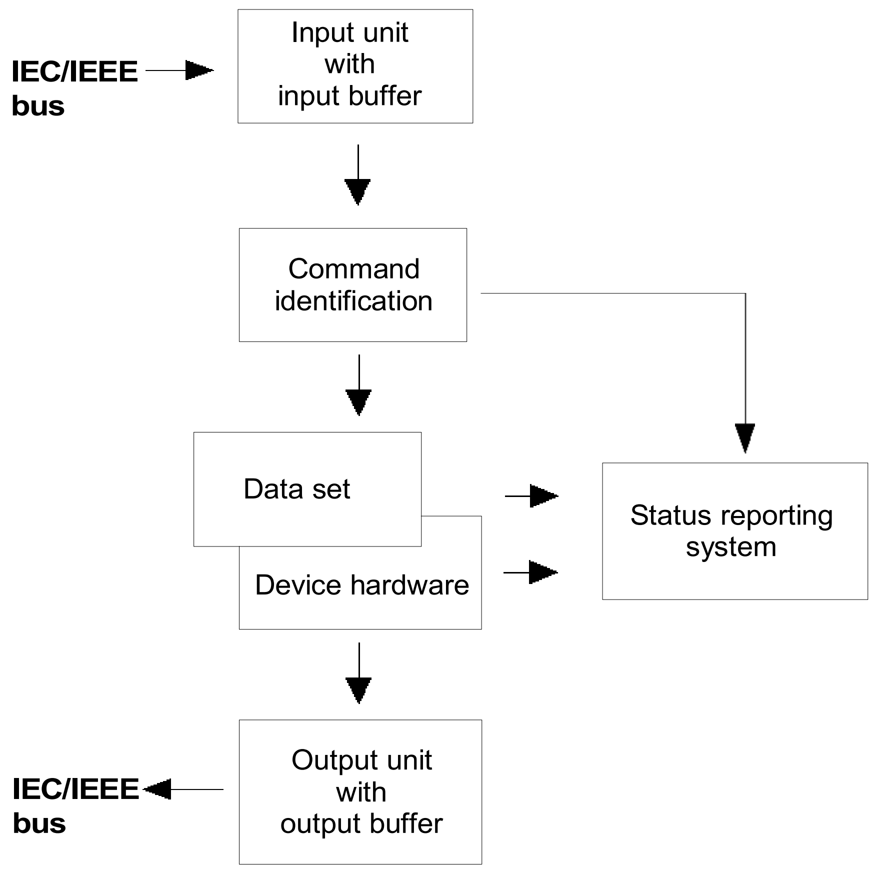


Fig. 3.7-1 Device model with remote control via IEC/IEEE bus

3.7.1 Input Unit

The input unit receives commands in the form of characters via the IEC/IEEE bus and collects them in the input buffer. The input buffer has a capacity of 1024 characters. The input unit sends a message to the command identification as soon as the input buffer is full or it receives a terminator, <PROGRAM MESSAGE TERMINATOR> as defined by IEEE 488.2 or the interface message DCL. If the input buffer is full, data transfer on the IEC/IEEE bus is stopped and the data received so far are processed. Data transfer is then continued. If the input buffer is not full when a terminator is received, the input unit can receive the next command during command identification and processing. Receiving a DCL message clears the input buffer and immediately causes a message to be sent to the command identification.

3.7.2 Command Identification

The command identification analyzes the data received from the input unit, proceeding in the order in which the data are received. Only a DCL is given priority but a GET (Group Execute Trigger) for instance is processed only after the previously received commands are executed. Any identified command is forwarded immediately to the data set but not immediately executed.

Syntax errors in the command are recognized and passed on to the status reporting system. The rest of a command line received after a syntax error is analyzed and processed as far as possible.

If the command identification receives a terminator or DCL, it requests the data set to execute the command in the device hardware. After this request further commands can be executed. This means that further commands can be executed while hardware setting is taking place (overlapping execution).

3.7.3 Data Set and Device Hardware

The term "device hardware" refers to that part of the device which performs the actual device functions — signal generation, measurements, etc. The controller is not included.

The data set is an exact representation of the device hardware in the software.

IEC/IEEE-bus commands cause a modification in the data set. The new values (eg frequency) are entered in the data set but forwarded to the hardware only after a request to do so from the command identification. Since this request is only sent at the end of a command line, the sequence of commands in a line is irrelevant.

Immediately before the data are forwarded to the device hardware, they are verified for compatibility with other data and with the device hardware. If it turns out that the setting is not possible, the message execution error is sent to the status reporting system. Modifications of the data set are ignored and the hardware is not set. Because of the delayed verification and hardware setting it may happen that illegal device states are set briefly within a command line without an error message being issued (example: simultaneous activation of FM and PM). However, a legal device status must be obtained at the end of a command line.

Prior to handing the data to the hardware, the settling bit is set in the STATus:OPERation Register (see section 3.8.3.4). The hardware carries out the settings and as soon as a settled state is reached the bit is reset. This bit may be used for synchronization of the command processing.

IEC/IEEE-bus queries cause the data set management to send the desired data to the output unit.

3.7.4 Status Reporting System

The status reporting system collects information on the device status and makes it available to the output unit on request. Structure and function are described in detail in section 3.8.

3.7.5 Output Unit

The output unit collects the information requested by the controller from the data set management. It processes the information in line with SCPI rules and makes it available to the output buffer. The output buffer has a capacity of 1024 characters. If the requested information is longer, it will be made available in portions in a way that is not noticeable to the controller.

If the device is addressed as a talker and the output buffer does not contain any data or expect data from the data set management , the output unit sends the error message "Query UNTERMINATED" to the status reporting system. No data will be sent on the IEC/IEEE interface and the controller waits until its time limit is reached. This procedure is prescribed by SCPI.

3.7.6 Command Sequence and Command Synchronization

The description above shows that overlapping command processing is permissible. Likewise, setting commands of a command line need not be executed in the sequence of their arrival.

To ensure that commands are executed in a desired sequence, each command has to be sent in a separate line, ie with its own IBWRT() call.

To prevent an overlapping execution of commands, one of the commands `*OPC`, `*OPC?` or `*WAI` must be sent. All three commands have the effect that a certain action is triggered only after the hardware has been set and is settled. The controller can be forced by suitable programming to wait for an action (see Table 3.7-1).

Table 3.7-1 Synchronization with *OPC, *OPC? and *WAI

Command	Action after hardware settling	Programming of controller
*OPC	Setting the Operation-Complete bits in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for a service request (SRQ)
*OPC?	Writing "1" into the output buffer	Addressing the device as a talker
*WAI	Continuing the IEC/IEEE-bus handshake	Sending the next command

An example of command synchronization is given in Appendix D3 "Program Examples".

3.8 Status Reporting System

The status reporting system (see Fig. 3.8-1) stores all information on the current operating status of the device, eg that an AUTORANGE is being performed at present, and on errors occurred. The information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via the IEC/IEEE bus.

The information is hierarchically structured. The highest level is formed by the Status Byte Register (STB) defined by IEEE 488.2 and the associated mask register Service Request Enable (SRE). The STB receives its information from the Standard Event Status Register (ESR) also defined in IEEE 488.2 and the associated mask register Standard Event Status Enable (ESE) as well as from the SCPI-defined STATus:OPERation and STATus:QUEStionable registers which contain detailed information on the device.

The status reporting system also includes the IST (Individual STatus) flag and the Parallel Poll Enable Register (PPE) assigned to it. The IST flag, just as SRQ, combines the complete device status in a single bit. The PPE has an analog function for the IST flag like the SRE for the service request.

The output buffer contains the messages returned by the device to the controller. It is not part of the status reporting system but it determines the value of the MAV bit in the STB so that it is also shown in Fig. 3.8-2.

3.8.1 Structure of an SCPI Status Register

Each SCPI register consists of five 16-bit registers which assume different functions (see Fig. 3.8-1). The individual bits are independent of each other, ie each hardware status is assigned a bit number which is the same for all five registers. Bit 3 of the STATus:OPERation Registers for instance is assigned in all five registers to the hardware status "Wait for trigger". Bit 15 (the most significant bit) is set to zero in all status registers. Thus the contents of the registers can be processed by the controller as a positive integer.

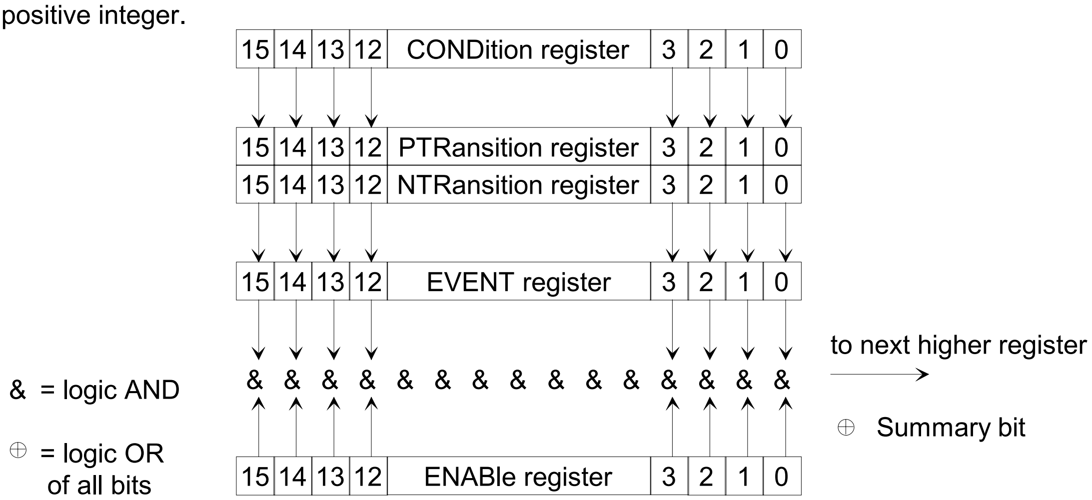


Fig. 3.8-1 Status register model

CONDition register The CONDition register is directly written by the hardware or the summary bit of the next lower register. Its content reflects the current device status. This register can only be read but neither written nor cleared. Reading the register does not change its content.

PTRansition register The Positive TRansition register acts as a transition filter. Upon transition of a bit of the CONDition register from 0 to 1, the associated PTR bit decides whether the EVENt bit will be set to 1.
PTR bit = 1: the EVENt bit is set.
PTR bit = 0: the EVENt bit is not set.
This register can be written and read. Reading the register does not change its content.

NTRansition register The Negative TRansition register also acts as a transition filter. Upon transition of a bit of the CONDition register from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR bit = 1: the EVENt bit is set.
NTR bit = 0: the EVENt bit is not set.
This register can be written and read. Reading the register does not change its content.

With the aid of these two transition filter registers the user can define the status change of the CONDition register (none, 0 to 1, 1 to 0 or both) that is to be reported in the EVENt register.

EVENt register The EVENt register reports whether an event has occurred since its last readout, it is the memory of the CONDition register. It only registers events that have been reported by the transition filters. The EVENt register is continuously updated by the device. It can only be read by the user. Reading the register clears its content. The register is frequently referred to as the overall register.

ENABle register The ENABle register determines whether the EVENt bit affects the summary bit (see below). Each bit of the EVENt register is ANDed (symbol '&') with the associated ENABle bit. The events of all logical operations of this register are ORed (symbol '+') and passed on to the summary bit.
ENAB bit = 1: the associated EVENt bit does not affect the summary bit.
ENAB bit = 0: if the associated EVENT bit is "1", the summary bit is also set to "1".
This register can be written and read by the user. Reading the register does not change its content.

Summary bit As stated above, the summary bit for each register is derived from the EVENt and ENABle registers. The result is entered into a bit of the CONDition register of the next higher register.
The device automatically generates the summary bit for each register. An event, eg an unlocked PPL, may thus cause a service request through all hierarchical levels.

Note: *The Service Request Enable Register SRE defined by IEEE 488.2 may be used as the ENABle register for STB provided the structure of STB is in line with SCPI rules. Likewise can the ESE be used as the ENABle register for ESR.*

3.8.2 Overview of Status Registers

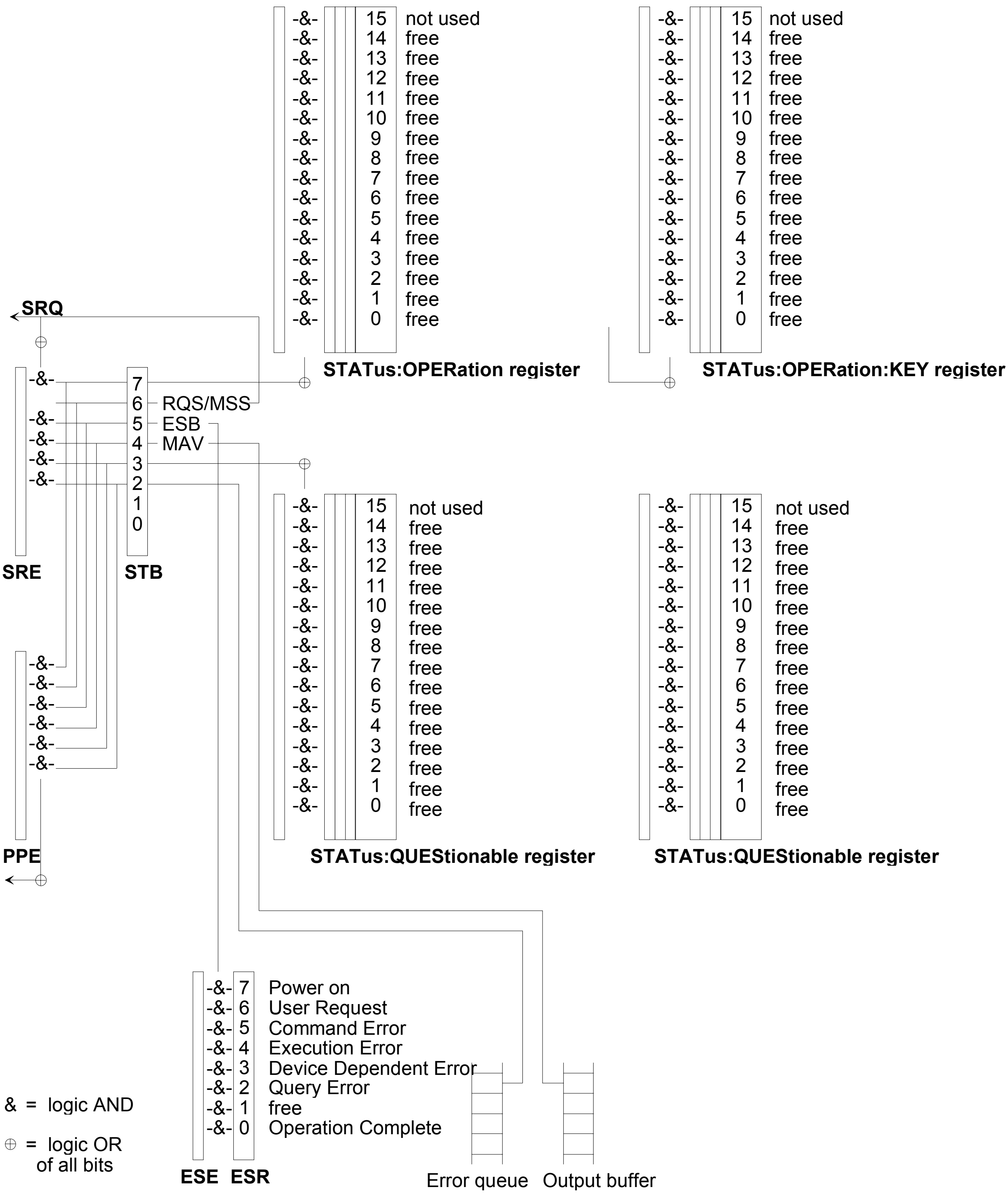


Fig. 3.8-2

3.8.3 Description of Status Registers

3.8.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The Status Byte Register is already defined in IEEE 488.2. Since it collects all the information of the other lower-order registers it gives a rough overview on the device status. Its function corresponds to that of the CONDition register of an SCPI register and assumes the highest level in the SCPI hierarchy. A special characteristic is that bit 6 is used as summary bit for all other bits of the Status Byte.

The Status Byte is read with command `*STB?` or by a serial poll.

SRE is associated with the STB. Its function corresponds to that of the ENABle register of the SCPI register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) will be generated on the IEC/IEEE bus, which triggers an interrupt in the controller provided the controller has been configured accordingly, and can be further processed by the controller.

The SRE can be set with `*SRE` and read by the query `*SRE?`.

Table 3.8-1 Definition of bits used in the Status Byte Register

Bit No.	Definition
2	**Error Queue not empty** This bit is set when the error queue receives an entry. If this bit is enabled by the SRE, each entry of the error queue will generate a service request. An error can thus be recognized and specified in detail by querying the error queue. The query returns an informative error message. This procedure is recommended as it considerably reduces the problems of IEC/IEEE-bus control.
3	**QUEStionable Status summary bit** This bit is set if in the QUEStionable Status Register an EVENt bit is set and the associated ENABle bit is set to 1. A set bit denotes a questionable device status which can be specified in greater detail by querying the QUEStionable Status Register.
4	**MAV bit** (message available) This bit is set if a readable message is in the output buffer. This bit may be used to automate reading of data from the device into the controller (see Appendix D3, Program Examples)
5	**ESB bit** Summary bit of the Event Status Register. This bit is set if one of the bits in the Event Status Register is set and enabled in the Event Status Enable Register. Setting of this bit denotes a serious error which can be specified in greater detail by querying the Event Status Register.
6	**MSS bit** (master status summary bit) This bit is set if the device issues a service request. This is the case if one of the other bits of this register is set together with its mask bit in the Service Request Enable Register SRE.
7	**OPERation Status Register summary bit** This bit is set if an EVENt bit is set in the OPERation Status Register and the associated ENABle bit is set to 1. A set bit denotes that an action is just being performed by the device. Information on the type of action can be obtained by querying the OPERation Status Register.

3.8.3.2 IST Flag and Parallel Poll Enable Register (PPE)

Similar to the SRQ, the IST flag combines the complete status information in a single bit. It can be queried by a parallel poll (see section 3.8.4.3) or by the query `*IST?`.

The Parallel Poll Enable Register (PPE) determines which bits of the STB affect the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, bit 6 being used too - in contrast to the SRE. The IST flag is obtained by ORing all results together. The PPE can be set by the command `*PRE` and read by the query `*PRE?`.

3.8.3.3 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is already defined in the IEEE 488.2 standard. It is comparable to the EVENt register of an SCPI register. The Event Status Register can be read out by the query `*ESR?`.
The ESE forms the associated ENABle register. It can be set by the command `*ESE` and read by the query `*ESE?`.

Table 3.8-2 Definition of bits used in the Event Status Register

Bit No.	Definition
0	**Operation Complete** Upon reception of the *OPC command this bit is set exactly when all previous commands have been executed.
2	**Query Error** This bit is set if the controller wants to read data from the device but has not sent a data request command or has not read requested data and sends new commands to the device instead. A frequent cause is an incorrect query which cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number denoting the error in greater detail will be entered into the error queue (see Appendix A, Error Messages).
4	**Execution Error** This bit is set if the syntax of the command received is correct but the command cannot be executed due to various marginal conditions. An error message with a number between -200 and -300 describing the error in greater detail will be entered into the error queue (see Appendix B3, Error Messages).
5	**Command Error** This bit is set if an undefined command or a command with incorrect syntax is received. An error message with a number between -100 and -200 describing the error in greater detail will be entered into the error queue (see Appendix B3, Error Messages).
6	**User Request** This bit is set when the [LOCAL] key is pressed, ie when the device is switched to manual operation.
7	**Power On** This bit is set upon power on of the device.

3.8.3.4 STATus:OPERation Register

This register contains information in the CONDition register on operations currently performed by the device or in the EVENt register on operations performed by the device since the last readout. It can be set by the commands `STATus:OPERation:CONDition` or `STATus:OPERation[:EVENt]` and read by the queries `STATus:OPERation:CONDition?` or `STATus:OPERation[:EVENt]?.`

Table 3.8-3 Definition of bits used in the STATus:OPERation Register

Bit No.	Definition
0	**CALibrating** This bit is set as long as a calibration is being performed by the device.
1	**SETTling** This bit is set as long as settling goes on after a setting command. It is set only if the settling time is longer than the time required for command execution.
3	**SWEeping** This bit is set as long as a sweep is being performed by the device.
4	**MEASuring** This bit is set as long as a measurement is being performed by the device.
5	**WAIT for TRIGGER** This bit is set as long as the device waits for a trigger event.

3.8.3.5 STATus:QUEStionable-Register

This register contains information on questionable device states. These may for instance occur if the device is operated out of specifications. The register can be read by the queries `STATus:QUEStionable:CONDition` or `STATus:QUEStionable[:EVENt]` and queried by the commands `STATus:QUEStionable:CONDition?` or `STATus:QUEStionable[:EVENt]?.`

Table 3.8-4 Definition of bits used in the STATus:QUEStionable Register

Bit No.	Definition
0	**VOLTage** This bit is set when a questionable voltage occurs.
4	**FREQuency** This bit is set when a questionable frequency occurs.
5	**PHASe** This bit is set when a questionable phase value occurs.
6	**MODulation** This bit is set when a questionable modulation is performed.
7	**CALibration** This bit is set when a calibration procedure is not properly performed.

3.8.4 Use of Status Reporting Systems

For an efficient use of the status reporting system, the information contained therein has to be transferred to the controller and further processed. There are various methods which are described in the following. Detailed program examples are given in Appendix D3

3.8.4.1 Service Request, Use of Hierarchical Structure

Under certain conditions, the device may send a service request (SRQ) to the controller. This service request usually causes an interrupt at the controller to which the control program can respond by suitable action. As shown in Fig. 3.8-2 (Section 3.8.2), an SRQ will always be triggered if one or several of the bits 2, 3, 4, 5 or 7 have been set in the Status Byte Register and enabled in the SRE. Each of these bits combines the information from a further status register, from the error queue or the output buffer. By suitably setting the ENABle registers of the status registers, it is possible for any bit in any status register to trigger an SRQ. To utilize the possibilities of the service request, all bits in the enable registers SRE and in the ESE must be set to "1".

Example (see also Fig. 3.8-2, section 3.8.2 and Program Examples, Appendix D3):

Using the `*OPC` command to generate an SRQ

- Set bit 0 (Operation Complete) in the ESE
- Set bit 5 (ESB) in the SRE
  The device generates an SRQ upon completion of its settings.

Indicating the end of a sweep by an SRQ on the controller

- Set bit 7 (summary bit of the STATus:OPERation Register) in the SRE
- Set bit 3 (sweeping) of the STATus:OPERation:ENABle register
- Set bit 3 in the STATus:OPERation:NTRansition register so that the transition of sweeping bit 3 from 1 to 0 (sweep end) will also be recorded in the EVENt register
  After termination of the sweep the device generates an SRQ

The SRQ is thus the only way for the device to become active of its own. A controller program should set the device so that a service request will be generated in case of malfunctions. The program should suitably respond to the service request. A detailed example of a service request routine is given in Appendix D3, Program Examples.

3.8.4.2 Serial Poll

Same as the command `*STB`, serial poll is used to query the contents of the status byte register. However, since the query is performed via interface commands it is considerably faster. The serial poll method has already been defined in the IEEE 488.1 standard and was previously the sole comprehensive means for querying the status byte. This method functions also with devices that neither comply with SCPI nor with IEEE 488.2.

The QuickBASIC command `IBRSP()` is used for a serial poll. The serial poll is mostly used to obtain a fast overview of the states of devices connected to the IEC/IEEE bus.

3.8.4.3 Parallel Poll

In the parallel poll mode each of up to eight devices is requested simultaneously by a single command from the controller to transmit 1 information bit on the data lines, ie to pull the data line assigned to it to logic 0 or 1. Similar to the SRE register which defines the conditions under which an SRQ will be generated, there is a Parallel Poll Enable Register (PPE) which is also ANDed bit by bit with the STB taking into account bit 6. The result is ORed and returned (if required in inverted form) as a reply to a parallel poll of the controller. The result can also be read out by the command `*IST` without a parallel poll.

First the device must be set for the parallel poll by the QuickBASIC command `IBPPC()`. This command assigns a data line to the device and determines whether the response should be inverted or not. The parallel poll itself is made by `IBRPP()`.

The parallel poll mode is mainly used to find out quickly which of the devices connected to the IEC/IEEE bus has raised an SRQ. To do this SRE and PPE must be set to the same value. A detailed example on parallel poll is given in Appendix D3, Program Examples.

3.8.4.4 Queries

Each individual register of a status register can be read out by queries. The individual queries are given in the detailed description of the registers in section 3.8.3. The queries always return a number representing the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are mainly used after an SRQ to obtain detailed information on the cause for the SRQ.

3.8.4.5 Error Queue Query

Each error condition in the device causes an entry in the error queue. The entries in the error queue are detailed error messages in plain text which can be read out of the ERROR menu manually or via the IEC/IEEE bus by the query `SYSTem:ERRor?`. Each query `SYSTem:ERRor?` returns an entry from the error queue. If there are no more error messages in the queue, 0 = "No error" is returned.

The error queue should be queried in the controller program after each SRQ since the entries provide more detailed information on the error source than the status registers. Particularly in the test phase of a controller program the error queue should be queried regularly as it also registers erroneous commands from the controller to the device.

3.8.5 Resetting the Status Reporting System

Table 3.8-5 contains the various commands and events causing a reset of the status reporting system. None of the commands with the exception of *RST and SYSTem:PRESet affects the functional device settings. In particular DCL does not clear the device settings.

Table 3.8-5 Resetting device functions

Event / Effect	Switching on AC supply voltages – Power On Status Clear 0	Switching on AC supply voltages – Power On Status Clear 1	DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
Clears STB, ESR	—	yes	—	—	—	yes
Clears SRE, ESE	—	yes	—	—	—	—
Clears PPE	—	yes	—	—	—	—
Clears EVENt registers	—	yes	—	—	—	yes
Clears ENABle registers of all OPERation and QUESTionable Registers, fills the ENABle registers of all other registers with "1".	—	yes	—	—	yes	—
Fills PTRansition registers with "1", clears NTRansition registers	—	yes	—	—	yes	—
Clears error queue	yes	yes	—	—	—	yes
Clears output buffer	yes	yes	yes	1)	1)	1)
Clears command processing and input buffer	yes	yes	yes	—	—	yes

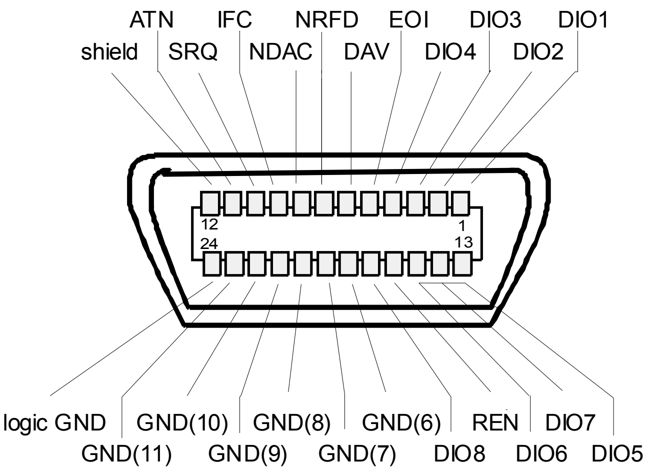
1) Any command that is the first in a command line, ie immediately follows a <PROGRAM MESSAGE TERMINATOR>, clears the output buffer.

Appendix A3 IEC/IEEE-Bus Interface

The device is equipped with an IEC/IEEE-bus interface as standard. The IEEE 488 connector is located at the rear. For remote control of the device, a controller may be connected via this interface by means of a screened cable.

A.1 Interface Characteristics

- 8-bit parallel data transmission
- Bidirectional data transmission
- Three-wire handshake
- High transmission rate, max. 350 Kbyte/s
- Up to 15 external devices connectible
- Max. length of connecting cables: 15 m (length of single cable: 2 m)
- Wired OR links when several devices are parallel-connected.



A.1.1 Bus Lines

1. **Data bus with 8 lines DIO 1 to DIO 8**
   Transmission is bit-parallel and byte-serial in ASCII/ISO code. DIO 1 is the least-significant and DIO 8 the most-significant bit.

2. **Control bus with 5 lines**
   IFC (Interface Clear),
   active LOW resets the interfaces of connected devices to a defined initial condition.

   ATN
   (Attention),active LOW signals the transmission of interface messages.
   inactive HIGH signals the transmission of device messages.

   SRQ (Service Request),
   active LOW enables a device to send a service request to the controller.

   REN (Remote Enable),
   active LOW allows switchover to the remote control mode.

   EOI (End or Identify),
   in connection with ATN has two functions:
   ATN = HIGH   active LOW signals the end of a data transmission.
   ATN = LOW   active LOW triggers a parallel poll.

3. **Handshake bus with three lines**
   DAV (Data Valid),
   active LOW signals that a valid data byte is on the bus.

   NRFD (Not Ready For Data),
   active LOW signals that one of the connected devices is not ready to accept data.

   NDAC (Not Data Accepted),
   active LOW, until the connected device has accepted the data on the bus.

A.1.2 Interface Functions

Devices controlled via IEC/IEEE bus may be provided with different interface functions. The interface functions of FSQ are listed in Table A3-1.

Table A-1 Interface functions

Control character	Interface function
SH1	Source handshake
AH1	Acceptor handshake
L3..L4/LE3..LE4	Listener
T5..T8/TE5..TE8	Talker, capability to answer serial poll
SR1	Service request
PP1	Parallel poll
RL1	Remote/local switchover
DC1	Device clear
DT1	Device trigger
C1...C27	Controller

A.2 Interface Messages

Interface messages are sent to the device on data lines, the ATN line being active LOW. They are used for communication between device and controller.

A.1.1 Common commands

Common commands are in the code range 10 to 1F hex. They affect all devices on the bus without any addressing being required.

Table A-2 Common commands

Command	QuickBASIC command	Function in the device
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Interrupts processing of received commands and sets the command processing software to a defined initial state. The device setup remains unchanged.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to their initial condition.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial poll
SPD (Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial poll
PPU (Parallel Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of parallel poll query status

A.1.2 Addressed commands

The addressed commands are in the code range 00 to 0F hex. They only affect devices addressed as a listener.

Table A-3 Addressed commands

Command	QuickBASIC command	Function in the device
SDC (Selected Device Clear)	IBCLR (device%)	Interrupts processing of received commands and sets the command processing software to a defined initial state. The device setup remains unchanged.
GTL (Go to Local)	IBLOC (device%)	Change to local mode (manual control)
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configures device for parallel poll. The Quick BASIC command executes PPE / PPD in addition.

Appendix B

B.1 List of Error Messages

The list below contains all error messages that could occur in the device during remote control. The meaning of negative error codes is specified by SCPI, positive error codes identify device-specific errors.

The left column in the table below states the error code. In the right column, the text of the error message entered in the error/event queue (and displayed) is written in bold. Below this text, an explanation is given.

B.2 SCPI-Specific Error Messages

No error

Error number	**Text displayed upon an error queue query** Explanations
0	**No error** This message is displayed when there are no entries in the error queue.

Command errors - faulty command, causes bit 5 in the ESR register to be set

Error number	**Text displayed upon an error queue query** Explanations
-100	**Command Error** Command faulty or invalid.
-101	**Invalid Character** Command contains a character which is invalid for that type. Example: a header containing an ampersand "`SOURCE&`".
-102	**Syntax error** Command invalid. Example: a string is received when the device does not accept strings.
-103	**Invalid separator** Command contains an illegal character where a separator is expected. Example: the semicolon was omitted after the command.
-104	**Data type error** Command contains an invalid data element. Example: numeric data for frequency setting were expected and ON was encountered.
-105	**GET not allowed** A Group Execute Trigger (GET) was received within a program message.
-108	**Parameter not allowed** More parameters were received than expected. Example: The command `SOURce:FM:INTernal:FREQuency` accepts one frequency parameter.

Error number	**Text displayed upon an error queue query** Explanations
-109	**Missing parameter** Fewer parameters were received than required. Example: The command `SOURce:FM:INTernal:FREQuency` requires a frequency parameter to be specified.
-110	**Command header error** An error was detected in the header.
-111	**Header separator error** Header contains a character which is not a legal separator. Example: There is no "White Space", "`*ESE255`" between header and data section.
-112	**Program mnemonic too long** Header contains more than 12 characters.
-113	**Undefined header** The header is undefined for this specific device. Example: `*XYZ` is not defined for any device.
-114	**Header suffix out of range** He header contains a numeric suffix which makes the header invalid. Example: `SOURce3` does not exist in the device.
-120	**Numeric data error** Command contains an erroneous numeric parameter.
-121	**Invalid character in number** A numeric contains an invalid character. Example: "A" in a decimal numeric or "9" in an octal data.
-123	**Exponent too large** The magnitude of the exponent was larger than 32000.
-124	**Too many digits** Numeric contains too many digits.
-128	**Numeric data not allowed** A legal numeric element was received but the device does not expect one in this position. Example: The command `SOURce:FREQuency:MODE` requires character data to be specified.
-130	**Suffix error** The command contains a faulty suffix.
-131	**Invalid suffix** The suffix is illegal for this device. Example: nHz is not defined.
-134	**Suffix too long** Suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix was encountered which is not allowed for this command or at this position in the command. Example: Command `*RCL` does not accept a suffix.
-140	**Character data error** Command contains faulty character data.
-141	**Invalid character data** Either the character data element contains an invalid character or the element received is not valid for this command. Example: Writing error when entering a parameter: `SOURce:FREQuency:MODE FIKSed.`
-144	**Character data too long** The character data element contains more than 12 characters.
-148	**Character data not allowed** A legal character data element was encountered where prohibited by the device. Example: Command `*RCL` required numeric data to be specified.

Error number	**Text displayed upon an error queue query** Explanations
-150	**String data error** Command contains faulty string data.
-151	**Invalid string data** Command contains an invalid string data element. Example: an END message was received before the terminal quote character.
-158	**String data not allowed** A string data element was encountered but was not allowed by the device at this point. Example: a character data element is market by quotes, `SOURce:FREQuency:MODE "FIXed"`
-160	**Block data error** Command contains faulty block data.
-161	**Invalid block data** A block data element was expected bur was illegal for some reason. Example: an END message was received before the length was satisfied.
-168	**Block data not allowed** A legal block data element was encountered but was not allowed at this point.
-170	**Expression error** The command contains an invalid expression data element.
-171	**Invalid expression** Command contains an invalid expression data element. Example: unmatched parentheses
-178	**Expression data not allowed** A legal expression data was encountered but was not allowed at this point.
-180	**Macro error** Error generated when defining a macro or executing a macro.
-181	**Invalid outside macro definition** A macro parameter placeholder was encountered outside the macro definition.
-183	**Invalid inside macro definition** The program message unit sequence is syntactically invalid.
-184	**Macro parameter error** A command inside the macro definition had the wrong number or type of parameter.

Execution errors -
error encountered upon command execution, causes bit 4 in the ESR register to be set

Error number	**Text displayed upon an error queue query** Explanations
-200	**Execution error** Error encountered upon command execution.
-201	**Invalid while in local** The command is not executable while the device is in local due to a hard local control element. Example: a device with a rotary switch receives a message which would change the switch state, but since the device is in local the message cannot be executed.
-202	**Settings lost due to rtl** A setting associated with a hard local control was lost when the device changed from LOCS to REMS or from LWLS to RWLS.
-210	**Trigger error** Error upon device trigger.
-211	**Trigger ignored** A GET, *TRG or trigger signal was received and recognized but was ignored. Example: device was not ready to respond.
-212	**Arm ignored** An arming signal was received and recognized but was ignored.
-213	**Init ignored** A request for a measurement initiation was ignored as another measurement was already in progress.
-214	**Trigger deadlock** The trigger signal cannot be executed. (The trigger source for the initiation of a measurement is set to GET and a subsequent measurement query is received. The measurement cannot be started until a GET is received but the GET would cause an INTERRUPTED error.)
-215	**Arm deadlock** The arming signal cannot be executed.
-220	**Parameter error** Command contains a faulty or invalid parameter.
-221	**Settings conflict** A legal program data element was received but could not be executed due to the current device state. Example: FM1 and PM1 cannot be switched on simultaneously.
-222	**Data out of range** A legal program data element was received but could not be executed because the value was outside the legal range. Example: command *RCL allows only values between 0 to 50 to be specified.
-223	**Too much data** Command contains more data than the device can handle. Example: the device has not enough memory capacity.
-224	**Illegal parameter value** The parameter is invalid. Example: an illegal parameter is given, `TRIGger:SWEep:SOURce TASTe`
-230	**Data corrupt or stale** Data are incomplete or invalid. Example: a measurement was aborted by the device.

Error number	**Text displayed upon an error queue query** Explanations
-231	**Data questionable** The measurement accuracy is suspect.
-240	**Hardware error** A command cannot be executed because of a hardware problem in the device.
-241	**Hardware missing** The command cannot be executed because of a missing device hardware. Example: an option is not installed.
-250	**Mass storage error** Error in the mass memory.
-251	**Missing mass storage** Command cannot be executed because of missing mass memory. Example: an option is not installed.
-252	**Missing media** Command could not be executed because of a missing media. Example: no disk in the drive.
-253	**Corrupt media** The media is faulty. Example: disk has the wrong format.
-254	**Media full** The media was full. Example: disk out of space.
-255	**Directory full** The media directory was full.
-256	**File name not found** The file name could not be found on the device media.
-257	**File name error** The file name on the device media was in error. Example: an attempt was made to copy to a duplicate file name.
-258	**Media protected** The media was protected. Example: the write-protect tab on a disk was present.
-260	**Expression error** Command contains an error related to an expression program data element.
-261	**Math error in expression** The expression contains a math error. Example: division by zero.
-270	**Macro error** A macro-related execution error occurred.
-271	**Macro syntax error** A syntactically legal macro program data sequence cannot be executed due to a syntax error.
-272	**Macro execution error** A syntactically legal macro program data sequence cannot be execution due to an error in the macro definition.

Error number	**Text displayed upon an error queue query** Explanations
-273	**illegal macro label** The macro label defined in the DMC* command was a legal string syntax but could not be accepted by the device. Example: the label was too long, the same as a common command header or contained invalid header syntax.
-274	**Macro parameter error** The macro definition improperly used a macro parameter placeholder.
-275	**Macro definition too long** The macro program data sequence could not be executed because the string or block contents were too long for the device to handle.
-276	**Macro recursion error** A macro program data sequence could not be executed because the device found it to be recurrent. Example: the event causing the recurrence to stop is not received.
-277	**Macro redefinition not allowed** The macro label in the *DMC command could not be executed because it was already defined.
-278	**Macro header not found** A legal macro label in the *GMC? query could not be executed because the header was not previously defined.
-280	**Program error** A downloaded program-related execution error occurred.
-281	**Cannot create program** An attempt to create a program was unsuccessful.
-282	**illegal program name** The program name was invalid. Example: the name refers to a nonexistent program.
-283	**illegal variable name** The entered variable is nonexistent in the program.
-284	**Program currently running** The operation is illegal while the program is running.
-285	**Program syntax error** The downloaded program contains a syntax error.
-286	**Program runtime error**

Device-specific error - causes bit 3 in the ESR register to be set

Error number	**Text displayed upon an error queue query** Explanations
-300	**Device-specific error** SM3-specific error that cannot be defined more precisely.
-310	**System error** A system internal error has occurred. Please inform the R&S service team.
-311	**Memory error** An error was detected in the device memory.
-312	**PUD memory lost** The protected user data saved by the *PUD command has been lost.
-313	**Calibration memory lost** The nonvolatile calibration data used by the *CAL? command has been lost.
-314	**Save/recall memory lost** The nonvolatile calibration data used by the *SAV? command has been lost.
-315	**Configuration memory lost** The nonvolatile calibration data saved by the device has been lost.
-330	**Self-test failed** The selftest could not be performed.
-350	**Queue overflow** Error code entered in the queue instead of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded. Five of these entries can be made in the queue.

Query errors - error upon data query, causes bit 2 in the ESR register to be set

Error number	**Text displayed upon an error queue query** Explanations
-400	**Query error** Generic query error for devices that cannot detect more specific error.
-410	**Query INTERRUPTED** The query was interrupted. Example: a query is followed by new data before a response was completely sent.
-420	**Query UNTERMINATED** An incomplete query error was received. Example: the device was addressed to talk and an incomplete program message was received.
-430	**Query DEADLOCKED** The query cannot be processed. Example: both input and output buffer are full and the device cannot continue.
-440	**Query UNTERMINATED after indefinite response** A query is received in the same program message after a query requesting an indefinite response.

B.3 Device-Dependent Error Messages

Device-dependent errors - device-dependent error, causes bit 3 in the ESR register to be set

Error number	**Text displayed upon an error queue query** Explanations
105	**Frequency underrange** Frequency below the guaranteed limit value.
110	**Output unlevelled** Level control loop out of function.
115	**Level overrange** Level above the guaranteed limit value.
130	**FM modulator VCO unlocked** FM modulator VCO not synchronized.
131	**AM modulation frequency out of range** AM modulation frequency outside permissible range.
132	**PM modulation frequency out of range** PM modulation frequency outside permissible range.
147	**A/D converter not responding** Device unable to address the diagnosis converter on the controller module.

Anhang/ Appendix C Liste der Befehle mit SCPI-Konformitätsinformation / List of Commands with SCPI Conformity Information

Das Gerät unterstützt die SCPI-Version 1995.0.
Für die Fernsteuerung wurden weitgehend Befehle verwendet, die in dieser SCPI-Version festgelegt oder anerkannt wurden. Befehle, die nicht Teil der SCPI-Festlegung sind, sind in der SCPI-Info mit "nicht / non SCPI" gekennzeichnet.

The instrument supports SCPI version 1995.0.
Commands specified or accepted by this SCPI version are mostly used for remote control. Commands not specified by SCPI are marked "non-SCPI" in the SCPI info column.

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
*CLS		SCPI	
*ESE	<numeric>	SCPI	
*ESR?		SCPI	
*IDN?		SCPI	
*IST?		SCPI	
*OPC		SCPI	
*OPC?		SCPI	
*OPT?		SCPI	
*PRE	<numeric>	SCPI	
*PSC	<numeric>	SCPI	
*RST		SCPI	
*SRE	<numeric>	SCPI	
*STB?		SCPI	
*TST?		SCPI	
*WAI		SCPI	
*RCL	1 bis / to 30 101 bis / to 199	SCPI	
*SAV	1 bis / to 30 101 bis / to 199	SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
CALibration:DC:OFFSet:EXTern		nicht / non SCPI	
CALibration:DC:OFFSet:INTern		nicht / non SCPI	
CALibration:ALL		nicht / non SCPI	
CALibration:LEVel		nicht / non SCPI	
CALibration:LEVel:DATE		nicht / non SCPI	
CALibration:MODulation		nicht / non SCPI	
CALibration:MODulation:DATE		nicht / non SCPI	
CALibration:SYNThesis		nicht / non SCPI	
CALibration:SYNThesis:DATE		nicht / non SCPI	
CALibration:CSPL		nicht / non SCPI	
CALibration:CSPL:DATE		nicht / non SCPI	
CALibration:ISDBT		nicht / non SCPI	
CALibration:ISDBT:DATE		nicht / non SCPI	
CALibration:NOISe		nicht / non SCPI	
CALibration:NOISe:ALL		nicht / non SCPI	
CALibration:NOISe:ALL:DATE		nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
DIAGnostic:CARDs[:STATe]?			
DIAGnostic:POSition?	<numeric> | MAXimum | MINimum, <numeric> | MAXimum | MINimum	nicht / non SCPI	
DIAGnostic:CSPL		nicht / non SCPI	
DIAGnostic:CSPL:ERRor?		nicht / non SCPI	
DIAGnostic:ISDBT:ERRor?		nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
OUTPut[:STATe]	<numeric> | OFF | ON	SCPI	ON

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
READ:FM[:BASeband]:DEViation?		nicht / non SCPI	22.5 MHZPP
READ:FM[:BASeband]:ENERgy[:DISPersal]:DOUBle[:STATe]?		nicht / non SCPI	
READ:IQCoder:DATarate?		nicht / non SCPI	
READ:IQCoder:Packetlength?		nicht / non SCPI	
READ:IQCoder:SYMBols[RATE]?		nicht / non SCPI	
READ:IQCoder:USEFul[:RATE]?		nicht / non SCPI	
READ:IQCoder:COFDm:INPut:DATarate [:LOW]?		nicht / non SCPI	
READ:IQCoder:COFDm:INPut:DATarate: HIGH?		nicht / non SCPI	
READ:IQCoder:COFDm:USEFul[:RATE] [:LOW]?		nicht / non SCPI	
READ:IQCoder:COFDm:USEFul[:RATE]: HIGH?		nicht / non SCPI	
READ:IQCoderISDBt:InPut:DATarate?		nicht / non SCPI	
READ:IQCoder:ISDBt:USEFul[:RATE]:A?		nicht / non SCPI	
READ:IQCoder:ISDBt:USEFul[:RATE]:B?		nicht / non SCPI	
READ:IQCoder:ISDBt:USEFul[:RATE]:C?		nicht / non SCPI	
READ:IQCoder:ISDBt:USEFul[:RATE]:MAX:A ?		nicht / non SCPI	
READ:IQCoder:ISDBt:USEFul[:RATE]:MAX:B ?		nicht / non SCPI	
READ:IQCoder:ISDBt:USEFul[:RATE]:MAX:C ?		nicht / non SCPI	
READ:BER:?		nicht / non SCPI	
READ:BER:ALL?		nicht / non SCPI	
READ:BER:GATE[:RATio]?		nicht / non SCPI	
READ:BER:STATe?		nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
ROUTe:FM[:BASeband]:VIDeo:INPut	FR1M | FR75 | RE1 | RE2 | AUTO | FRONt1m | FRONt75 | REAR1 | REAR2	nicht / non SCPI	FRONt75
ROUTe:MONitor	INTernal | EXTernal	nicht / non SCPI	INTernal
ROUTe:REFerence:CLOCk	INTernal | EXTernal	nicht / non SCPI	INTernal

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
SENSe:BER:MEASurement	<numeric> | OFF | ON	nicht / non SCPI	OFF
SENSe:BER[:INPut][:SELect]	SERial | PARallel	nicht / non SCPI	SERial
SENSe:BER[:INPut]:SERial:DATA	NORMal | INVerted	nicht / non SCPI	NORMal
SENSe:BER[:INPut]:SERial:CLOCk	NORMal | INVerted	nicht / non SCPI	NORMal
SENSe:BER[:INPut]:SERial:ENABle	ALWays | HIGH | LOW	nicht / non SCPI	ALWays
SENSe:BER[:INPut]:PARallel[:MODE]	NORMal | INVerted | NULL | PID	nicht / non SCPI	NORMal
SENSe:BER:PRBS[:SEQuence]	P23_1 | P15_1	nicht / non SCPI	P23_1

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]DM:CW:STATe	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]DM:FORMat	S4 | (QPSK |)* S8 | S16 | S4T | S8T | C16 | (QAM16 |)* C32 | (QAM32 |)* C64 | (QAM64 |)* C128 | (QAM128 |)* C256 | (QAM256 |)* T4 | (COFDmqpsk |)* T16 | (COFDm16qam |)* T64 | (COFDm64qam |)* T161 | (COFDm16qam1 |)* T162 | (COFDm16qam2 |)* T164 | (COFDm16qam4 |)* T641 | (COFDm64qam1 |)* T642 | (COFDm64qam2 |)* T644 | (COFDm64qam4 |)* J83B64 | J83B256 | VSB8 | IPDD | IPDC | IPCC | IDDD | IDDC | IDCC | ICCC (* veraltet / obsolet, legacy code)	nicht / non SCPI	S4 T64 J83B64 VSB8 ICCC abhängig von / dependent on HW
[SOURce:]DM:IQRatio[:MAGNitude]	<numeric> [ONE | PCT] | MAXimum | MINimum	SCPI	0%
[SOURce:]DM:MODulation:OFFSet	<numeric> [ONE | PCT] | MAXimum | MINimum	nicht / non SCPI	0%
[SOURce:]DM:POLarity[:ALL]	NORMal | INVerted	SCPI	NORMAL
[SOURce:]DM:QUADrature:ANGLe	<numeric> [DEG] | MAXimum | MINimum	nicht / non SCPI	0 DEG
[SOURce:]DM:SOURce	EXTernal | INTernal	nicht / non SCPI	EXTernal
[SOURce:]DM:STATe	<numeric> | OFF | ON	SCPI	ON

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce]:DM:IQEXternal:INPut:CORRection	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0.00 DB
[SOURce]:DM:IQEXternal:INPut:SIGNal	NOM | DVBT	nicht / non SCPI	NOM

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce:]FM:EXTernal:COUPling	AC | DC	SCPI	AC
[SOURce:]FM:EXTernal:DEViation	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ | HZPP | AHZPP | FHZPP | PHZPP | NHZPP | UHZPP | KHZPP | MHZPP | GHZPP | THZPP | PEHZPP | EXHZPP] | MAXimum | MINimum	nicht / non SCPI	22.5 MHZPP
[SOURce:]FM:EXTernal:POLarity	NORMal | INVerted	SCPI	NORMal
[SOURce:]FM:EXTernal:STATe	<numeric> | OFF | ON	nicht / non SCPI	OFF

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce:]FM:SOURce	EXTernal | INTernal	SCPI	INTernal
[SOURce:]FM:STATe	<numeric> | OFF | ON	SCPI	OFF

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce:]FM[:BASeband]:CW[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]FM[:BASeband]:ENERgy[:DISPersal]:DEViation	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ | HZPP | AHZPP | FHZPP | PHZPP | NHZPP | UHZPP | KHZPP | MHZPP | GHZPP | THZPP | PEHZPP | EXHZPP] | MAXimum | MINimum	nicht / non SCPI	2 MHZPP
[SOURce:]FM[:BASeband]:ENERgy[:DISPersal]:POLarity	NORMal | INVerted	nicht / non SCPI	NORMal
[SOURce:]FM[:BASeband]:ENERgy[:DISPersal][:STATe]	<numeric> | OFF | ON	nicht / non SCPI	OFF

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT:FREQuency	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	1.02 KHZ
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT:VOLume	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	-20 DB
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:LEFT[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:PREemphasis[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt:FREQuency	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	2.04 KHZ
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt:VOLume	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	-20 DB
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio:RIGHt[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:AUDio[:MODE]	SINGle | DUAL | STEReo | JOINt	nicht / non SCPI	STEReo
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:RF:DEViation	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ | HZPP | AHZPP | FHZPP | PHZPP | NHZPP | UHZPP | KHZPP | MHZPP | GHZPP | THZPP | PEHZPP | EXHZPP] | MAXimum | MINimum	nicht / non SCPI	2.5 MHZPP
[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:RF:FREQuency	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	6.12 MHZ 6.30 MHZ 6.48 MHZ 6.66 MHZ 6.84 MHZ 7.74 MHZ 7.92 MHZ 8.10 MHZ 8.28 MHZ 8.46 MHZ 7.38 MHZ 7.56 MHZ

<table>
<tr><th>Befehl / Command</th><th>Parameter</th><th>SCPI-Info</th><th>nach / to *RST</th></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:STATe</td><td><numeric> | OFF | ON</td><td>nicht / non SCPI</td><td>OFF</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:ANCillary</td><td>OFF | DAT1 | DAT2 | DAT3 | DAT4</td><td>nicht / non SCPI</td><td>OFF</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:BER:RATE</td><td><numeric> | MAXimum | MINimum</td><td>nicht / non SCPI</td><td>10E-6</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:BER[:STATe]</td><td><numeric> | OFF | ON</td><td>nicht / non SCPI</td><td>OFF</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:POLarity</td><td>NORMal | INVerted</td><td>nicht / non SCPI</td><td>NORMal</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:ADR[1|2|3|4|5|6|7|8|9|10|11|12][:DATA]:SOURce</td><td>INTernal | EXTN | EXTI | PRBS | CW | TST1 | TST2 | TST3</td><td>nicht / non SCPI</td><td>INTernal</td></tr>
</table>

<table>
<tr><th>Befehl / Command</th><th>Parameter</th><th>SCPI-Info</th><th>nach / to *RST</th></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:DEViation</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ | HZPP | AHZPP | FHZPP | PHZPP | NHZPP | UHZPP | KHZPP | MHZPP | GHZPP | THZPP | PEHZPP | EXHZPP] | MAXimum | MINimum</td><td>nicht / non SCPI</td><td>150 KHZ</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:FREQuency</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>nicht / non SCPI</td><td>1 KHZ</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:LPASs[:STATe]</td><td><numeric> | OFF | ON</td><td>nicht / non SCPI</td><td>ON</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio:SOURce</td><td>EXTernal | INTernal</td><td>nicht / non SCPI</td><td>INTernal</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:AUDio[:STATe]</td><td><numeric> | OFF | ON</td><td>nicht / non SCPI</td><td>OFF</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:PREemphasis:TIME</td><td>US50 | US75 | J17</td><td>nicht / non SCPI</td><td>US50</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:PREemphasis[:STATe]</td><td><numeric> | OFF | ON</td><td>nicht / non SCPI</td><td>ON</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:RF:DEViation</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ | HZPP | AHZPP | FHZPP | PHZPP | NHZPP | UHZPP | KHZPP | MHZPP | GHZPP | THZPP | PEHZPP | EXHZPP] | MAXimum | MINimum</td><td>nicht / non SCPI</td><td>2.5 MHZPP</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6]:RF:FREQuency</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>nicht / non SCPI</td><td>6.50 MHZ
7.02 MHZ
7.20 MHZ
7.38 MHZ
7.56 MHZ
7.74 MHZ</td></tr>
<tr><td>[SOURce:]FM[:BASeband]:SUBCarrier:FM[1|2|3|4|5|6][:STATe]</td><td><numeric> | OFF | ON</td><td>nicht / non SCPI</td><td>OFF</td></tr>
</table>

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]FM[:BASeband]:VIDeo:COUPling	AC | DC	nicht / non SCPI	AC
[SOURce:]FM[:BASeband]:VIDeo:CLAMping:SYNC	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce:]FM[:BASeband]:VIDeo:CLAMping:TYPE	HARD | SOFT	nicht / non SCPI	HARD
[SOURce:]FM[:BASeband]:VIDeo:CLAMping[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]FM[:BASeband]:VIDeo:DEViation	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ | HZPP | AHZPP | FHZPP | PHZPP | NHZPP | UHZPP | KHZPP | MHZPP | GHZPP | THZPP | PEHZPP | EXHZPP] | MAXimum | MINimum	nicht / non SCPI	22.5 MHZPP
[SOURce:]FM[:BASeband]:VIDeo:LPASs[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]FM[:BASeband]:VIDeo:POLarity	NORMal | INVerted	nicht / non SCPI	NORMal
[SOURce:]FM[:BASeband]:VIDeo:PREemphasis[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]FM[:BASeband]:VIDeo:STANdard	PAL | SECam | NTSC	nicht / non SCPI	PAL
[SOURce:]FM[:BASeband]:VIDeo[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	OFF

<table>
<tr><th>Befehl / Command</th><th>Parameter</th><th>SCPI-Info</th><th>nach / to *RST</th></tr>
<tr><td>[SOURce:]FREQuency:CENTer</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td>150 MHZ</td></tr>
<tr><td>[SOURce:]FREQuency:CHANnel:TABLe</td><td>NONE | USR1 | USR2 | USR3 | USR4 | USR5 | USER1 | USER2 | USER3 | USER4 | USER5</td><td>nicht / non SCPI</td><td>NONE</td></tr>
<tr><td>[SOURce:]FREQuency:CHANnel</td><td><numeric> | MAXimum | MINimum | UP | DOWN</td><td>nicht / non SCPI</td><td></td></tr>
<tr><td>[SOURce:]FREQuency:CW</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td>1000MHz</td></tr>
<tr><td>[SOURce:]FREQuency:FIXed</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td>1000MHz</td></tr>
<tr><td>[SOURce:]FREQuency:MODE</td><td>CW | FIXed | SWEep</td><td>SCPI</td><td>CW</td></tr>
<tr><td>[SOURce:]FREQuency:RESolution</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td></td></tr>
<tr><td>[SOURce:]FREQuency:SHIFt</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>nicht / non SCPI</td><td>0 MHZ</td></tr>
<tr><td>[SOURce:]FREQuency:SPAN</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td>100 MHZ</td></tr>
<tr><td>[SOURce:]FREQuency:STARt</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td>100 MHZ</td></tr>
<tr><td>[SOURce:]FREQuency:STOP</td><td><numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum</td><td>SCPI</td><td>200 MHZ</td></tr>
</table>

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce]:FREQuency:ACTual:CENTer	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ]	nicht / non SCPI	1000MHz + (10.7622377622 /4) MHz
[SOURce]:FREQuency:NOMinal:CENTer	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ]	nicht / non SCPI	1000MHz + (10.7622377622 /4) MHz
[SOURce]:FREQuency:OOC[:STATe]?	<numeric> | OFF | ON	nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce]:CHANnel:TABLe:SET	USR1 | USR2 | USR3 | USR4 | USR5, <numeric>, <numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ]	nicht / non SCPI	
[SOURce]:CHANnel:TABLe:ASSign	USR1 | USR2 | USR3 | USR4 | USR5, <string>	nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]IQCoder:DVBC:DATarate (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:DATarate)	<numeric> [MB] | MAXimum | MINimum	nicht / non SCPI	38.015 MB
[SOURce:]IQCoder:DVBC:INPut (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:INPut)	TSP | ASI | SPI | ASX | SPX	nicht / non SCPI	TSP
[SOURce:]IQCoder:DVBC:LOCKed? (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:LOCKed?)	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL | ERROR | NOREF | CABER	nicht / non SCPI	
[SOURce:]IQCoder:DVBC:MODE (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:MODE)	DATA | AUTO | PRBS | NTSP | PTSP	nicht / non SCPI	I/Q Coder: AUTO CSPL Coder: DATA
[SOURce:]IQCoder:DVBC:PACKetlength (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:PACKetlength)	P188 | P204	nicht / non SCPI	P188
[SOURce:]IQCoder:DVBC:ROLLoff (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:ROLLoff)	<numeric> | MAXimum | MINimum	nicht / non SCPI	0.15
[SOURce:]IQCoder:DVBC:SYMBols[:RATE] (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM:SYMBols[:RATE])	<numeric> | MAXimum | MINimum	nicht / non SCPI	I/Q Coder: 6.875 MS CSPL Coder: 6.9 MS
[SOURce:]IQCoder:DVBC[:SPECial]: INTerleave (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM[:SPECial]:INTerleave)	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:DVBC[:SPECial]: REEDsolomon (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM[:SPECial]:REEDsolomon)	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:DVBC[:SPECial]: SCRamble (veraltet / obsolet, legacy code: [SOURce:]IQCoder:QAM[:SPECial]:SCRamble	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:DVBC[:SPECial]: SYNC[:BYTE]:INVersion	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:DVBC[:SPECial]:PLL:DATA	FIFO | TS	nicht / non SCPI	FIFO
[SOURce]:IQCoder:DVBC[:SPECial]:PLL: INT	REF10 | TCXO | VCXO	nicht / non SCPI	REF10
[SOURce]:IQCoder:DVBC:UNLock:CAUSe?	<string>	nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]IQCoder:SAT:DATarate [SOURce:]IQCoder:QPSK:DATarate	<numeric> [MB] | MAXimum | MINimum	nicht / non SCPI	38.015 MB
[SOURce:]IQCoder:SAT:INPut [SOURce:]IQCoder:QPSK:INPut	TSP | ASI | SPI | ASX | SPX	nicht / non SCPI	TSP
[SOURce:]IQCoder:SAT:LOCKed? [SOURce:]IQCoder:QPSK:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL | ERROR | NOREF| CABER |	nicht / non SCPI	
[SOURce:]IQCoder:SAT:MODE [SOURce:]IQCoder:QPSK:MODE	DATA | AUTO | PRBS | NTSP | PTSP	nicht / non SCPI	AUTO
[SOURce:]IQCoder:SAT:PACKetlength [SOURce:]IQCoder:QPSK:PACKetlength	P188 | P204	nicht / non SCPI	P188
[SOURce:]IQCoder:SAT:RATE [SOURce:]IQCoder:QPSK:RATE	R1_2 | R2_3 | R3_4 | R5_6 | R7_8	nicht / non SCPI	R3_4
[SOURce:]IQCoder:SAT:ROLLoff [SOURce:]IQCoder:QPSK:ROLLoff	<numeric> | MAXimum | MINimum	nicht / non SCPI	0.35
[SOURce:]IQCoder:SAT:SYMBols[:RATE] [SOURce:]IQCoder:QPSK:SYMBols[:RATE]	<numeric> | MAXimum | MINimum	nicht / non SCPI	27.500 MS
[SOURce:]IQCoder:SAT[:SPECial]: INTerleave [SOURce:]IQCoder:QPSK[:SPECial]: INTerleave	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:SAT[:SPECial]: REEDsolomon [SOURce:]IQCoder:QPSK[:SPECial]: REEDsolomon	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:SAT[:SPECial]: SCRamble [SOURce:]IQCoder:QPSK[:SPECial]: SCRamble	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:SAT[:SPECial]: SYNC[:BYTE]:INVersion	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:SAT[:SPECial]:PLL: DATA	FIFO | TS	nicht / non SCPI	FIFO
[SOURce]:IQCoder:SAT[:SPECial]:PLL:INT	REF10 | TCXO | VCXO	nicht / non SCPI	REF10
[SOURce]:IQCoder:SAT:UNLock:CAUSe?	<string>	nicht / non SCPI	

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce]:IQCoder:COFDm:INPut[:LOW]	TSP | SPI | ASI | ASX | SPX | SPIAUX | TSPAUX	nicht / non SCPI	TSP
[SOURce]:IQCoder:COFDm:INPut:HIGH	TSP | SPI | ASI | ASX | SPX | SPIAUX | TSPAUX	nicht / non SCPI	SPIAUX
[SOURce]:IQCoder:COFDm:INPut:DATarate [:LOW]?	<numeric> [MB] | MAXimum | MINimum	nicht / non SCPI	27.144386
[SOURce]:IQCoder:COFDm:INPut:DATarate: HIGH?	<numeric> [MB] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:IQCoder:COFDm:USED [:BANDwidth]	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	7.607143 MHZ
[SOURce]:IQCoder:COFDm:CHANnel[:BAND width]	BW_8 | BW_7 | BW_6	nicht / non SCPI	BW_8
[SOURce]:IQCoder:COFDm:PACKetlength [:LOW]	P188 | P204	nicht / non SCPI	P188
[SOURce]:IQCoder:COFDm:PACKetlength: HIGH	P188 | P204	nicht / non SCPI	P188
[SOURce]:IQCoder:COFDm:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL	nicht / non SCPI	
[SOURce]:IQCoder:COFDm:LOCKed:LOW?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL	nicht / non SCPI	
[SOURce]:IQCoder:COFDm:LOCKed:HIGH?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL	nicht / non SCPI	
[SOURce]:IQCoder:COFDm:PACKetlength [:LOW]	P188 | P204	nicht / non SCPI	P188
[SOURce]:IQCoder:COFDm:PACKetlength: HIGH	P188 | P204	nicht / non SCPI	P188
[SOURce]:IQCoder:COFDm:MODE[:LOW]	DATA | PBEC | PAFC | NTSP | PTSP | PBEM	nicht / non SCPI	DATA
[SOURce]:IQCoder:COFDm:MODE:HIGH	DATA | PBEC | PAFC | NTSP | PTSP | PBEM	nicht / non SCPI	DATA
[SOURce]:IQCoder:COFDm:DATA	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:DATA:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:PILot	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:PILot:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:TPS	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:TPS:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:EQUal [:CARRiers]	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce]:IQCoder:COFDm:GUARd	G1_4 | G1_8 | G1_16 | G1_32 | OFF	nicht / non SCPI	G1_32
[SOURce]:IQCoder:COFDm:FFT:MODE	M2K | M8K	nicht / non SCPI	M8K
[SOURce]:IQCoder:COFDm:RATE[:LOW]	R1_2 | R2_3 | R3_4 | R5_6 | R7_8	nicht / non SCPI	R3_4
[SOURce]:IQCoder:COFDm:RATE:HIGH	R1_2 | R2_3 | R3_4 | R5_6 | R7_8	nicht / non SCPI	R3_4

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce]:IQCoder:COFDm[:SPECial]:SCRamble[:LOW]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:SCRamble:HIGH	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:CONV[:INTerleaver][:LOW]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:CONV[:INTerleaver]:HIGH	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:BIT[:INTerleaver]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:SYMBol[:INTerleaver]	<numeric> | OFF | ON	nicht / non SCPI	ON
©	<numeric>	nicht / non SCPI	“#0000“
[SOURce]:IQCoder:COFDm[:SPECial]:TPSReserved:STATe	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce]:IQCoder:COFDm[:SPECial]:TPSReserved:VALue	<numeric>	nicht / non SCPI	“#00“
[SOURce]:IQCoder:COFDm[:SPECial]:SYNC[:BYTE]:INVersion[:LOW]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:SYNC[:BYTE]:INVersion:HIGH	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:REEDsolomon[:LOW]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm[:SPECial]:REEDsolomon:HIGH	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:COFDm:DISable:CARRiers	<string>	nicht / non SCPI	““
[SOURce]:IQCoder:COFDm:IFFT:SYNC[:OUTPut]	<numeric> | OFF | ON	nicht / non SCPI	OFF

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]IQCoder:VSB:DATarate	<numeric> [MB] | MAXimum | MINimum	nicht / non SCPI	17.00000000MB
[SOURce:]IQCoder:VSB:INPut	TSP | ASI | SPI | ASX | SPX | SMPTe | SMX	nicht / non SCPI	TSP
[SOURce:]IQCoder:VSB:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL	nicht / non SCPI	
[SOURce:]IQCoder:VSB:MODE	PRBS | DATA | NTSP | PTSP | PBET | PAFT | SYNC	nicht / non SCPI	DATA
[SOURce:]IQCoder:VSB:ROLLoff	<numeric> | MAXimum | MINimum	nicht / non SCPI	0.115
[SOURce:]IQCoder:VSB:SYMBols[:RATE]	<numeric> | MAXimum | MINimum	nicht / non SCPI	9.349MS *)
[SOURce:]IQCoder:VSB [:SPECial]: RANDomizer	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:VSB [:SPECial]: INTerleave	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:VSB [:SPECial]: PILot[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:VSB [:SPECial]: PILot:VALue	<numeric> | MAXimum | MINimum	nicht / non SCPI	1.25

*) abhängig von den Eingangsdaten / dependent on input data

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]IQCoder:J83B:DATarate	<numeric> [MB] | MAXimum | MINimum	nicht / non SCPI	24.00000MB *)
[SOURce:]IQCoder:J83B:INPut	TSP | ASI | SPI | ASX | SPX	nicht / non SCPI	TSP
[SOURce:]IQCoder:J83B:INTerleaver:MODE	<numeric>	nicht / non SCPI	1
[SOURce:]IQCoder:J83B:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL	nicht / non SCPI	
[SOURce:]IQCoder:J83B:MODE	PRBS | DATA | NTSP | PTSP | PBET | PAFT | SYNC	nicht / non SCPI	DATA
[SOURce:]IQCoder:J83B:ROLLoff	<numeric> | MAXimum | MINimum	nicht / non SCPI	0.18
[SOURce:]IQCoder:J83B:SYMBols[:RATE]	<numeric> | MAXimum | MINimum	nicht / non SCPI	4.500MS *)
[SOURce:]IQCoder:J83B[:SPECial]: RANDomizer	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:J83B[:SPECial]: INTerleave	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]IQCoder:J83B[:SPECial]: REEDsolomon	<numeric> | OFF | ON	nicht / non SCPI	ON

*) abhängig von den Eingangsdaten / dependent on input data

Befehl / Command	**Parameter**	**SCPI-Info**	**nach / to *RST**
[SOURce]:IQCoder:ISDBt:AC	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:AC:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:ACData[1|2]	ALL1 | PRBS	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:BANDwidth	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	5.572421 MHZ
[SOURce]:IQCoder:ISDBt:CONStel:A	C_DQpsk | C_QPsk | C_16qam | C_64qam	nicht / non SCPI	C_64qam
[SOURce]:IQCoder:ISDBt:CONStel:B	C_DQpsk | C_QPsk | C_16qam | C_64qam	nicht / non SCPI	C_64qam
[SOURce]:IQCoder:ISDBt:CONStel:C	C_DQpsk | C_QPsk | C_16qam | C_64qam	nicht / non SCPI	C_64qam
[SOURce]:IQCoder:ISDBt:CP	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:CP:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:DATA	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:DATA:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:FFT:MODE	M1_2K | M2_4K | M3_8K	nicht / non SCPI	M3 8K
[SOURce]:IQCoder:ISDBt:GUARd	G1_4 | G1_8 | G1_16 | G1_32 | OFF	nicht / non SCPI	G1_8
[SOURce]:IQCoder:ISDBt:INPut	ASI | SPI | TSPaux	nicht / non SCPI	SPI
[SOURce]:IQCoder:ISDBt:LOCKed?	LOCK | UNL | NOCL | NOD | FRER | OVERFL | UNDERFL | WICL | ERROR | PIDER	nicht / non SCPI	
[SOURce]:IQCoder:ISDBt:MODE:A	DATA | NTSP | PTSP | PBEC | PAFC	nicht / non SCPI	DATA
[SOURce]:IQCoder:ISDBt:MODE:B	DATA | NTSP | PTSP | PBEC | PAFC	nicht / non SCPI	PTSP
[SOURce]:IQCoder:ISDBt:MODE:C	DATA | NTSP | PTSP | PBEC | PAFC	nicht / non SCPI	PTSP
[SOURce]:IQCoder:ISDBt:RATE:A	R1_2 | R2_3 | R3_4 | R5_6 | R7_8	nicht / non SCPI	R7_8
[SOURce]:IQCoder:ISDBt:RATE:B	R1_2 | R2_3 | R3_4 | R5_6 | R7_8	nicht / non SCPI	R7_8
[SOURce]:IQCoder:ISDBt:RATE:C	R1_2 | R2_3 | R3_4 | R5_6 | R7_8	nicht / non SCPI	R7_8
[SOURce]:IQCoder:ISDBt:SEGMents:A	<numeric>	nicht / non SCPI	13
[SOURce]:IQCoder:ISDBt:SEGMents:B	<numeric>	nicht / non SCPI	0
[SOURce]:IQCoder:ISDBt:SEGMents:C	<numeric>	nicht / non SCPI	0
[SOURce]:IQCoder:ISDBt:SEGMents[:STATe]	<numeric>, <numeric> | OFF | ON	nicht / non SCPI	<0..12> ON
[SOURce]:IQCoder:ISDBt:SP	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:SP:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:A	<numeric>	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:B	<numeric>	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:TIME[:INTerleaving]:C	<numeric>	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:TMCC	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt:TMCC:MOD	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt[:SPECial]:ALERt[:BROadcast]	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce]:IQCoder:ISDBt[:SPECial]:BIT[:INTerleaver]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt[:SPECial]:BYTE[:INTerleaver]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt[:SPECial]:FREQuency[:INTerleaver]	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt[:SPECial]:PID:A	<numeric> | OFF | ON	nicht / non SCPI	“#1FFF”
[SOURce]:IQCoder:ISDBt[:SPECial]:PID:B	<numeric> | OFF | ON	nicht / non SCPI	“#1FFF”
[SOURce]:IQCoder:ISDBt[:SPECial]:PID:C	<numeric> | OFF | ON	nicht / non SCPI	“#1FFF”
[SOURce]:IQCoder:ISDBt[:SPECial]:REEDsolomon	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce]:IQCoder:ISDBt[:SPECial]:SCRambler	<numeric> | OFF | ON	nicht / non SCPI	ON

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce:]IQCoder:PRBS[:SEQuence]	P23_1 | P15_1	nicht / non SCPI	P23_1

Befehl / Command	Parameter	SCPI-Info	Nach / to *RST
[SOURce:]MODulator[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce:]NOISe[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce:]NOISe:CN	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:DVBS:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:DVBC:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:DVBT:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:VSB:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:J83B:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:IQEXternal:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:FM:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:FMEXternal:CN:SHIFt	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	0 dB
[SOURce:]NOISe:COUPling	<numeric> | OFF | ON	nicht / non SCPI	ON
[SOURce:]NOISe:BANDwidth	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	35 MHZ

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
SOURce:FSIMulator:SELECT	1 | 2 | 3 | 4 | 5	nicht / non SCPI	
SOURce:FSIMulator:PRESET[1|2|3|4|5]	EASY3 | ECHO | FX_echo | PT_echo | SFN_echo | TU6 | RA6 | RC6_anx_b | RL6_anx_b | RED_ht100 | ET50 | VALidate100 | RC12_anx_b | RL12_anx_b | TU3_12path | TU50_12path | HT100_12path | AA_Static | AB_Static | AC_Static | AD_Static | AE_Static | AF_Static | AG_Static | B_ECho | C1_Random | C2_Random | C3_Random	nicht / non SCPI keine Abfrage / no Query	
[SOURce]:FSIMulator[:STATe]	<numeric> | OFF | ON	nicht / non SCPI	OFF
[SOURce]:FSIMulator:SPEed:UNIT	MPS | KMPH | MPH	nicht / non SCPI	MPH
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:SPEed	<numeric> [NOUNT | MPS | KMH | MPH] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:STATe	<numeric> | OFF | ON	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:PROFile	RICE | PDOPpler | RAYLeigh | CONStphase	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:STATe	<numeric> | OFF | ON	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:PRATio	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DCOMponent:FRATio	<numeric> | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:FDOPpler	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOSS	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:DELay	<numeric> [S | AS | FS | PS | NS | US | MS | KS | MAS | GS | TS | PES | EXS] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:STATe	<numeric> | OFF | ON	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:LCONstant	<numeric> [M] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:LOGNormal:CSTD	<numeric> [DB] | MAXimum | MINimum	nicht / non SCPI	
[SOURce]:FSIMulator:PATH[1|2|3|4|5|6|7|8|9|10|11|12]:PHASe	<numeric> [DEG] | MAXimum | MINimum	nicht / non SCPI	0 DEG
[SOURce]:FSIMulator:SPEed:REFerence	SPEed | FDOP	nicht / non SCPI	SPEed
[SOURce]:FSIMulator:POWer[:LEVel]:MODE	MULTipath | MAIN	nicht / non SCPI	MULTipath

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
[SOURce:]POWer:ALC:LEARn		nicht / non SCPI	
[SOURce:]POWer:ALC:MODE	OFF | ON | AUTO	nicht / non SCPI	AUTO
[SOURce:]POWer:ALC:OFFMode	TABLe | HOLD	nicht / non SCPI	HOLD
[SOURce:]POWer:ALC:SEARch		nicht / non SCPI	
[SOURce:]POWer[:LEVel]:MODE	NORMal | CONTinuous	nicht / non SCPI	NORMAL
[SOURce:]POWer[:LEVel][:IMMediate] [:AMPLitude]	<numeric> [DBM] | MAXimum | MINimum	SCPI	-99 dBm
[SOURce:]POWer[:LEVel][:IMMediate] :SHIFt	<numeric> [DBM] | MAXimum | MINimum	SCPI	0 dB
[SOURce:]SWEep:STEP	<numeric> [HZ | AHZ | FHZ | PHZ | NHZ | UHZ | KHZ | MHZ | GHZ | THZ | PEHZ | EXHZ] | MAXimum | MINimum	SCPI	1 MHZ
[SOURce:]SWEep:DWELL	<numeric> [S | AS | FS | PS | NS | US | MS | KS | MAS | GS | TS | PES | EXS] | MAXimum | MINimum	SCPI	100 MS
[SOURce:]VOLTage[:LEVel][:IMMediate] [:AMPLitude]	<numeric> [DBM | AV | FV | PV | NV | UV | MV | V | KV | MAV | GV | TV | PEV | EXV | DBAV | DBFV | DBPV | DBNV | DBUV | DBMV | DBV | DBKV | DBMAV | DBGV | DBTV | DBPEV | DBEXV] | MAXimum | MINimum	SCPI	-99 dBm

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
STATus:OPERation:CONDition?		SCPI	
STATus:OPERation:ENABle	<numeric>	SCPI	
STATus:OPERation[:EVENt]?		SCPI	
STATus:PRESet		nicht / non SCPI	
STATus:QUEStionable:CONDition?		SCPI	
STATus:QUEStionable:ENABle	<numeric>	SCPI	
STATus:QUEStionable[:EVENt]?		SCPI	
STATus:QUEue[:NEXT]?		SCPI	

Befehl / Command	Parameter	SCPI-Info	nach / to *RST
SYSTem:BASeband:ADR[1|2|3|4|5|6|7|8|9|10|11|12]:PREEet		nicht / non SCPI	
SYSTem:BASeband:ENERgy[:DISPersal]:RESet		nicht / non SCPI	
SYSTem:BASeband:FM[1|2|3|4|5|6]:PRESet		nicht / non SCPI	
SYSTem:BASeband:PRESet?		nicht / non SCPI	
SYSTem:BASeband:VIDeo:PRESet		nicht / non SCPI	
SYSTem:BEEPer:STATe	<numeric> | OFF | ON	SCPI	
SYSTem:CODer:PRESet		nicht / non SCPI	
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	<numeric> | MAXimum | MINimum	SCPI	
SYSTem:COMMunicate:REMote	OFF | GPIB | SERial | BOTH	nicht / non SCPI	
SYSTem:COMMunicate:SERial[:RECeive]:BAUD	<numeric> | MAXimum | MINimum	SCPI	
SYSTem:COMMunicate:SERial[:RECeive]:BITS	<numeric> | MAXimum | MINimum	SCPI	
SYSTem:COMMunicate:SERial[:RECeive]:PACE	NONE | XON | ACK	SCPI	
SYSTem:COMMunicate:SERial[:RECeive]:PARity[:TYPE]	ODD | EVEN | ZERO | ONE | NONE	SCPI	
SYSTem:COMMunicate:SERial[:RECeive]:SBITs	<numeric> | MAXimum | MINimum	SCPI	
SYSTem:DATE	<numeric> | MAXimum | MINimum, <numeric> | MAXimum | MINimum, <numeric> | MAXimum | MINimum	SCPI	
SYSTem:DISPlay:UPDate[:STATe]	<numeric> | OFF | ON	Nicht / non SCPI	
SYSTem:ERRor?		SCPI	
SYSTem:FREQuency:RESolution	LOW | HIGH	nicht / non SCPI	
SYSTem:INFormation?		nicht / non SCPI	
SYSTem:MODulation:PRESet		nicht / non SCPI	
SYSTem:TIME	<numeric> | MAXimum | MINimum, <numeric> | MAXimum | MINimum, <numeric> | MAXimum | MINimum	SCPI	
SYSTem:VERSion?		SCPI	
UNIT:VOLTage	AV | FV | PV | NV | UV | MV | V | KV | MAV | GV | TV | PEV | EXV | DBAV | DBFV | DBPV | DBNV | DBUV | DBMV | DBV | DBKV | DBMav | DBGV | DBTV | DBPev | DBEXv | DBM	SCPI	

Appendix 3D

3D.1 Program Examples

The examples illustrate programming of the instrument and may be used as a basis for solving complex programming examples.

The programming language is QuickBASIC but the programs may be converted to other languages if required.

3D.1.1 Integration of IEC/IEEE-Bus Library for QuickBASIC

```
REM ------ Integrating IEC/IEEE-bus library for QuickBASIC -------
'$INCLUDE: 'c:\qbasic\qbdecl4.bas'
```

3D.1.2 Initialization and Default State

Before a program is started, the IEC/IEEE bus and the device setup are reset to a defined initial state. This is done by means of subroutines `"InitController"` and `"InitDevice"`.

3D.1.3 Initialization of Controller

```
REM ------------ Initializing the controller --------
REM InitController
iecaddress% = 28                          'IEC/IEEE-bus addresse of SFQ
CALL IBFIND("DEV1", generator%)           'Opens channel to SFQ
CALL IBPAD(generator%, iecaddress%)       'Informs controller on SFQ address
CALL IBTMO(generator%, 11)                'Sets response time to 1 s
REM ************************************************************************
```

3D.1.4 Initialization of Device

The IEC/IEEE-bus status registers and SFQ settings are reset to a defined initial state.

```
REM ------------ Initializing thee instrument --------
REM InitDevice
CALL IBWRT(generator%, "*CLS")          'Resets the status register
CALL IBWRT(generator%, "*RST")          'Resets SFQ
CALL IBWRT(generator%, "OUTPUT ON")     'Switches on RF output
REM************************************************************************
```

3D.1.5 Sending Device Setting Commands

This example shows setting of output frequency, output level and AM. The settings correspond to the examples given in the section for manual operation by a first-time user. In addition to setting the step widths of the spinwheel, the step width for varying the RF frequency with UP and DOWN is set.

```
REM -------- Device setting commands -------------
CALL IBWRT(generator%, "FREQUENCY 250E6")  'RF frequency 250 MHz
CALL IBWRT(generator%, "POWER 3")          'Output power 3 dBm
CALL IBWRT(generator%, "DM:FORMAT QAM64")  'QAM modulation of the order 64
REM ***********************************************************************
```

3D.1.6 Switchover to Manual Control

```
REM -------- Switching the instrument to manual control ------
CALL IBLOC(generator%)              'Sets SFQ to local
REM ***********************************************************************
```

3D.1.7 Readout of Device Settings

The settings made in the example 3 are called up again using the short form of the commands.

```
REM --------- Readout of device settings ---------
RFfrequenz$ = SPACE$(20)            'Provides character string
                                     (20 characters)
CALL IBWRT(generator%, "FREQ?")     'Requests frequency setting
CALL IBRD(generator%, RFfrequenz$)  'Reads value

RFpegel$ = SPACE$(20)               'Provides character string
                                     (20 characters)
CALL IBWRT(generator%, "POW?")      'Requests level setting
CALL IBRD(generator%, RFpegel$)     'Reads value

DMFormat$ = SPACE$(20)              'Provides text string (20 characters)
CALL IBWRT(generator%, "DM:FORM?")  'Queries format for digital modulation
CALL IBRD(generator%, DMFormat$)    'Reads value

REM -------- Display of values -----------
PRINT "RF frequency:      "; RFfrequenz$,
PRINT "RF level:          "; RFpegel$,
PRINT "DM format:         "; DMFormat$,
REM************************************************************************
```

3D.1.8 Command Synchronization

The synchronization procedures in the example below are described in chapter 3, section 3.7.6, Command Sequence and Command Synchronization.

```
REM -------- Examples for command synchronization --------
REM Command CAL:MOD requires a relatively long time for execution.
REM It must be ensured that results are only queried
REM after calibration has been completed.

REM -------- First option: use of *WAI -------------------
CALL IBWRT(generator%, "CAL:MOD; *WAI; CAL:MOD?")

REM -------- Second option: use of *OPC? ---------------
OpcOk$ = SPACE$(2)              'Space for *OPC? - Provides response
CALL IBWRT(generator%, " CAL:MOD; *OPC?")
REM -------- Here the controller may serve other devices ---------
CALL IBRD(generator%, OpcOk$)          'Wait for "1" from *OPC?

REM -------- Third option: use of *OPC
CALL IBWRT(generator%, "*SRE 32")      'Enables service request for ESR
CALL IBWRT(generator%, "*ESE 1")       'Sets the Event Enable bit for the
                                      Operation Complete bit
ON PEN GOSUB OpcReady                         'Initializes the service
request routine.
PEN ON
CALL IBWRT(generator%, " CAL:MOD; *OPC")

OpcReady:
REM As soon as the reference oscillator has settled, the program branches to
this subroutine
REM to program an appropriate response to the OPC service request.
RETURN
REM ***********************************************************************
```

3D.1.9 Service Request

The service request routine requires a further initialization of the device, in the course of which the appropriate bits in the transition and enable registers are set.

```
REM ---- Example for initializing SRQ in the case of errors ------
CALL IBWRT(generator%,"*SRE 168")     'Enables a service request for
                                       STAT:OPER,STAT:QUES and ESR registers
CALL IBWRT(generator%,"*ESE 60")      'Sets event-enable bit for command,
                                       execution, device-specific and query
                                       errors.
CALL IBWRT(generator%,"STAT:OPER:ENAB 32767") 'Sets OPERation Enable bit for
                                               all events
CALL IBWRT(generator%,"STAT:OPER:PTR 32767")  'Sets associated OPERation
                                               Ptransition bits
CALL IBWRT(generator%,"STAT:OPER:ENAB 32767") 'Sets Questionable Enable bits
                                               for all events
CALL IBWRT(generator%,"STAT:OPER:PTR 32767")  'Sets associated Questionable
                                               Ptransition bits
ON PEN GOSUB Srq                              'Initializes the service
                                               request routine
PEN ON
```

A service request is handled in the service request routine.

```
Srq:
REM ------------ Service request routine -----------
DO
  SRQFOUND% = 0
  FOR I% = TeilnehmerN% TO TeilnehmerM%      'Sends a service request to all
                                              bus users
       ON ERROR GOTO noTeilnehmer            'No bus user found
       CALL IBRSP(I%, STB%)                  'Serial poll, read status byte
       IF (STB% AND 64) > 0 THEN             'The instrument has set bits
                                              in STB
         SRQFOUND% = 1
         IF (STB% AND 16)  > 0 THEN GOSUB Outputqueue
         IF (STB% AND 4)   > 0 THEN GOSUB Failure
         IF (STB% AND 8)   > 0 THEN GOSUB Questionablestatus
         IF (STB% AND 128) > 0 THEN GOSUB Operationstatus
         IF (STB% AND 32)  > 0 THEN GOSUB Esrread
       END IF
noTeilnehmer:
  NEXT I%
LOOP UNTIL SRQFOUND% = 0
ON ERROR GOTO Fehlerbehandlung
ON PEN GOSUB Srq: RETURN                     'Reactivates SRQ routine;
                                             'Terminates SRQ routine
PEN ON
```

Radout of event status register, output buffer and error/event queue in subroutine.

```
REM -------- Subroutine for individual STB bits ------
Outputqueue:                                  'Reads the output buffer
Nachricht$ = SPACE$(100)                      'Provides space for response
CALL IBRD(generator%, Nachricht$)
PRINT "Nachricht im Ausgabepuffer :"; Nachricht$
RETURN

Failure:                                      'Reads error queue
ERROR$ = SPACE$(100)                          'Provides space for error
                                               variable
CALL IBWRT(generator%, "SYSTEM:ERROR?")
CALL IBRD(generator%, ERROR$)
PRINT "Fehlertext :"; ERROR$
RETURN

Questionablestatus:                      'Reads questionable status register
Ques$ = SPACE$(20)                       'Defines character variable with
                                          space

CALL IBWRT(generator%, "STATus:QUEStionable:EVENt?")
CALL IBRD(generator%, Ques$)
IF (VAL(Ques$) AND 128) > 0 THEN PRINT "Calibration ?"  'Calibration
                                                         questionable
IF (VAL(Ques$) AND 1) > 0 THEN PRINT "Voltage ?"        'Output level
                                                         questionable
RETURN

Operationstatus:                    'Reads operation status register
Oper$ = SPACE$(20)                  'Defines text variable with space
CALL IBWRT(generator%, "STATus:OPERation:EVENt?")
CALL IBRD(generator%, Oper$)
IF (VAL(Oper$) AND 1) > 0 THEN PRINT "Calibration"
IF (VAL(Oper$) AND 2) > 0 THEN PRINT "Settling"
IF (VAL(Oper$) AND 4) > 0 THEN PRINT "Ranging"
IF (VAL(Oper$) AND 8) > 0 THEN PRINT "Sweeping"
IF (VAL(Oper$) AND 32) > 0 THEN PRINT "Wait for trigger"
RETURN

Esrread:                            'Reads event status register
Esr$ = SPACE$(20)                   'Defines text variable with space
CALL IBWRT(generator%, "*ESR?")     'Reads ESR
CALL IBRD(generator%, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN PRINT "Operation complete"
IF (VAL(Esr$) AND 4) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 8) > 0 THEN PRINT "Device-dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 32) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 64) > 0 THEN PRINT "User request"
IF (VAL(Esr$) AND 128) > 0 THEN PRINT "Power on"
RETURN
REM **********************************************************************

REM ------------ Error routine ---------------
Fehlerbehandlung:
PRINT "ERROR"                                 ' Displays error message
STOP                                          ' Stops software
```

4 Maintenance

4.1 General

Note:	*This chapter describes troubleshooting down to module level . For a more detailed fault finding refer to the Service Manual with the Order No.* ***2072.6489.22***

The instrument requires no regular maintenance. Generally maintenance is confined to cleaning the instrument.

4.2 Cleaning

The outside of the instrument should best be cleaned with a soft, lint-free cloth or a brush. In the case of heavier contamination use spirit or mild soap suds for cleaning. In no case use solvents like nitro thinner, acetone, etc to avoid damaging of front-panel labels or plastic parts.

Dust within the instrument should be removed regularly to ensure effective cooling (approx. every 1 to 2 years depending on operating hours per day and amount of dust in the rooms).

For cleaning the inside, remove the instrument from the cabinet or rack. Remove the dust by means of a brush or grease-free compressed air.

4.3 Storage

The storage temperature range of the instrument is:

- 40 to +70 °C.

Protect the instrument against dust when it is stored for an extended period of time.

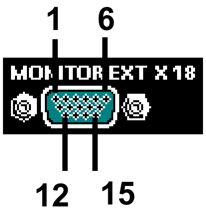
4.4 Function Check / Mechanical Check

The rated specifications should be checked from time to time. Data and tolerances are specified in the data sheet. In most cases slight deviations can be corrected by means of tuning elements.

When the instrument is open, eg for cleaning the inside, check whether the PC boards are seated properly. Also check the mechanical function of all control elements such as potentiometers and switches.

4.5 Pin assignment important Connectors

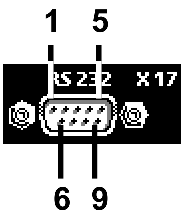
4.5.1 MONITOR Connector



Pin assignment X18:

1	red
2	green
3	blue
4	GND
5	Intens./N.C.
6...11	GND
12	N.C.
13	H SYNC
14	V SYNC
15	N.C.

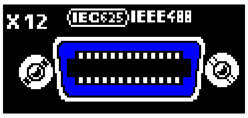
4.5.2 RS-232 Connector



Pin assignment X17:

1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

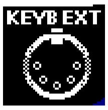
4.5.3 IEC/IEEE-Bus Connector



Pin assignment X12:

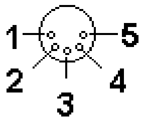
1	DIO 1
2	DIO 2
3	DIO 3
4	DIO 4
5	EOI
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	SHIELD
13	DIO 5
14	DIO 6
15	DIO 7
16	DIO 8
17	REN
18	GND (6)
19	GND (7)
20	GND (8)
21	GND (9)
22	GND (10)
23	GND (11)
24	LOGIC GND

4.5.4 KEYBOARD Connector

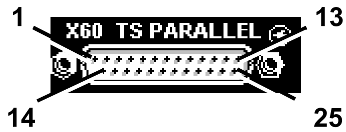


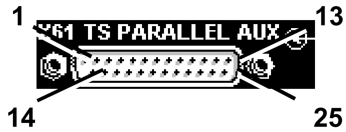
Pin assignment X15:

1	CLK
2	DATA
3	RESET
4	GND
5	+5V



4.5.5 TS-PARALLEL Connector





Pin assignment X60 / X61

Pin	Labelling	Signal
1	CLOCK A	data word clock
2	GND	ground
3	DATA BIT 7 A (MSB)	data bit 7 (most-significant bit)
4	DATA BIT 6 A	data bit 6
5	DATA BIT 5 A	data bit 5
6	DATA BIT 4 A	data bit 4
7	DATA BIT 3 A	data bit 3
8	DATA BIT 2 A	data bit 2
9	DATA BIT 1 A	data bit 1
10	DATA BIT 0 A (LSB)	data bit 0 (least-significant bit)
11	DVALID A	data word valid
12	PSYNC A	packet sync
13	GND	ground
14	CLOCK B	data word clock inverted
15	GND	ground
16	DATA BIT 7 B (MSB)	data bit 7 inverted (most-significant bit)
17	DATA BIT 6 B	data bit 6 inverted
18	DATA BIT 5 B	data bit 5 inverted
19	DATA BIT 4 B	data bit 4 inverted
20	DATA BIT 3 B	data bit 3 inverted
21	DATA BIT 2 B	data bit 2 inverted
22	DATA BIT 1 B	data bit 1 inverted
23	DATA BIT 0 B (LSB)	data bit 0 inverted (least-significant bit)
24	DVALID B	data word valid inverted
25	PSYNC B	packet sync inverted