KWS ELECTRONIC TEST EQUIPMENT GMBH

AMA 310

Antenna measuring receiver

Manual

KWS GERMAN ENGINEERING

Contents

Chapter 1 otes on Safety, Usage, Maintenance and Service

1.1 Safety notes

This instrument has been built and tested in accordance with the standard DIN 61010-1 (Safety requirements for electrical equipment for measurement). The instrument is in perfect working order upon leaving the factory. To maintain this condition and to ensure safe operation, the user must check the instrument and the power cord regularly for damage. A damaged power cord must be replaced immediately.
Please note the instructions and warnings contained in these operating instructions.

This instrument meets the requirements of protection class II (protective insulation).

The instrument complies with the IP20 protection class according to EN60529.

You may operate this instrument using mains voltage between 100 V and 240 V with 50 Hz and 60 Hz.

Discharging via connectors may damage the instrument. Protect the instrument from electrostatic discharge when handling and operating it.

Make sure that no external voltages greater than 70 V_{eff} (60 Veff = Instrument delivered before April 2010) are applied to the measuring receiver's RF input since they may destroy the input circuits.

Do not cover the ventilation slots on the instrument. Doing so can lead to reduced air circulation in the instrument, causing heat to accumulate. The electronic components can overheat as a result.

Lithium batteries must not be exposed to high temperatures or fire. If battery is replaced incorrectly, there is a risk of explosion. Replace the batteries only with the original type
(available from a salesman in your area, wholesaler, or the manufacturer of the instrument). Do not short-circuit the batteries. Lithium batteries are hazardous waste. Only dispose of them in containers provided for this purpose

Passage from the battery regulations (BattV).
This device contains a battery which incorporates hazardous substances. It must not be disposed of I domestic waste. At the end of its working life it should be disposed of only through the ESC customer service department or at a designated collection point.

1.2 Usage notes/guarantee

The guarantee for a new instrument ends 24 months after delivery.

The guarantee is invalidated if the instrument is opened (except for battery change).

Sharp tools (such as screwdrivers) can damage the plastic pane in front of the TFT display and thus ruin the TFT.

The contrast of the TFT deteriorates at ambient temperatures below 5˚C.

The TFT display does not reach maximum brightness until several seconds after the instrument is cold-started.

The instrument reaches full measurement accuracy after about 5 minutes of operation.

Wireless DECT telephones and GSM mobile phones can cause malfunctions and incorrect measurements if they are operated in the immediate vicinity of the measuring receiver.

1.3 Maintenance

The instrument is maintenance-free.

1.4 Cleaning

Clean the case and the TFT display with a soft, lint-free dust cloth. Never use solvents such as diluents for cellulose lacquers, acetone or similar, since they may damage plastic parts or the coating on the front panel.

Remove dust from the ventilation slots regularly so that the air circulation provided by the integrated ventilator is not obstructed.

1.5 Calibration

The instrument should be recalibrated at least every two years. The instrument will be calibrated at the factory if returned for service.

1.6 Service

Service address: see back cover of operating manual.

Chapter 2 Technical Data

FREQUENCY RANGES		
SAT		910 – 2,150 MHz Resolution 500 kHz IF- / Transponder frequency
TV	Devices until 08/2015	45 – 868 MHz 868 – 1050 MHz (Option)
	Devices from 08/2015	45 – 1214 MHz
	Resolution	50 kHz Frequency input- / channel input
FM (VHS)		87.4 – 108.2 MHz
	Resolution	50 kHz
RC (Return channel)		5 – 65 MHz
	Resolution	50 kHz
EMI (Option)	Resolution	same as TV Range 50 kHz
DAB (Option)	Resolution	170 – 250 MHz 50 kHz

OPERATION	
Input	Illuminated silicone keypad (numeric keypad)
Monitor	5.5" TFT, VGA resolution 640*480)
Display	Separate LCD for measured values (320*64)
User Prompting	German and English
Audio reproduction	Integrated loudspeaker, headphone jack

RF INPUT	IEC socket / 75 Ohm (DIN 45 325)
Return loss	> 12 dB (5 - 910 MHz) > 10 dB (910 - 2,150 MHz)
RF sum power	max. 500 mW (5 – 910 MHz)
External voltage	max. 70 V_{eff} (DC – 50 Hz)

INPUT ATTENUATOR	0 – 60 dB in 2 dB increments

LEVEL RANGE		
Measuring ranges	SAT	30 – 120 dBµV
	TV	20 – 120 dBµV
	FM	20 – 120 dBµV
	RC	20 – 120 dBµV
	DAB	20 – 120 dBµV
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB (at 20˚C) warm up time > 5 min. ± 2.0 dB (0˚C-40˚C) warm up time > 5 min.
	Units	dBµV, dBmV or dBm adjustable
Measuring bandwidth (RBW(-3dB))	SAT analog	8 MHz
	SAT DVB-S/S2	8 MHz, 4 MHz or 1 MHz depending on symbol rate
	TV analog	Video carrier 200 kHz Audio carrier 200 kHz
	DVB-T	4 MHz
	DVB-C	4 MHz, 1 MHz or 200 kHz depending on symbol rate
	FM	200 kHz
	DAB	1 MHz
	RC	1 MHz, 200 kHz or 90 kHz depending on bandwidth symbol rate setting
	EMI	200 kHz
Acoustic level trend indicator		can be switched on/off

ANALYZER		
Measuring bandwidth (RBW(-3dB))	SAT	8 MHz, 4 MHz, 1 MHz
	TV	4 MHz, 1 MHz, 200 kHz, 90 kHz
	FM	200 kHz, 90 kHz
	RC	200 kHz, 90 kHz
	DAB	1 MHz, 200 kHz
Span (frequency segment)	SAT	Total range, 600 MHz, 150 MHz, 75 MHz
	TV	Total range, 300 MHz, 100 MHz, 60 MHz, 30 MHz
	FM	Total range , 6 MHz, 3 MHz
	RC	Total range, 30 MHz
	DAB	Total range, 30 MHz
MAX hold function		
Direct switching between analyzer mode and receiver mode		

DVB-S

QPSK demodulator		(per ETS 300421)
Symbol rates		2 – 45 MSym/s
Frequency offset (df)	Resolution	0.1 dB
	Measuring accuracy	± 100 kHz
Measuring parameters		
	CBER (before Viterbi)	$1.00 \cdot 10^{-8}$
	VBER (after Viterbi)	$1.00 \cdot 10^{-8}$
	MER	up to 20 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PE (packet errors)	up to $4 \cdot 10^{9}$ Counts packet errors since the start of measurement
Automatic detection	DVB-S / DVB-S2	(only with DVB-S2)
Scan function		

DVB-S2

QPSK/ 8PSK demodulator		(per ETS 302307)
16APSK, 32APSK		Devices from Q3/2016
FEC 1/4, 1/3, 2/5		Devices from Q3/2016
PLS (Physical Layer Scrambling		On request
MIS (Multiple Input Stream)		On request
Symbol rates		10 – 30 MSym/s (Devices until Q2/2010) 2 – 45 MSym/s (Devices from Q2/2010)
Frequency offset (df)		
	Resolution	0.1 dB
	Measuring accuracy	± 100 kHz
Measuring parameters		(per ETR 290)
	CBER (before LDPC)	$1.00 \cdot 10^{-8}$
	LBER (after LDPC)	$1.00 \cdot 10^{-8}$
	MER	to 20 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PE (packet errors)	to $4 * 10^{9}$ Counts packet errors since the start of measurement
Automatic detection	DVB-S/DVB-S2	
Scan function		

TV ANALOG	
Television standards	B/G, D/K, L, I, M/N
Color standards	PAL, NTSC, SECAM
Sound demodulator	Soundcarrier 1 and 2 Decoding of MONO, STEREO and dual sound broadcasts
Sound carrier measurement	Soundcarrier 1 and 2 relative to the video carrier in dB
Resolution	± 1.5 dB
Measuring accuracy	± 1.5 dB
Frequency offset (df)	Video carrier
Resolution	0.01 MHz
Measuring accuracy	± (0.5 digit + 3 kHz)
Scan function	

VIDEOTEXT	
ATV	(per ETS 300706)
Sources	TV analog, SCART Zoom function VPS evaluation (per ETS 300231)
DVB	(per ETS 300472) (only with MPEG-4 decoder)
Sources	DVB-S/S2, DVB-C, DVB-T/-T2, ASI Zoom function

SUBTITLE	
DVB	(per ETS 300743) (only with MPEG-4 decoder)
Sources	DVB-S/S2, DVB-C, DVB-T/-T2, ASI

S/N MEASURING	on analog video signals Evaluated measurement according to CCIR 569
Sources	TV analog, SCART
Measuring range	40 – 55 dB (SAT, TV) 40 – 60 dB (SCART)
Resolution	0.1 dB
Measuring accuracy	± 1.5 dB

SCOPE	Oscillographic display of analog television lines in real time
Sources	SAT analog, TV analog, SCART
Line selection	1 – 625 respectively 1 – 525 (NTSC)
Zoom function	1H, 1/2H, 1/4H, 1/8H (H = 64 µs)
Pre/Posttrigger	± 1/2H
Hum measurement	Display of low-frequency AM superimposition

NICAM-DECODER	(per ETS 300163)
Sound carrier	5.85 MHz (B/G, D/K, L) respectively 6.552 MHz (I) Decoding of MONO, STEREO and dual sound broadcasts
Measuring parameters	
BER	$1.00 \cdot 10^{-5}$

DVB-C AND EURO-DOCSIS	
QAM demodulator	(per ETS 300163)
Symbol rates	0.5 – 7.2 MSym/s
Modulation scheme	16, 32, 64,128 and 256 QAM
Frequency offset (df)	
Resolution	0.001 MHz
Measuring accuracy	± 5 kHz
Measuring parameters	(per ETR 290)
BER	$1.00 \cdot 10^{-8}$ or $1.00 \cdot 10^{-9}$
MER	up to 40 dB
Resolution	0.1 dB
Measuring accuracy	± 1.5 dB
PJ (Phase Jitter)	0.40° - 5.00°
Resolution	0.01°
Measuring accuracy	± 10% (of displayed value)
HUM	0.5% - 5.00%
Resolution	0.1%
Measuring accuracy	± 10% (of displayed value)
PE (Packet Errors)	To $4 \cdot 10^9$ Counts packet errors from the beginning of the measurement
Scan function	

OFDM-DOCSIS

OFDM-Demodulator		FPGA-based
Bandwidth		24 - 192MHz
FFT		4k, 8k
Cyclic Prefix		0.9375; 1.25; 2.5; 3.75; 5.0µs
Roll-Off		0; 0.3125; 0.625; 0.9375, 1.25µs
Frequency offset (df)		
	Resolution	0.1 kHz
	Measuring accuracy	± 0.3 kHz
Measuring parameters		
	PLC-Level	20 - 120dBµV
	Channel-Level	35 - 120dBµV
	PLC_BER	$1.00 \cdot 10^{-5}$
	MER	up to 45 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	HUM	1.0% - 5.0%
	Resolution	0.1%
	Measuring accuracy	± 10% (of displayed value)
	Channel spektrum	Realtime
	Constellation	Realtime
	Frequency response	Realtime
	Impulse response	Realtime Attenuation relative to the primary impulse 0-60 dB Delay relative to the primary impulse in µs or km
	PLC-Decoding	
	MER over Frequency	
	Level/MER over 8MHz-Channel	

PRBS (AT RETURN CHANNEL)

QAM demodulator		
Dates		PRBS23
Symbol rates		0.3 – 7.2 MSym/s
Modulation scheme		QPSK, 16, 64 and 256 QAM
Frequency offset (df)		
	Resolution	0.001 MHz
	Measuring accuracy	± 5 kHz
Measuring parameters		(per ETR 290)
	BER	$1.00 \bullet 10^{-8}$
	MER	up to 40 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PJ (Phase Jitter)	0.40° - 5.00°
	Resolution	0.01°
	Measuring accuracy	± 10% (of displayed value)
	HUM	0.5% - 5.00%
	Resolution	0.1%
	Measuring accuracy	± 10% (of displayed value)

J83B (US-DOCSIS)

QAM demodulator		(per ITU-T J83B)
Symbol rates		5.057, 5.361 MSym/s
Modulation scheme		64, 256 QAM
De-Interleaver-Depths		I=8 / J=16, 16/8, 32/4, 64/2, 128/1
Frequency offset (df)		
	Resolution	0.001 MHz
	Measuring accuracy	± 5 kHz
Measuring parameters		(Per ETR 290)
	VBER (after Viterbi)	$1.00 \bullet 10^{-8}$
	MER	up to 40 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PJ (Phase Jitter)	0.40° - 5.00°
	Resolution	0.01°
	Measuring accuracy	± 10% (of displayed value)
	HUM	0.5% - 5.00%
	Resolution	0.1%
	Measuring accuracy	± 10% (of displayed value)
	PE (Packet Errors)	up to $4*10^9$ Counts packet errors from the beginning of the measurement
Scan function		

DOCSIS 3.0-ANALYZER

Downstream-demodulator

	USDOCSIS	see J83B
	EURODOCSIS	see DVB-C
	Frequency	111 MHz – 868 MHz 111 MHz – 1002 MHz

Upstream-modulator

	Modulation scheme	QPSK, 8QAM, 16QAM, 32QAM, 64QAM, 128QAM (only S-CDMA)
	Symbol rates	160, 320, 640, 1,280, 2,560, 5,120 kSym/s
	Access method	TDMA, A-TDMA, S-CDMA
	Frequency	5 MHz – 65 MHz
	Encryption	BPI/BPI+

Level	Receive level	minimum 50 dBµV
	Max. transmission	114 dBµV
	Measuring accuracy	± 1.5 dB (at 20˚C) ± 2.0 dB (0˚C - 40˚C)

Continuous ranging (synchronization with CMTS)
Continuous analysis of downstream/upstream level

Evaluation of the upstream equalizer parameters
Downstream channel utilization (DF = duty factor)
IP synchronization
Scalable PING test
Time slice analysis
Selection of the upstream frequency for ranging
Speed test (data throughput measurement) in the uplink and downlink directions
Graphical representation of channel bonding for downstream and upstream
Channel Bonding
8 x downstream (must be within 64 MHz)
4 x upstream (5 – 65 MHz)

Scan function

DOCSIS 3.1-ANALYZER

Downstream-demodulator

QAM (US-DOCSIS)	see J83B
QAM(EU-DOCSIS)	see DVB-C
OFDM	4k oder 8k FFT, bandwidth up to 192 MHz
Frequency	108 MHz/258 MHz – 1218 MHz (switchable diplexer)

Upstream-modulator

Modulation scheme	QPSK, 8QAM, 16QAM, 32QAM, 64QAM, 128QAM 256QAM (only S-CDMA), OFDM (2k and 4k, bandwidth up to 96 MHz)
Symbol rates	160, 320, 640, 1280, 2560, 5120 kSym/s
Access method	TDMA, A-TDMA, S-CDMA, OFDMA
Frequency	5 MHz – 85 MHz/ 204 MHz (switchable diplexer)
Encryption	BPI/BPI+

Pegel

Receive level	minimum 50 dBµV
Max. transmission	114 dBµV
Measuring accuracy	± 1,5 dB (at 20˚C) ± 2,0 dB (0˚C - 40˚C)

Continuous ranging (synchronization with CMTS)
Continuous analysis of downstream/upstream level

Evaluation of the upstream equalizer parameters (only ScQAM)
Downstream channel utilization (DF = duty factor) (only ScQAM)
IP synchronization
Scalable PING test
Speed-Test with FTP Server at CMTS
Time slice analysis
Graphical representation of channel bonding for downstream and upstream

Channel Bonding
32 xScQAM + 2xOFDM downstream
8 xScQAM + 2xOFDM upstream (5 – 85MHz/ 204MHz)
MER(f) (only OFDM downstream)
Pegel(f) (only OFDM downstreams)

Scan function (only ScQAM downstream)

DVB-T

COFDM demodulator		(per ETS 300744)
Bandwidth		6, 7, 8 MHz
FFT		2k, 8k
Modulation scheme		QPSK, 16QAM, 64QAM
Guard intervals		1/4, 1/8, 1/16, 1/32
Frequency offset (df)		
	Resolution	0.001 MHz
	Measuring accuracy	± 3 kHz
Measuring parameters		(per ETR 290)
	CBER (before Viterbi)	$1.00 \cdot 10^{-6}$
	VBER (after Viterbi)	$1.00 \cdot 10^{-8}$
	MER	up to 35 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PE (Packet Errors)	up to $4 \cdot 10^{9}$ counts packet errors from the beginning of the measurement
	Impulse response	Attenuation relative to the primary impulse 0-30 dB or 0-40 dB Delay relative to the primary impulse in µs or km
Scan function		

DVB-T2

COFDM demodulator		(per ETS 302755)
Bandwidth		6, 7, 8 MHz
FFT		1k, 2k, 4k, 8k, 16k, 32k
Modulation scheme		QPSK, 16QAM, 64QAM, 256QAM
Guard intervals		1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Pilot pattern		PP1…PP8
Frequency offset (df)		
	Resolution	0.001 MHz
	Measuring accuracy	± 3 kHz
Measuring parameters		(per ETR 290)
	CBER (before Viterbi)	$1.00 \cdot 10^{-6}$
	LBER (after Viterbi)	$1.00 \cdot 10^{-8}$
	MER	up to 35 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PE (Packet Errors)	up to $4 \cdot 10^{9}$ Counts packet errors from the beginning of the measurement
	Impulse response	Attenuation relative to the primary impulse 0-40 dB Delay relative to the primary impulse in µs or km
Scan function		

DTMB		
DTMB demodulator		(per GB20600-2006)
Bandwidth		8 MHz
Carrier mode		Single carrier modulation (C1) Multiple carrier modulation OFDM (C3780)
Modulation scheme		4QAM, 4QAM_NR, 16QAM, 32QAM, 64QAM
Guard intervals		PN420v, PN595c, PN945v, PN420c, PN945c
FEC		0.4, 0.6, 0.8
Time interleaver		M_240, M_720
Frequency offset (df)		
	Resolution	0.001 MHz
	Measuring accuracy	± 3 kHz
Measurement parameters		(per ETR 290)
	CBER (before Viterbi)	$1.00 \cdot 10^{-6}$
	LBER (after Viterbi)	$1.00 \cdot 10^{-8}$
	MER	up to 32 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
	PE (Packet Errors)	up to $4 \cdot 10^{9}$ Counts packet errors from the beginning of the measurement
	Impulse response	Attenuation relative to the primary impulse 0–40 dB Delay relative to the primary impulse in µs or km
Scan function		

CONSTELLATION DIAGRAM		I/Q analysis of digitally modulated signals
Sources		DVB-S/S2, DVB-C, J83B, DVB-T/T2, DTMB, PRBS
Repetition rate		Real time (not with DVB_T2 and DTMB)
3-dimensional display (Status frequency)		In color
Zoom function		In all 4 quadrants
Stop function		Freezes the diagram
Single carrier display		Only with DVB-T

RC (RETURN CHANNEL)		
Max hold function		
Receiver setting	CW (unmodulated)	DVB-C, J83B, PRBS

FM (VHF)		
MONO/STEREO indicator		
RDS (Radio Data System)		Station name PI code Dynamic radiotext
Scan function		

DAB/DAB+

COFDM demodulator		(per ETSI EN 300401)
FFT		2k
Mode		1
Modulation scheme		DQPSK
Guard intervals		¼
Measuring parameters		
	CBER (before Viterbi)	$1.00 \cdot 10^{-6}$
	VBER(after Viterbi)	$1.00 \cdot 10^{-5}$ (only on DAB+ service playing)
	MER	up to 25 dB
	Resolution	0.1 dB
	Measuring accuracy	± 1.5 dB
DAB+frame decoding		(per ETS TS 102563)
Scan function		
TII evaluation		

MPEG-2/4/H/AVS-DECODER

Video decoding	MPEG-2 MP@HL	ISO/IEC 13818-3	
	MPEG-4 AVC	ISO/IEC 14496-10	
		ITU-T H.264	
	MPEG-H L5.1	ISO/IEC 23008	**(Option)**
		ITU-T H.265	
	AVS/AVS+	AVS1-P2 (Jizhun)	**(Option)**
		AVS1-P16 (Guangbo)	
Audio decoding	MPEG-1 Layer I/II	ISO/IEC 13818-3	
	MPEG-2 AAC	ISO/IEC 13818-7	
	MPEG-4 AAC	ISO/IEC 14496-3	
	Dolby Digital AC-3		
	Dolby Digital Plus		
	DRA	DigiRise Technology (China)	
DAB Audio decoding	MPEG-1 Layer II	ISO/IEC 11172-3 und 13818-3	
DAB+ Audio decoding	HE-AACv2	ISO/IEC 14496-3	
Chinese font set		GB2312	
Cyrillic font set			

CI (COMMON INTERFACE)

2 PCMCIA slots for accepting up to 2 CA modules according to EN50221

Changing of the CA module via the hinged lid on the top panel of the instrument

ASI		
Input	Input level	500 – 880 mV_{pp}
	Incoming data rate	max. 160 MBit/s
	Connection	BNC socket
Input impedance		75 Ohm
Output	Output level	typ. 800 mV_{pp}
	Connection	BNC socket
Output impedance		75 Ohm

DVI		
		Digital video output for connection of a TV with DVI/HDMI input
Source		DVB
Output impedance		100 Ohm
Difference output level		typ. 1 V_{pp}

SCART		
	FBAS input	Input impedance 75 Ohm (typ. 1 V_{pp})
	FBAS output	1 V_{pp} at 75 Ohm
	RGB input	Input impedance 75 Ohm (typ. 700 mV_{pp})
	RGB output	700 mV_{pp} at 75 Ohm
	Audio input L/R	Input impedance 600 Ohm (typ. 1 V_{pp})
	Audio output L/R	1 V_{pp} at 600 Ohm

USB		
	USB-A	V1.1 (Full Speed)
	USB-B	V1.1 (Full Speed)

ETHERNET		
		RJ-45 10Base-T (10MBit/s)

REMOTE CONTROL (OPTION)		Through Ethernet interface SNMPv1-Protokoll

OPTICAL REVEIVER

Connector	SC/APC (with protective cap)
Wavelength (Lambda)	1,260 – 1,620 nm (no optical filter)
Max. optical input power	+8 dBm (continuous power)
Return loss	> 40 dB
Equivalent input noise (ON)	< 8 pA/√Hz
RF frequency range	5 – 2,150 MHz
Input power, nominal	-7…+3 dBm
Measuring parameters	
Optical power	-35 dBm…+9 dBm
Wavelength (calibrated)	1,310 nm, 1,490 nm, 1,550 nm
Resolution	0.1 dB
Measuring accuracy	± 0.35 dB
Optical modulation index (OMI)	Individual OMI and total OMI
Resolution	0.1%
Measuring accuracy	± 10% (of displayed value)

ELECTRO MAGNETIC INTERFERENCE MEASUREMENT (EMI)

	Evaluation of the 13-digit identifier for the KFG 242 frequency identification generator and measurement of the interference field strength in connection with the Peilset, consisting of the EMI 240/Y Yagi antenna, EMI 240/V pre-amplifier and EMI 240/K adapter cable, or with the EMI 241 antenna Other antenna sets can be user defined
Measuring range	3 – 103 dBµV/m (EMI 241) 5 – 105 dBµV/m (EMI 240)
Resolution	0.1 dB
Measuring accuracy	± 1.5 dB (at 20˚C) ± 2.0 dB (0˚C – 40˚C)

UPSTREAM MONITORING SYSTEM (UMS)

Return channel measurement system (together with appropriate handheld devices)
Measurements during active DOCSIS modem service
Up to 10 handheld devices connectable
Netto data rate of DVB transport stream for data transmission between headend devices and field device: < 700 kbit/s
ASI/IP-TS-Output
ASK modulation for signaling of the handheld device to the head end device.

UPSTREAM-MONITORING-SYSTEM (UMS)			
Measurements			
Real-time spectrum		Frequency range	4.32 – 65.76 MHz
		Measuring range	0 – 120 dBµV
		Resolution	0.1 dB
		Measuring accuracy	± 1.5 dB (at 20˚C) ± 2.0 dB (0˚C - 40˚C)
Sweep function			
TILT function			
Measuring parameters			
	MER	(with QAM-PRBS signal)	
		Measuring range	up to 40 dB
		Resolution	0.1 dB
		Measuring accuracy	± 1.5 dB
	BER	(with QAM-PRBS signal)	
		Depth of measurement	$1.00 \cdot 10^{-8}$

CPU	
	32 bit RISC architecture RTOS (Real Time Operating System) FAT32 file system 64 MByte flash disk
Software update	Via USB stick

TUNING MEMORY	
Memory locations	200
Memory preview	
Memory protection function	
Automatic saving	

PRINTER	
	Thermal printer
Horizontal resolution	384 pixel

REMOTE SUPPLY		per RF input
Voltage		5 – 20 V
Power		up to 500 mA (short circuit-proof)
22 kHz modulation	only at SAT	0,8 V_{pp}
DiSEqC	only at SAT	V1.0, V1.1, V1.2, V2.0, UNICABLE, JESS
Current measuring		
	Measuring range	0 – 500 mA
	Resolution	1 mA
	Measuring accuracy	± 2% of final value
Short circuit message		Automatic switch-off

POWER SUPPLY		
Line		Integrated power supply
Mains voltage		100-120 VAC, 200-240 VAC; 50 – 60 Hz
Power consumption		max. 45W
External 12V		Through extra-low voltage jack per DIN 45323
	Voltage	10 – 15 V DC
		Max. current 4.0 A
Battery		Lithium ion battery pack
	Capacity	14.4 V / 6.6 Ah
	Operating time	Min. 3 hours
		Automatic switch-off with undervoltage
	Battery management	Capacity display via charge status bars
	Charging	Via mains, external 12 V
	Charging time	Approx. 6 hours

ENVIRONMENTAL CONDITIONS	
Operating temperature	0˚C - +45˚C
Storage temperature	-10˚C - +55˚C
Battery charging temperature	+15˚C - +35˚C

ELECTROMAGNETIC COMPATIBILITY	Per EN 61326-1

PROTECTION	Per EN 61010-1

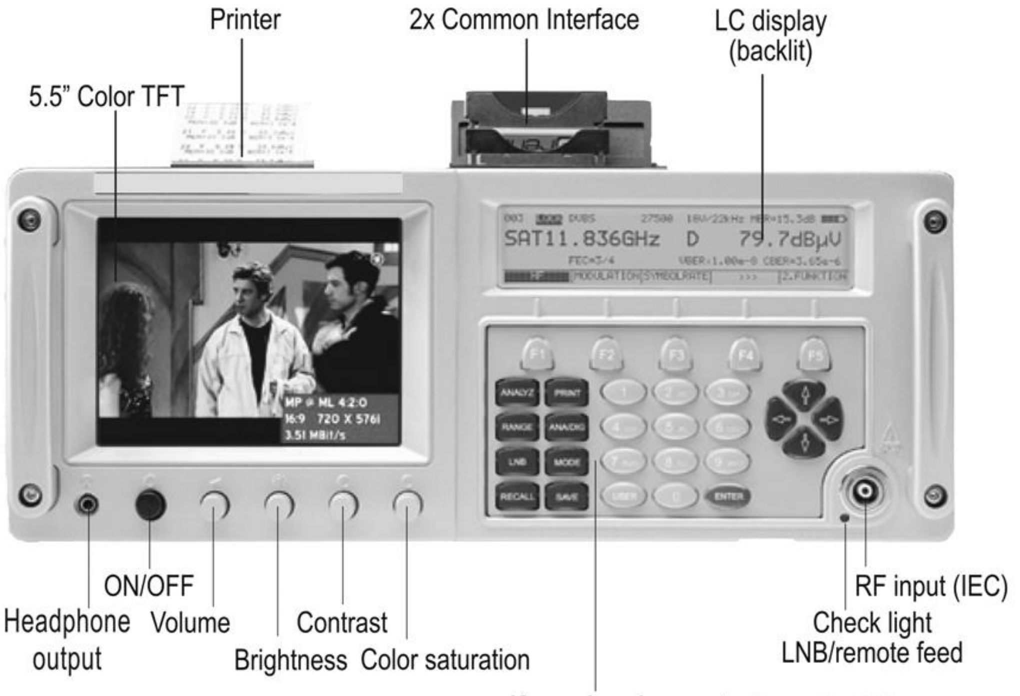
DIMENSIONS (W X H X D)	W: 360 mm, H: 160 mm, D: 300 mm

WEIGHT	Approx. 6.1 kg with installed battery pack

QUANTITY OF DELIVERY	
Included in the delivery	AMA.remote PC software (download from www.kws electronic.de „PRODUCTS“ – „AMA.remote“) Power cable IEC measuring cable 75 Ohm Fiber cable SC/APC to SC/APC Manual USB stick Leather case
Accessories	Rack mounting kit 19”, 5 RU

Chapter 3 Control and Connection Elements, Pin Configurations

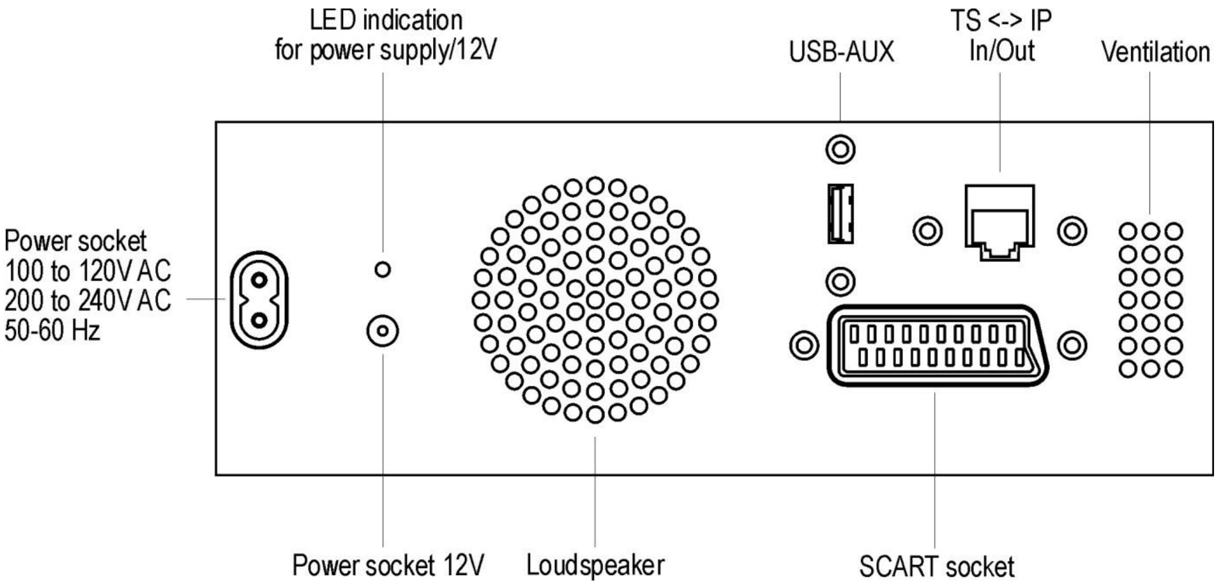
3.1 Front panel



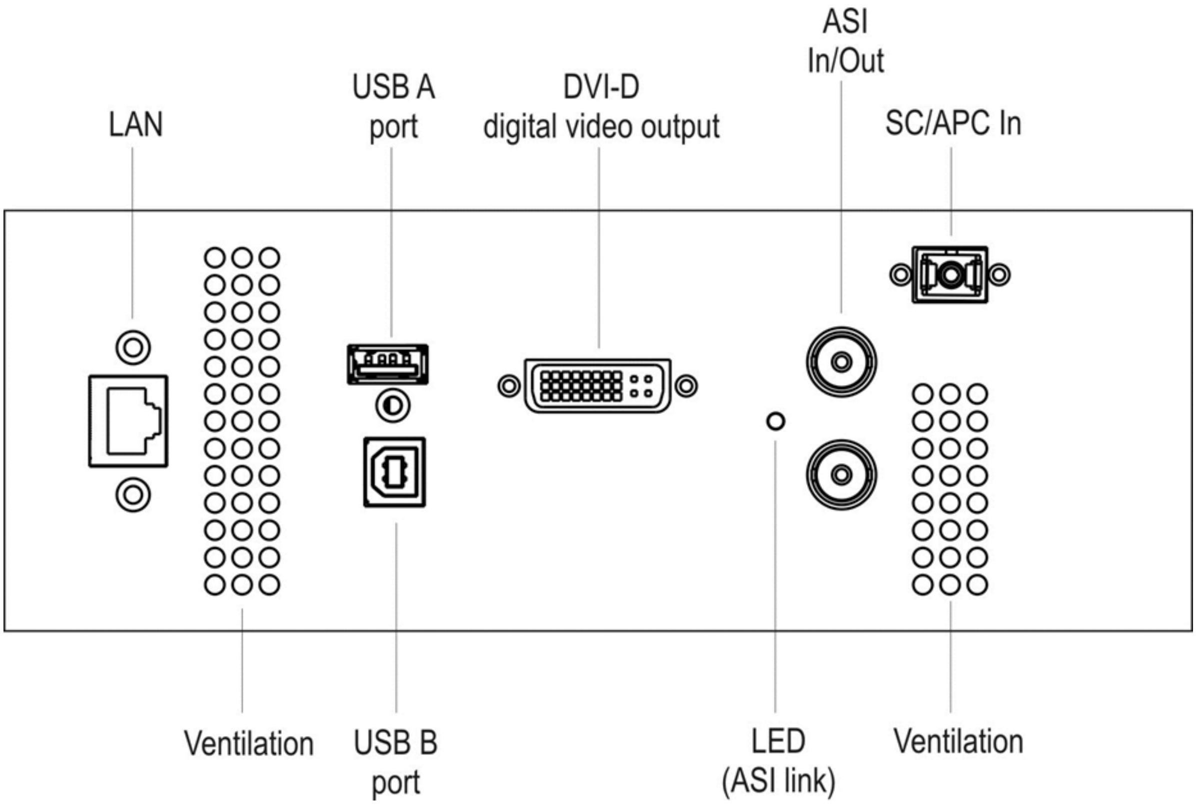
Keypad assignments (Keypad backlit)

ANALYZ	- Analyzer function	ENTER	- Confirm entry/trigger function
PRINT	- Printer function	HOME	- Start menue
RANGE	- Set range	0 - 9	- Numeric entry
ANA/DIG	- Analog/Digital	↕	- Up/down
LNB	- LNB-/remote feed	↔	- Left/right
MODE	- Special programs	F1-F5	- Function keys

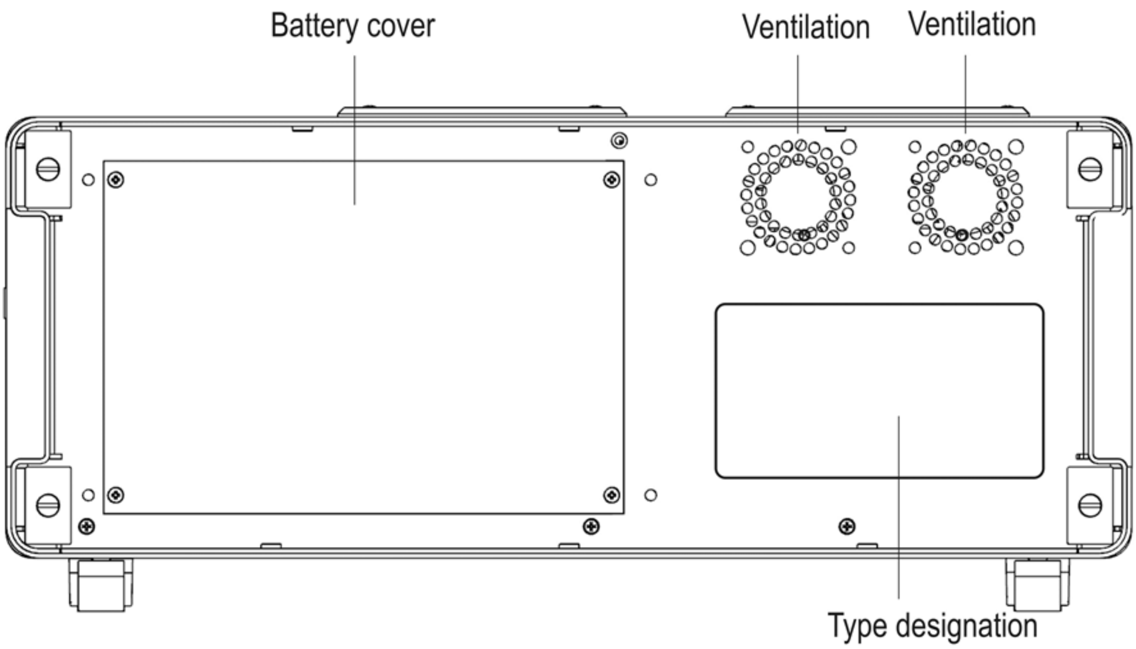
3.2 Left side view



3.3 Right side view

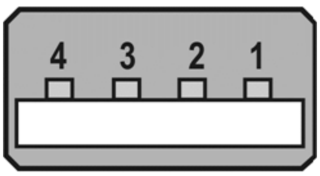


3.4 Rear panel



3.5 USB-A

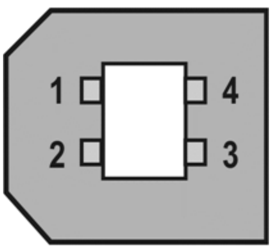
Pin 1 = V_{CC} (+5V)
Pin 2 = Data D -
Pin 3 = Data D +
Pin 4 = GND



Socket A

3.6 USB-B

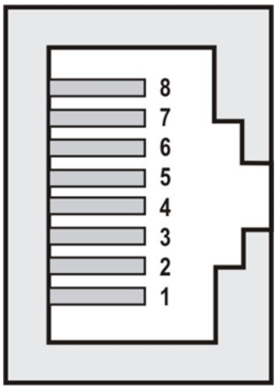
Pin 1 = V_{CC} (+5V)
Pin 2 = Data D -
Pin 3 = Data D +
Pin 4 = GND



Socket B

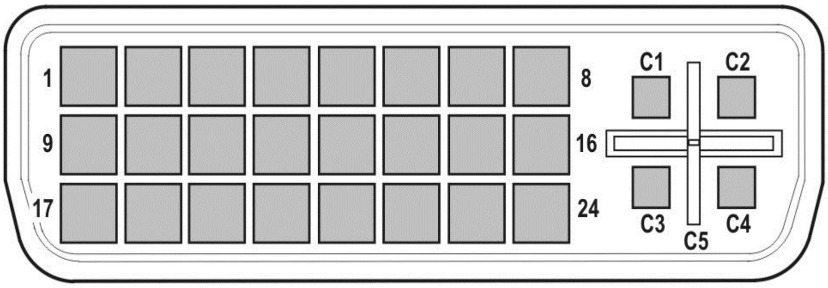
3.7 Ethernet

Pin 1 = TXD +
Pin 2 = TXD -
Pin 3 = RXD +
Pin 4 = n.c.
Pin 5 = n.c.
Pin 6 = RXD -
Pin 7 = n.c.
Pin 8 = n.c.



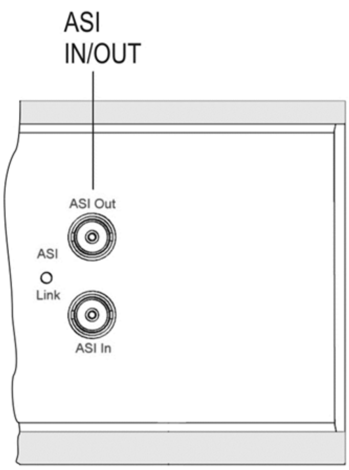
3.8 DVI output

Compliant with DDWG (Digital Display Working Group) DVI (Digital Visual Interface) Revision 1.0

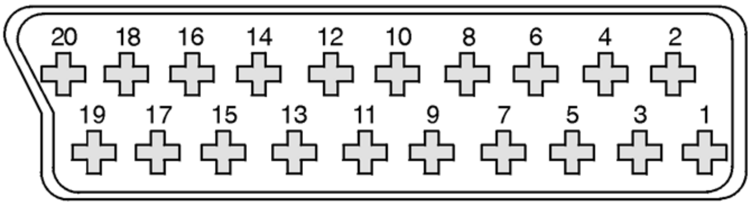


1 = T.M.D.S. Data 2-	11 = T.M.D.S. Data 1/3 Shield	21 = n.c.
2 = T.M.D.S. Data 2+	12 = n.c.	22 = T.M.D.S. Clock Shield
3 = T.M.D.S. Data 2/4 Shield	13 = n.c.	23 = T.M.D.S. Clock+
4 = n.c.	14 = +5V Power	24 = T.M.D.S. Clock-
5 = n.c.	15 = GND	
6 = DDC Clock	16 = Hot Plug Detect	C1 = n.c.
7 = DDC Data	17 = T.M.D.S. Data 0-	C2 = n.c.
8 = n.c.	18 = T.M.D.S. Data 0+	C3 = n.c.
9 = T.M.D.S. Data 1-	19 = T.M.D.S. Data 0/5 Shield	C4 = n.c.
10 = T.M.D.S. Data 1+	20 = n.c.	C5 = n.c.

3.9 ASI IN/OUT



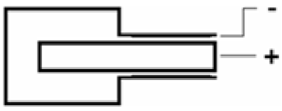
3.10 SCART socket (Euro AV)



1 = Audio output right
2 = Audio input right
3 = Audio output left
4 = Audio chassis ground
5 = RGB ground
6 = Audio input left
7 = Blue (output)
8 = Switching voltage 12V
9 = RGB ground
10 = not used
11 = Green (output)
12 = not used
13 = RGB ground
14 = RGB ground
15 = Red (output)
16 = Blanking (output)
17 = Video ground
18 = Video ground
19 = Video output
20 = Video input
Screen = Chassis ground

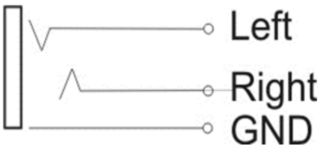
3.11 12 V power supply

Extra-low voltage jack per DIN 45 323



3.12 Headphone-jack

3.5 mm stereo jack



Chapter 4 Startup

4.1 Mains operation

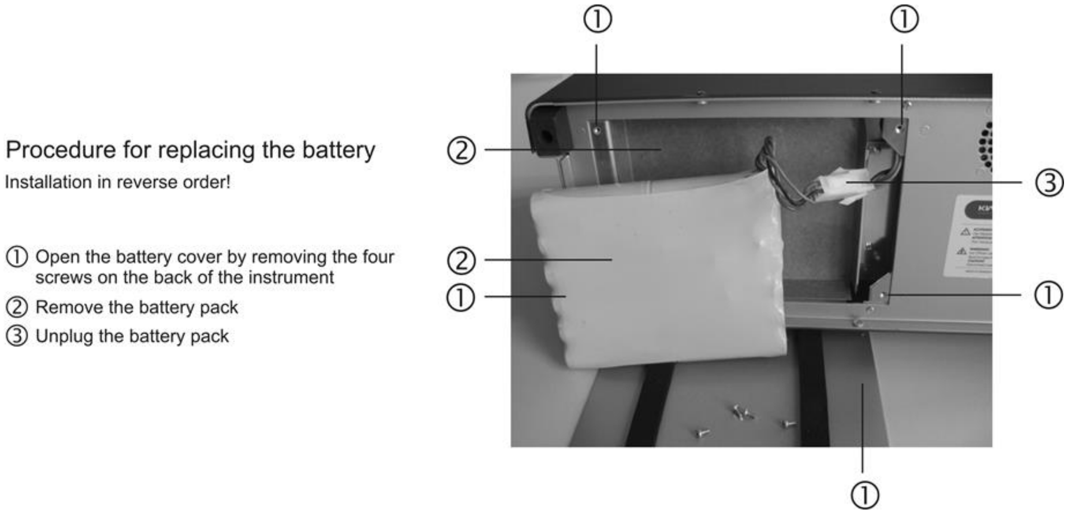
The mains connection is on the left side of the instrument. The measuring receiver is operated on the mains using the included 2-pin power cable. If the instrument is connected to the mains, the green LED lights up on the left side of the instrument next to the mains connection. This instrument meets the requirements of protection class II (protective insulation). When changing the battery, always disconnect the instrument from the mains.

4.2 Battery operation

The instrument is equipped as standard with a 14.4 V/6.6 Ah lithium ion battery. The charging time of a completely empty battery is approx. 5.5 hours with the instrument switched off. The battery life is approx. 3 hours at full power consumption of the instrument.

4.2.1 Replacing the battery

The customer can replace the installed battery.
For safety reasons, only the manufacturer's original batteries may be used when replacing the battery. These batteries are equipped with an internal protective circuit and are checked by the manufacturer.



When changing the battery, switch off the instrument and disconnect it from the mains.

Open the battery cover by removing the four screws on the back of the instrument.

Remove the battery and battery pack cable plug. After changing the battery, reattach and secure everything in the reverse order.

Important! **Perform a calibration run after every battery change (see "Chapter 4.2.3 - Battery management calibration").**

4.2.2 Battery management, charging/discharging the battery

The instrument has an internal battery management program that ensures optimal charging and discharging of the battery. As soon as the instrument is working on an external power source, the battery begins to be charged. This occurs even if the instrument is switched off. If the instrument is switched on, full charging current only flows in the default status. For other operating statuses, the charging current is reduced in accordance with the power reserves of the power supply unit. A battery symbol shows the charge status on the display.
The battery symbol is filled more or less depending on how much the battery is charged. If the battery charge reaches a critical level, the empty battery symbol flashes. You can complete the current measurement, but then the battery should be immediately recharged. To protect the battery from a deep discharge, the instrument switches off automatically.
If there is no battery build in then the battery symbol will not appear.

4.2.3 Battery management calibration

In order for the charge status indicator to show the correct value, the battery must be fully charged once and then completely discharged. If the battery symbol flashes, the battery has been discharged and the battery capacity available at the time is measured and stored. During normal operation of the instrument, the charge status indicator always recalibrates itself when the end points are reached (battery empty or full). Note also that the battery capacity depends on the discharging current.
For this reason, calibration should take place in the operating status most commonly used (e.g. DVB-C).
Do not store the instrument with an empty battery. After a long period of storage, the battery should be recharged

4.3 Operation using an external power supply

In addition to mains and battery operation, you can operate the instrument using external direct current. Direct current is fed in via the low voltage jack on the left side of instrument. Ensure that the polarity of the voltage is correct (see "Chapter 3.11 - 12 V power supply"). The external supply voltage must be in the range between 10 V and 15 V. The maximum current is 4 A. This means the measuring instrument can be supplied via a power supply unit or the cigarette lighter of a car. The advantage is that the internal battery can be charged via the external power supply. This makes it possible for the user to get the instrument ready for use again by charging it in his or her car, for example.

4.4 Control of the fans

Two integrated fans provide for sufficient ventilation of the electronic components. These are controlled by the microprocessor through measurement of the internal temperature of the instrument. In order to avoid overheating, make sure not to cover the ventilation slots on the sides of the instrument and the fan discharge openings.

Chapter 5 Menu Structure

The instrument is operated using a clear menu structure. You can select the individual menu items using soft keys (F1...F5). A menu page can contain up to 5 menu items. The menu also contains additional menu pages. You can scroll back and forth in the menu using the menu items **>>>** or **<<<**. Press **BACK** to go to the previous menu.

Every measuring range has its own menu that is adapted to the respective operating mode. To make operation easier, the configuration of the range menu adjusts to the current operating status of the measuring receiver. This means different menus appear when it is in the default status and when it is tuned.

After you press the **ANALYZER**, **PRINT**, **RANGE**, **LNB**, **MODE**, **RECALL** or **SAVE** keys, additional independent main menus also appear that break down the functional range of the instrument further. If you press the **ANALYZER**, **PRINT**, **RANGE**, **LNB** or **MODE** keys again, you return to the main menu of the respective measuring range.

Using the **HOME** key, you can put the measuring receiver back into the default status of the respective measuring range.

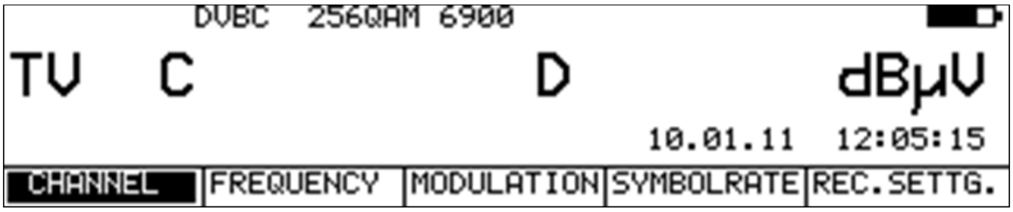
In the subsequent sections, the following notation is used to describe the menu navigation:

Key -> **Menu item in the main menu** -> **Menu item in the submenu** ….

Example: To change the user interface from English to German, you would use:

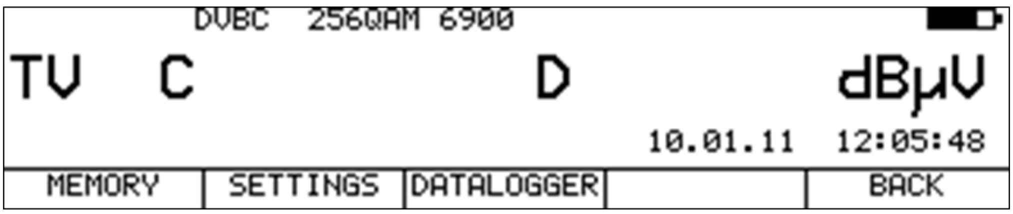
MODE -> **SETTINGS** -> **LANGUAGE** -> **ENGLISH**

The following figures clarify the process:

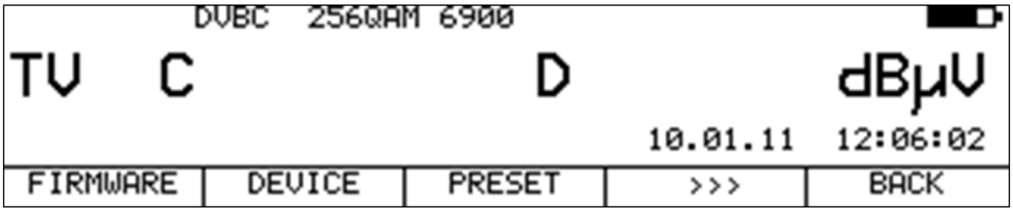


Initial state (e.g. main menu of the operating mode DVB-C).

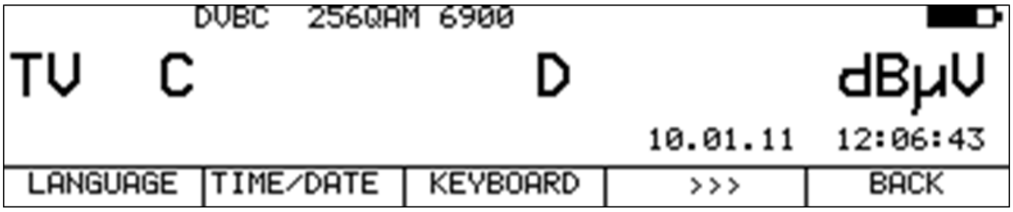
Press the **MODE** key ->



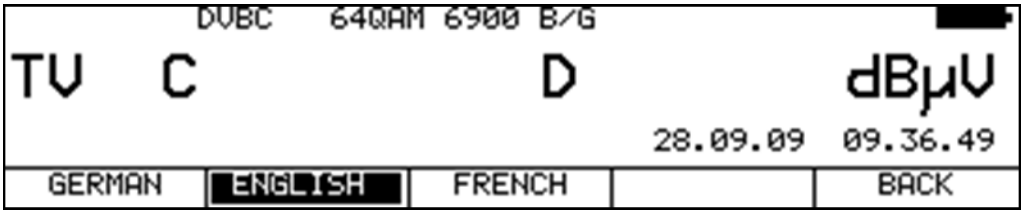
Press the **F2 (SETTINGS)** key ->



Press the **F2 (DEVICE)** key ->



Press the **F1 (LANGUAGE)** key ->

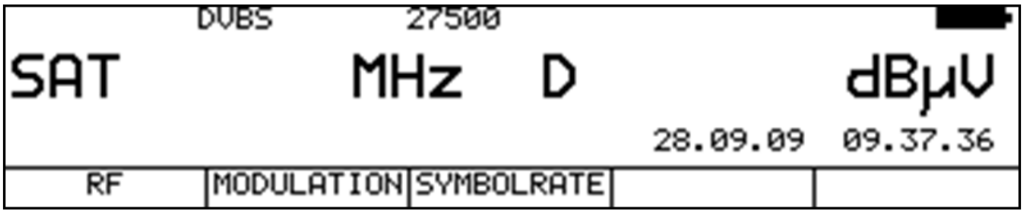


Press the **F2 (ENGLISH)** key ->

The user interface language is now set to German.

Chapter 6 SAT Measuring Range

You activate the SAT range via **RANGE** -> **SAT**.



6.1 Frequency input

You use the numeric keypad to enter the frequency. Here you can enter the SAT-IF frequency (910-2,150 MHz) or the direct transponder frequency (RF) of the satellite. When you press the **ENTER** key, the measuring receiver accepts the entry and begins the measurement procedure.

6.1.1 IF input

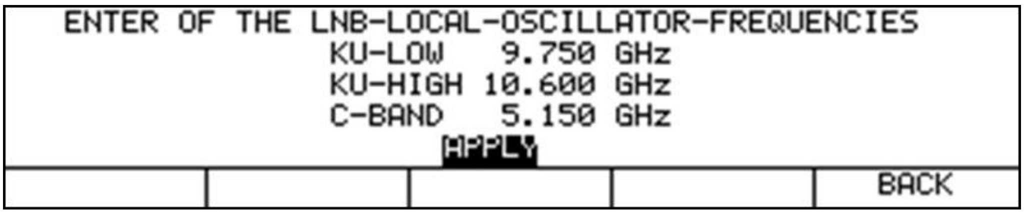
The figure above shows the default status for the entry of the SAT-IF frequency. The menu item **RF** is not activated. Here you can enter in the range 910 – 2,150 MHz.
Invalid entries are ignored.

6.1.2 RF input

The instrument offers the option of directly entering the transponder frequency in GHz.
For this, you must select the menu item **RF**, which is then displayed inverted.
The instrument calculates the SAT-IF frequency itself depending on the respective oscillator frequency in the LNB. For Ku band LNBs, oscillators usually operate under the RF frequency. The following is applicable here: IF = RF – LO. The instrument calculates its tuning frequency from this relationship. C band LNBs have oscillators that oscillate above the transponder frequency. The following is applicable here: IF = LO – RF. The measuring receiver has 3 preset oscillator frequencies available. These are for the Ku low, Ku high and C band.

6.1.2.1 Input of the oscillator frequencies

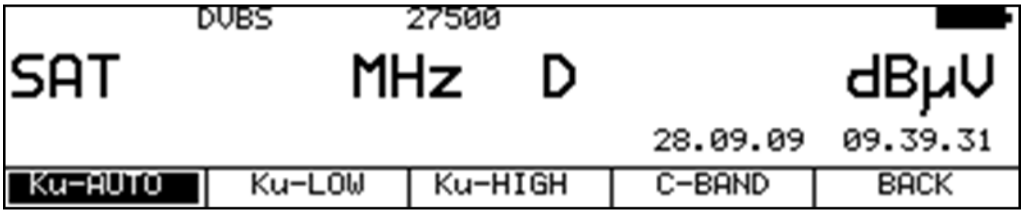
With **MODE** -> **SETTINGS** -> **LNB-LOs**, you can enter the LO frequencies.



This figure above shows the input window with the default settings. The frequencies for the Ku band can range between 9,000 und 11,000 GHz. For the C band, the range is between 4,000 and 6,000 GHz. You can confirm and store the entries in the non-volatile memory by pressing **ENTER**.

6.1.2.2 LO assignment

Here you set which oscillator frequencies are considered during RF input.
With **MODE** -> **SETTINGS** -> **LO-ALIGN**, the following selection appears.



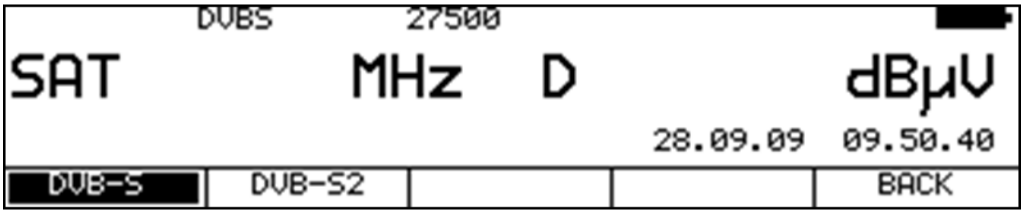
The default setting is Ku-AUTO. During RF input, the instrument switches automatically between Ku LOW and Ku-High. The threshold for switching to the high band is 11.7 GHz. After entry of the transponder frequency, the instrument then issues the corresponding DiSEqC or 22 kHz switching commands.
With the setting Ku-LOW, the Ku-LOW oscillator is taken into account independent of the SAT-IF layer that is set via the LNB supply. With Ku-HIGH, this is similarly applicable to the Ku-HIGH oscillator frequency. If you choose the menu item C-BAND, the instrument uses the frequency of the C band oscillator during RF input. After entry, the setting is stored in the non-volatile memory.

6.2 DVB-S/S2 operating mode

Here you can receive the digitally modulated QPSK/8PKS/16APSK/32APSK signals in the DVB-S/S2 standard and measure their signal quality.

6.2.1 Selection of modulation

Under **MODULATION** -> **DVB-S** or **DVB-S2**, you can select the modulation type DVB-S/S2.



Automatic standard detection:

The measuring receiver uses the set standard as the starting point for automatic standard detection. As soon as you enter a new frequency, the receiver attempts to demodulate the signal that is present. If it is not successful in the set standard, a different modulation type is automatically used. The standard of the signal received is shown on the display.

6.2.2 PLS and MIS at DVB-S2

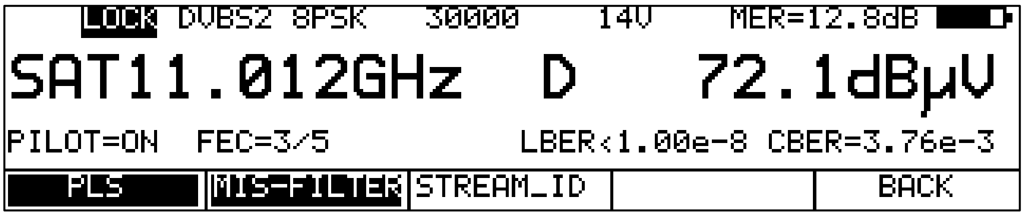
PLS (Physical Layer Scrambling)

There is the possibility to encrypt the payload with a code at DVB-S2. This is done by the DVB-S2 modulator. The receiver can demodulate the transport stream, if the hardware of the receiver supports this feature and the correspondent code is known to the demodulator. It is called PLS (Physical Layer Scrambling). The used code consists of a base code (ROOT or GOLD) plus a number. Both have to be known to the receiver.

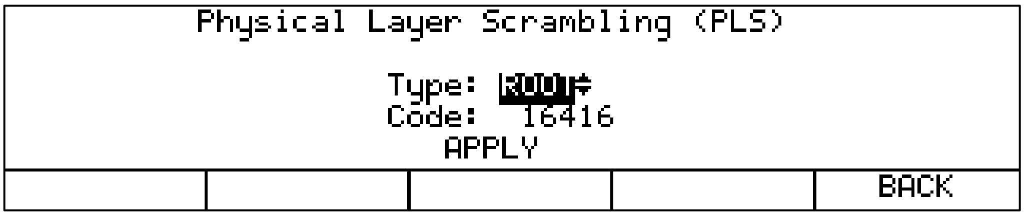
MIS (Multiple Input Stream)

Another feature of DVB-S2 includes the transmission of several independent transport streams on one satellite transponder. This is called MIS (Multiple Input Stream). With entering a stream ID the receiver is able to filter one single transport stream to be analyzed by the MPEG decoder.

If the measurement device supports this feature, it is shown under modulation at the menu item **ADAVANCED**. The necessary parameters can be entered here.



The menu item **PLS** activates the Physical Layer Scrambling of the receiver. The following input window appears.



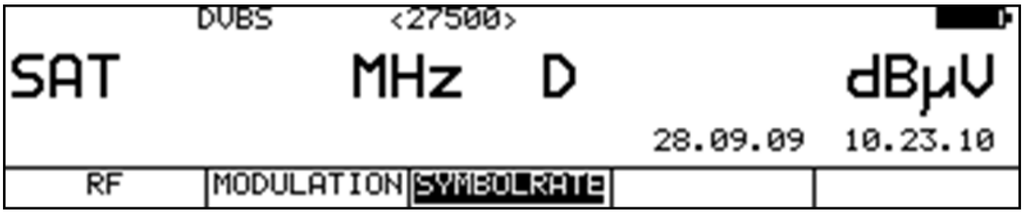
At “Type” the base code (ROOT or GOLD) can be chosen. The type is accepted with **ENTER**. Afterwards the code has to be entered. The inputs are confirmed by pressing the key **ENTER**. The settings are non-volatile and will be taken into account at the tuning memory.

With **MIS-FILTER** the transport stream filter of the receiver is started. The ID can be set at **STREAM_ID**. The following window appears and allows the settings to be entered:

You can confirm the entries by pressing **ENTER**. Also the Stream ID is stored in the non-volatile memory and will be taken into account at the tuning memory. If the receiver is tuned, the program list from the MPEG decoder will be re-established after entering a new Stream ID.

6.2.3 Symbol rate input

You must set the corresponding symbol rate before a DVB signal can be received.



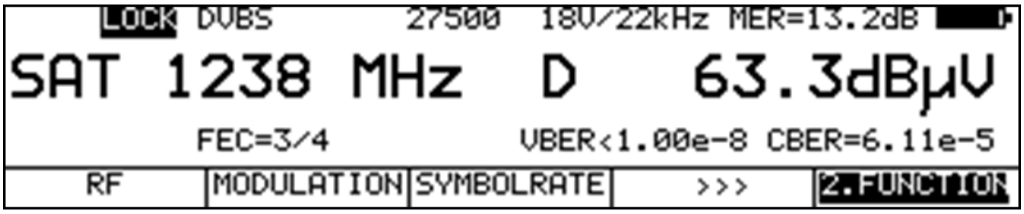
First select menu item **SYMBOLRATE**. The symbol rate indicator then appears in brackets. You can now enter the desired symbol rate in kBd using the numeric keypad. Press **ENTER** to store the setting.
For reference: 27,500 kBd = 27,500 kSym/s = 27.5 MBd = 27.5 MSym/s

Automatic symbol rate detection:

The measuring receiver uses the set symbol rate as the starting point for automatic detection. As soon as you enter a new frequency, the receiver attempts to use the set symbol rate to demodulate the signal that is present. If this is not successful, it uses the symbol rates 22,000 kBd and 27,500 kBd for additional attempts.

6.2.4 Scan

You can use this function to scan the entire SAT frequency range (910 - 2,150 MHz) for DVB-S signals. Within the scan, the DVB-S/S2 parameters or the set symbol rate plus 22,000 and 27,500 kBd are used.

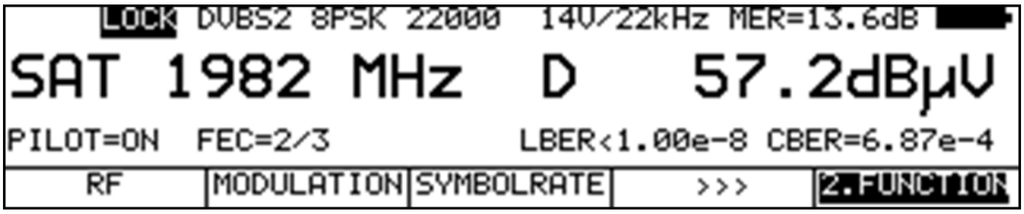


In the digital operating mode, the arrow keys have a dual function. After entry of a new frequency, the menu item **2.FUNCTION** appears in inverse. That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.
The scan is started by first tuning the measuring receiver to a frequency (see Frequency input) at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction.
When the band limit is reached, the scan continues at the other end of the range.
You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.

Note! **In the UNICABLE operating mode, the scan function is deactivated.**
If RF input mode is active and the LO assignment ist set to „Ku-AUTO“, the instrument switches automatically between the low and high bands during scanning. The switching threshold is 11.7 GHz (see "6.1.2.2 - LO assignment").

6.2.5 DVB-S/S2 parameters

As soon as the receiver has completed the synchronization process, several parameters are shown on the display. When LOCK appears, it means that the digital receiver is receiving a valid data stream. In contrast, UNLK means that either the quality of the signal that is present is insufficient, or the parameters of the receiver do not agree, or no DVB-S/S2 signal can be received at this frequency.
If the receiver has synchronized, the set standard (DVB-S/S2) and the current FEC (Forward Error Correction) are displayed.



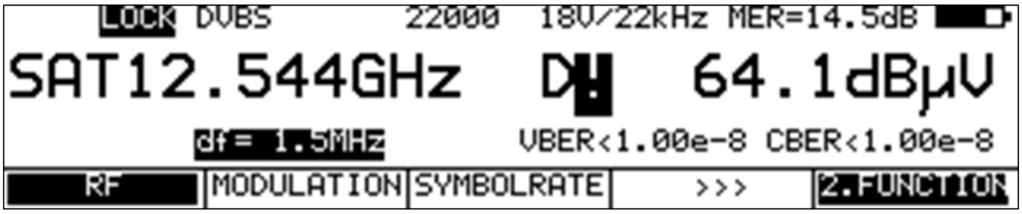
For DVB-S2, the modulation scheme (here 8PSK) and the presence of pilots are also displayed.

6.2.6 Special receiver settings

The device allows specific parameters in the DVB-S/S2 receiver to be changed.
This can be done using the **REC.SETTG.** menu item. If the measuring instrument is working with modified receiver settings, an inverted "!" symbol appears on the display.
These settings are volatile. This means that after the device has been switched off and on or the range has been changed, the measuring receiver switches back to the standard settings.

6.2.6.1 AFC (Automatic Frequency Control)

The device operates with the AFC switched on in the standard settings. This means that if the DVB-S/S2 receiver detects a frequency offset between the transmitter and the receiver, the tuner on the receiver is adjusted accordingly so that the frequency offset disappears.
However, if, for example, the frequency drift of an LNB is to be observed, it is useful to switch off the AFC. In this case, the device shows the frequency offset in the display.
The resolution is 0.1 MHz. The sign in front of the value is determined by the following relationship:
$f_{LNB} = f_{AMA} + df$.



Note! **The measured values from the measuring receiver are calibrated with AFC switched on. Therefore, the AFC should only be switched off in order to check for a frequency offset.**

The AFC of the receiver can be switched on and off using the **REC.SETTG.** -> **AFC** menu item.

6.2.7 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the qualitative assessment of a DVB signal.
To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction and the number of corrected bits is determined from that. This number is placed in a ratio to the total throughput of bits and the BER is calculated based on that. For DVB-S/S2, two independent error protection mechanisms work together. So-called internal error protection (after the demodulator) is called Viterbi with DVB-S and LDPC (Low Density Parity Check) with DVB-S2. The external error protection is carried out after that. It is called Reed-Solomon with DVB-S and BCH (Bose Chaudhuri Hocquenghem) with DVB-S2.

For DVB-S, the bit error rates are measured before Viterbi (CBER) and after Viterbi (VBER). Both values are shown on the display in exponential form. The depth of measurement is $1 \cdot 10^8$ bits for high symbol rates (>10,000 kBd) und $1 \cdot 10^7$ bits for low symbol rates.

For DVB-S2, the bit error rates are measured before LDPC (CBER) and after LDPC (LBER). Both values are displayed in exponential form. The depth of measurement is generally $1 \cdot 10^8$ bits.

6.2.8 MER measurement (Modulation Error Rate)

In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290. MER is calculated from the constellation points.
It is the counterpart to S/N measurement with analog transmission methods. The measuring range goes up to 20 dB with a resolution of 0.1 dB.

6.2.9 Constellation diagram

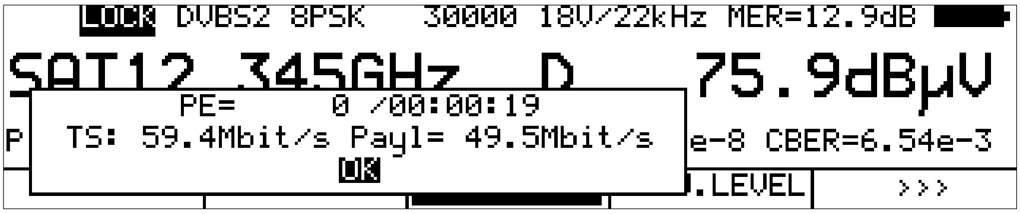
If the measuring receiver is tuned, you can access the constellation diagram via the menu item **CONST**. Additional information can be found in the "Chapter 12 - Constellation diagram".

6.2.10 PE measurement (Packet Error)

Short interruptions in the DVB-S/S2 signal usually cannot be detected using MER and BER measurement. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can lead to short picture freezes or sound that crackles.
The extent of this depends largely on the receiver hardware.
The measuring receiver has a function with which corrupt transport stream packets are summed from the point in time of entry of a new frequency.
This function runs in the background constantly. An additional window can be shown on the display using the menu item **INFO**. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed. Press **ENTER** to close the window.

6.2.11 Data rate measurement

Herein the device measures the data rate of the transport stream. On the one hand it measures the gross data rate (all transmitted packets including the null packets are measured) and on the other hand is measures the payload data rate (all transmitted packets with PID other than null PID are measured). This informations are displayed together with the packet errors in an additional window. This window can be shown using the menu item **INFO**. Press **ENTER** to close the window.



In the example above, the gross data rate of the transport stream is 59.4 Mbit/s and the payload data rate is 49.6 Mbit/s.

6.2.12 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
For more, see "Chapter 11 - MPEG Decoder".

6.3 Level measurement

As soon as the measuring receiver is tuned, the automatic attenuation control and level measurement starts.
The level measured is indicated on the right side of the LCD in dBµV with 0.1 dB resolution.
The measuring range spans from 30 to 120 dBµV. The measuring bandwidth is adjusted to the channel bandwidth of the signal measured. The measurement repetition rate is approx. 3 Hz.

6.3.1 Acoustic level trend

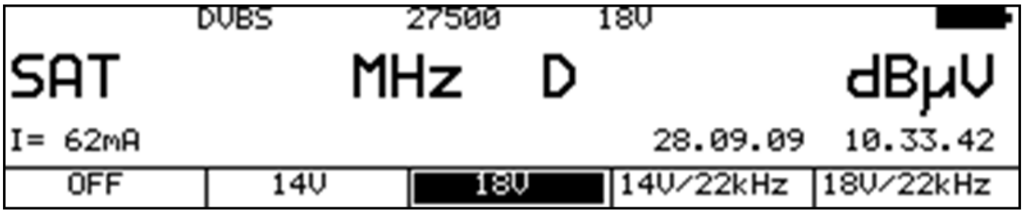
When no line of sight to the measuring instrument exists while lining up a parabolic antenna, an acoustic level trend signal can be switched on. A sound signal is emitted from the loudspeaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and vice versa.
This function can be switched on and off via the menu item **ACOU. LEVEL**. When the sound signal is switched on, the menu item is displayed inverted.

6.4 LNB supply

The measuring receiver controls a connected LNB or multi-switch with the conventional 14/18 V – 22 kHz control (max. 4 SAT-IF layers) or with DiSEqC control.
The supply is short circuit-proof and provides a maximum current of 500 mA. The instrument automatically switches off the LNB supply if there is a short circuit or if the current is too high.
The red LED on the RF input socket lights up as soon as the LNB supply is active.

6.4.1 14/18 V – 22 kHz control

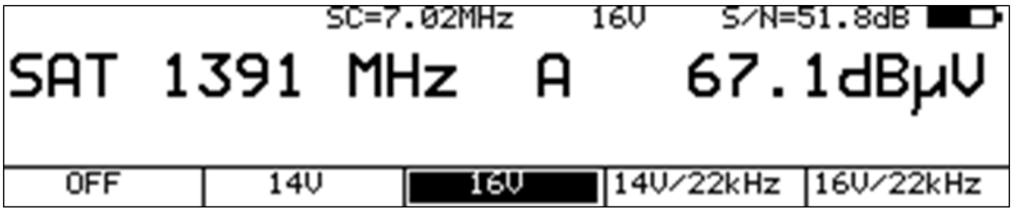
You activate the 14/18 V – 22 kHz control (and DiSEqC off) with: **LNB** > **DiSEqC** > **OFF**. Afterwards, the LNB supply is set to 0 V. With **LNB** > **Layer** > **14V**, **18V**, **14V/22kHz**, **18V/22kHz**, you can set the desired SAT-IF layer.
If you press the **LNB** key, the LNB menu is displayed. You must first switch off the DiSEqC or UNICABLE control with **DiSEqC** -> **OFF**. Then you can select one of the 4 SAT-IF layers via menu item **LAYER**.



The current selection is then shown on the top line of the display.

6.4.2 Changing the fixed voltages

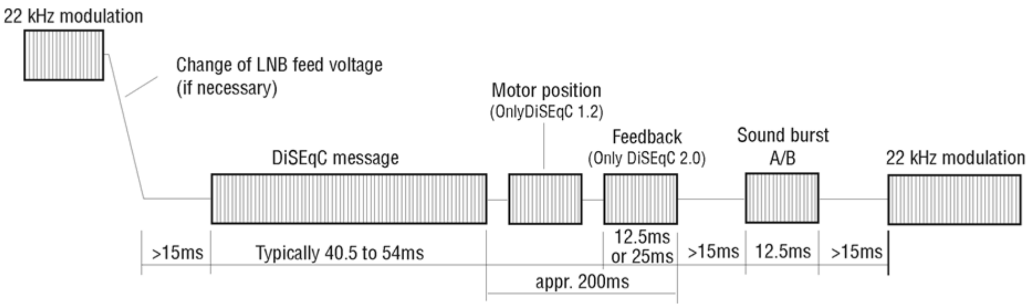
Two fixed voltages (14 V and 18 V) are set ex-works for the LNB supply.
In some cases, it can be useful to change the voltages (for example, to define the horizontal or vertical switching threshold of an LNB or multi-switch).
If the **LEYER** menu is opened as shown above, then the ↑ and ↓ keys can be used to change the LNB voltage from 5 V to 20 V in 1 V increments. The setting is non-volatile.



6.4.3 DiSEqC

DiSEqC defines a standard which transfers the control commands from the master (e.g. receiver) to the slave (e.g. multi-switch, positioner) via FSK (frequency scan for 22 kHz) on the RF cable. DiSEqC is backwards compatible to the 14V/18V/22 kHz control.

The following diagram shows the chronological sequence of a DiSEqC1.0 sequence.



The 14V/18V/22kHz control follows immediately after a DiSEqC sequence. This allows non-DiSEqC compatible components to be run when DiSEqC control is active.

6.4.3.1 DiSEqC V1.0 control

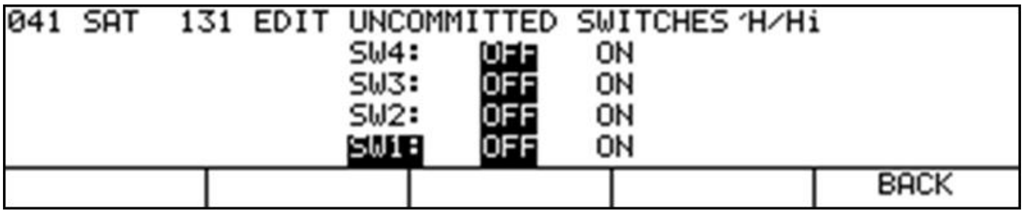
LNB -> **DiSEqC** -> **V1.0** activates DiSEqC standard V1.0.
This allows up to 5 satellite positions with up to 4 SAT-IF layers each to be controlled. You set a SAT-IF layer using LNB -> LAYER -> V/Lo, H/Lo, V/Hi or H/Hi.

You can set a satellite position using **LNB** > **POSITION** -> **P1** – **P4**. P1 can then be used for ASTRA and P2 for EUTELSAT, for example.

6.4.3.2 DiSEqC V1.1 control

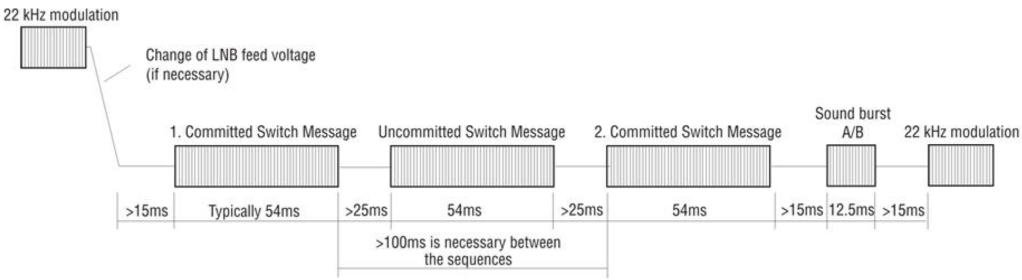
LNB -> **DiSEqC** -> **V1.1** switches the instrument to DiSEqC V1.1 control. V1.1 allows a total of up to 256 SAT-IF layers to be controlled. V1.1 also incorporates DiSEqC component cascading. That means that corresponding multi-switches or switching relays can be connected in series. This requires multiple repetitions of the DiSEqC command. See the example that follows for further information.

The settings for the SAT-IF layer and the satellite position are identical to those for V1.0. Added to this is the control of ‘Uncommitted switches’, which is operated under **LNB** -> **UNCOM.SWIT** “Uncommitted switches” allow the 16 SAT-IF layers possible with V1.0 to be split into another 16 branches using 4 additional switches (uncommitted switches), thanks to the cascading option. This allows a total of up to 256 SAT-IF layers to be controlled.



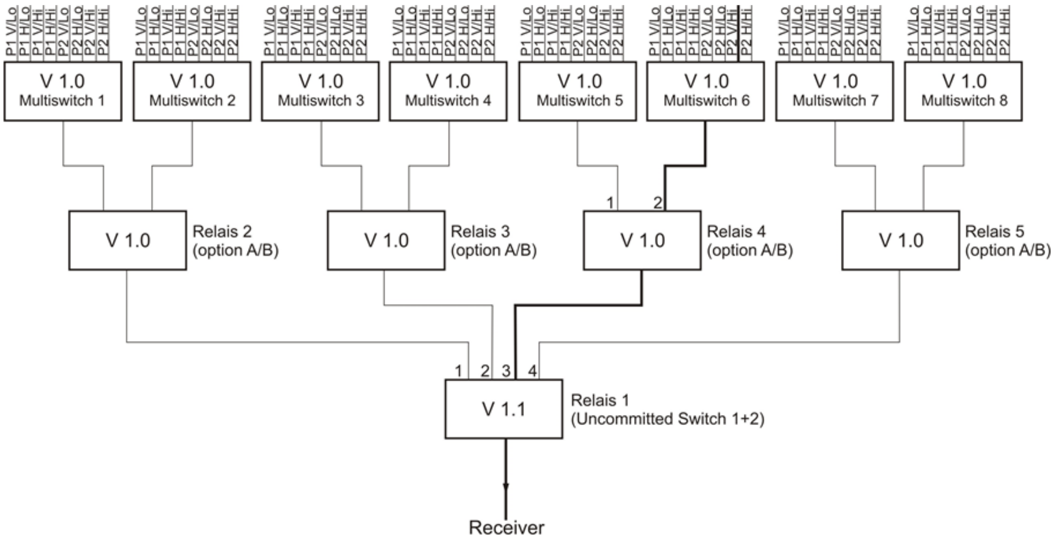
Using the arrow keys, you can change the settings of the “uncommitted switches”. Through these 4 switches, there are up to 16 additional combinations possible.
If you press **ENTER**, the settings are accepted.

V1.1 incorporates DiSEqC component cascading. Therefore, the commands must be repeated. The number of repetitions selected should be as low as possible, as otherwise unnecessary DiSEqC commands are sent, slowing the control. **LNB** -> **REPEATS** allows you to select between 0, 1 (default), 2 and 3 repetitions. If you press **ENTER** the setting is accepted.



DiSEqC1.1 control sequence with 1 repetition

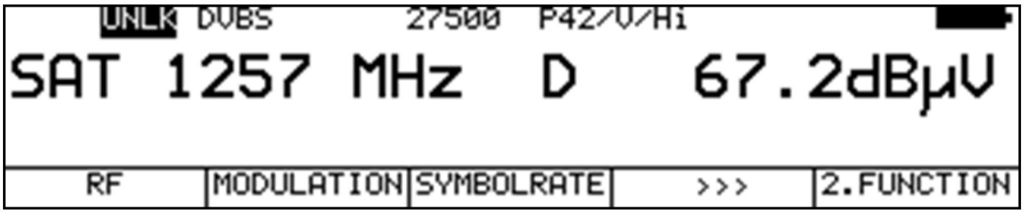
As already mentioned above, DiSEqC V1.1 is capable of cascading. For this, the control sequences must be repeated. DiSEqC components further back in the chain cannot receive the commands intended for them until the earlier components in the chain have processed their commands.
Therefore, DiSEqC1.0 (committed switches) and DiSEqC1.1 (uncommitted switches) commands are repeated. The next figure shows a possible setup in which 64 SAT-IF layers are controlled.



The structure includes 3 hierarchy levels. Consequently, 2 repetitions must be set. The following settings must be made to connect the SAT-IF route marked in bold type:
Relay 1 works with ‘uncommitted switches’ and reacts to switches 1 and 2. The binary combination “10” is required to connect the route to output 3. That means that SW1 must be set to OUT and SW2 must be set to ON. SW3 and SW4 are not relevant here and can be left on OFF.
Relay 4 works with ‘committed switches’ and reacts to the option bit. The option bit must be set to connect the route to output 2. This corresponds to DiSEqC1.0 positions P3 or P4.
Multi-switch 6 switches 8 SAT-IF layers. The selected path can be reached with P2 V/Hi. However, as relay 4 requires the option bit to be set, the “committed switches” setting must be P4 V/Hi.

Therefore, you must make settings in all 4 DiSEqC1.1 submenus for the marked SAT-IF route:

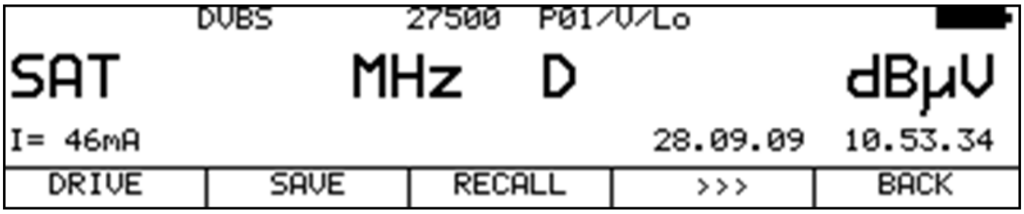
- Set SAT-IF layer to V/Hi
- Set satellite position to P4
- Set 'uncommitted switches’ to SW1:=OFF und SW2:=ON
- Set repetitions to 2



Afterwards, the display should show “P42/V/Hi”. This setting connects the SAT-IF route marked in bold type in the example. All settings are incorporated in the tuning memory and can easily be recalled later.

6.4.3.3 DiSEqC V1.2 control

LNB -> **DiSEqC** -> **V1.2** activates the DiSEqC V1.2 control. V1.2 can be used to control positioners with DiSEqC rotors. As with DiSEqC1.0, up to 4 SAT-IF layers can be operated.

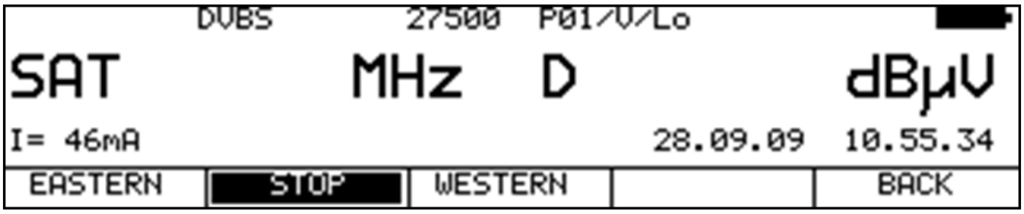


The display of the position after ‘P’ in the top line of the display refers to the most recent position number called from the position memory of the DiSEqC rotor. If you switch to DiSEqC1.2, position number 1 of the DiSEqC rotor is moved to first.

You can open the menu for rotor control via **LNB** -> **POSITIONER**. Here you can carry out the following functions:

Drive:

This allows the positioner to be turned to the east and west.



After the menu is opened, the menu item **STOP** (motor is stopped) is activated. If you press the F1 key, the rotor moves in the easterly direction. If you press **F3**, it moves in the westerly direction. If you press the **F2** key, it stops again.

East limit:

This enables an eastern limit to be set for the positioner that it cannot pass. To do so, proceed as follows: First use the **DRIVE** function to move the positioner to the position to be set as the eastern limit. If you select the menu item **LIMIT EAST**, the eastern limit of the positioner is stored.

West limit:

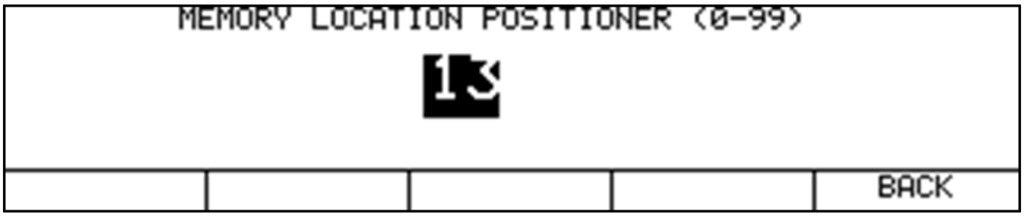
This enables a western limit to be set for the positioner that it cannot pass. To do so, proceed as follows: First use the **DRIVE** function to move the positioner to the position to be set as the western limit. If you select the menu item **LIMIT WEST**, the western limit of the positioner is stored.

Limits off:

This function allows you to override the eastern and western limits of the positioner. The motor can then travel to its mechanical limits again. If you select the menu item **LIM. ERASE**, the limits are deleted.

Save:

This function allows you to save in one of the 100 position memory locations a position to which you have previously moved. The numbering of the memory locations goes from 0-99.
Position 0 is reserved for reference position 0 degrees. If you select the menu item **SAVE**, the following entry field is displayed:



You can use the numeric keypad to enter a memory location between 0 and 99. If you press the **ENTER** key, the current rotor position is stored in the pertinent memory location of the rotor electronics.

Recall:

Under the menu item **RECALL**, you can recall a previously stored rotor position. The motor then turns to the saved position. Position 0 corresponds to the reference position 0 degrees. The most recently recalled rotor position is shown on the display.
This position is incorporated in the tuning memory of the measuring instrument. It allows various orbital positions to be recalled from the tuning memory. There is then no need to open this indirectly via the **LNB** -> **POSITIONER** -> **RECALL** menu.

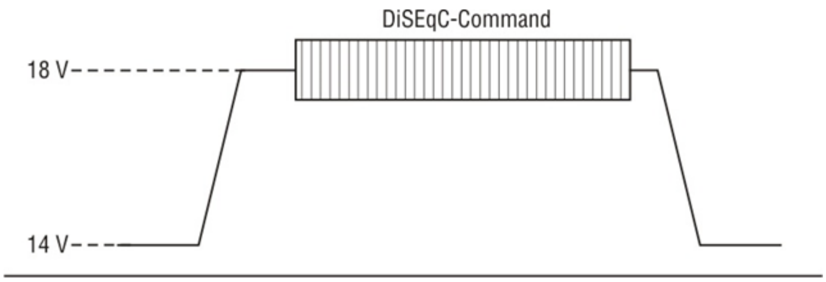
6.4.3.4 DiSEqC V2.0 control

LNB -> **DiSEqC** -> **V2.0** activates the DiSEqC V2.0 control. The difference from V1.0 is the additional feedback query of a controlled DiSEqC component.
When the instrument controls a multi-switch with DiSEqC V2.0, it sends an answer back to the instrument. The instrument evaluates this feedback and reports “Reply OK” if successful.

6.4.4 UNICABLE

UNICABLE (satellite signal distribution over a single coaxial cable distribution network) is a variant of the DiSEqC control and corresponds to the DIN EN 50494 standard. With this system, the desired transponder is converted to a fixed frequency (center frequency of the UB slot or band pass) in the UNICABLE unit (LNB or multi-switch). The information, regarding which transponders should be converted on which UB slot, is transmitted to the UNICABLE unit via a special DiSEqC command. The standard supports up to 8 UB slots. This allows up to 8 receivers to be operated on 1 cable.

The UNICABLE message contains the following information:
The SCR address, polarization (horizontal and vertical), low or high band and the tuning transponder frequency.
The following control routine is used in this instrument:

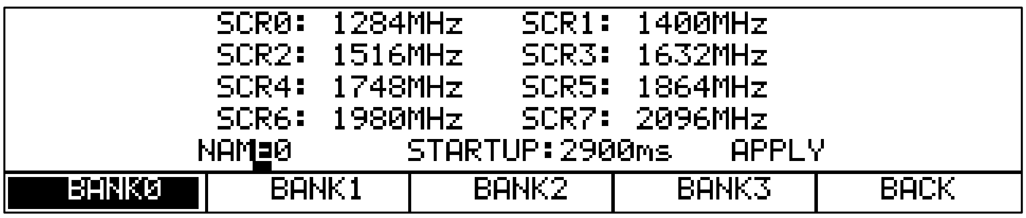


With UNICABLE systems, the signal-generating receiver generates a high DC level as it transmits, which is added to the UNICABLE message (special DiSEqC command). After transmitting the UNICABLE message, the receiver returns to an idle state in which a low DC level is generated. The receiver must return to a low DC level so that the system is available for other receivers.

The measuring receiver uses 14 V for the low DC level and 18 V for the high DC level.

6.4.4.1 Activation and configuration

LNB -> **DiSEqC** -> **UNICABLE** activates the UNICABLE control.
A menu is then displayed which can be used to edit the relationship between the satellite channel router (SCR) address and the center frequency of the user band (UB) band pass slot that the measuring receiver is to use. These parameters can be obtained from the data sheet of the UNICABLE unit being used. The name of the bank can also be edited. The user-defined name for the bank appears in the menu for selecting the bank.



Entering the center frequency of the UB slot

Using the ← or → arrow keys, you can move the cursor onto the desired SCR address. With the numeric keypad, you can enter the corresponding center frequency of the UB slot in the range of

950 to 2,150 MHz. You confirm the entry by pressing **ENTER**. The cursor then jumps to the next SCR address.
Alternatively, the slot frequencies can be read automatically from a connected CSS (Channel Stacking Switch), which is a multi-switch with a UNICABLE output (see "Chapter 6.4.4.3 - Reading UB slot frequencies from CSS").

Entering a name for the bank

Here you can assign a specific name to the bank. For example, you could enter the name of the manufacturer of the UNICABLE components. Using the ← or → arrow keys, you can move the cursor to the desired position in the label. With the numeric keypad, you can enter or edit a name up to 10 digits in length.

Entering a startup time for the bank

Here you can assign a specific startup time of the multi-switch until it can process DiseqC-commands after applying the LNB supply voltage. The default time is 700ms. It must be increased, if the mulit-switch does not operate correctly after switching on the remote supply, e.g. after recalling from station mem.

Confirming and saving the entry

If the cursor is on ACCEPT, pressing the **ENTER** key closes the input menu is and stores the values in non-volatile memory. The measuring receiver now operates with UNICABLE control.

SCR-ADR bank:

There are UNICABLE units for 4 and 8 receivers per cable. These units generally operate with differing UB center frequencies. To simplify the procedure for the user, the instrument offers a feature that enables switching between 4 SCR address banks. That means that the instrument has three banks of SCR addresses for UNICABLE units that operate with 8 receivers and a different bank of SCR addresses for UNICABLE units that operate with 4 receivers. The UB center frequencies can be changed within the 4 banks as described above. The set bank is non-volatile. That means that the next time the device is switched on, it will operate again with these SCR-ADR <-> UB center frequency relationships. In addition, the bank setting is stored in the tuning memory. This makes it possible for you to combine memory locations with Bank0 to Bank3 as desired. You can switch between the banks using **LNB** -> **SCR-ADR-Bk** -> **BANK0 up to BANK3**. The menu item names “BANK0” to “BANK3” are used in place of the user-defined bank designations.

Broadband RF mode:

Some UNICABLE units (LNB) operate only on a single oscillator frequency. This means that the low band and the high band are combined into a one band. This special mode can be set in the measuring instrument via **LNB** -> **MODE** -> **WIDEBD.RF**. The UNICABLE control is switched back into standard mode with 2 oscillator frequencies via **LNB** -> **MODE** -> **STAND.RF**. This is also the instrument’s default setting. This setting is non-volatile; the measuring receiver will work in this mode when UNICABLE control is next accessed. This setting is also stored in the tuning memory.

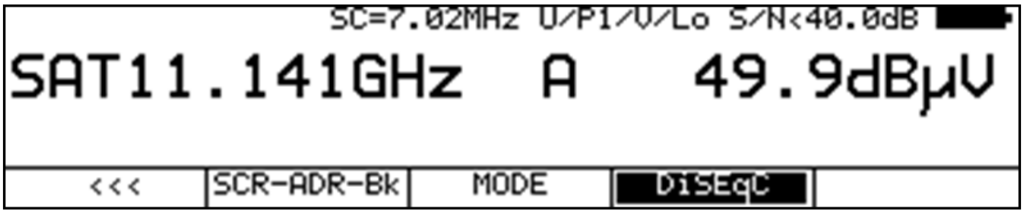
LO-Frequency (applies to broadband RF mode only):

As already mentioned, some UNICABLE units (LNB) operate only on a single oscillator frequency. This frequency must be set in the instrument before it can be used to control these units. You can choose between oscillator frequencies **10.000 GHz**, **10.200 GHz**, **13.250 GHz** and **13.450 GHz** via **LNB** -> **LO-FREQ**. The setting is also non-volatile. This setting is also additionally stored in the tuning memory. The default setting is 10.200 GHz.

6.4.4.2 Operation

The UNICABLE control can be used to convert a max. of 8 SAT-IF layers in a max. of 8 UB slots. These are further divided into 2 satellite positions with 4 SAT-IF layers each. Each connected receiver (max. 8) operates using a dedicated UB slot. This is defined by the SCR address.

These UNICABLE control parameters are set via **LNB** -> **LAYER**, -> **POSITION** and -> **SCR-ADR**. The measuring receiver is tuned as described in the "Chapter 6.1 - Frequency input". The difference when using the UNICABLE control is that the desired transponder frequency is converted to the center frequency of a UB slot in the UNICABLE unit. That means that the measuring receiver must send the transponder frequency to the UNICABLE unit using a UNICABLE command and then tune itself to the corresponding UB slot center frequency.
Whenever there is a new tuning process, the entire UNICABLE control command is sent to the UNICABLE unit again. Because UNICABLE enables the use of up to 8 receivers connected to one cable, collisions may occur between the connected receivers during control. Should this happen with the measuring receiver, the UNICABLE command can be repeated by entering a new frequency.
The following figure shows the LCD of the instrument in UNICABLE mode with the LNB menu open.



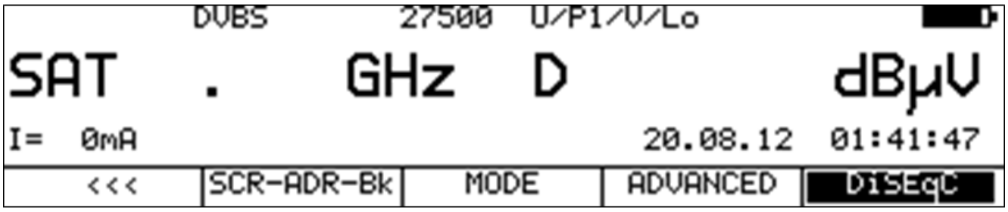
Broadband RF mode:

As described above, these UNICABLE units operate only on a single oscillator frequency, causing the low and high band to be combined in one band. This reduces the number of SAT-IF layers to 2 (vertical and horizontal).
If the instrument is in this mode, you can set the vertical (-> **V**) or horizontal (-> **H**) polarization via **LNB** -> **LAYER**. This also switches the measuring receiver to RF frequency input mode. You can enter a transponder frequency between 10.700 GHz and 12.750 GHz.

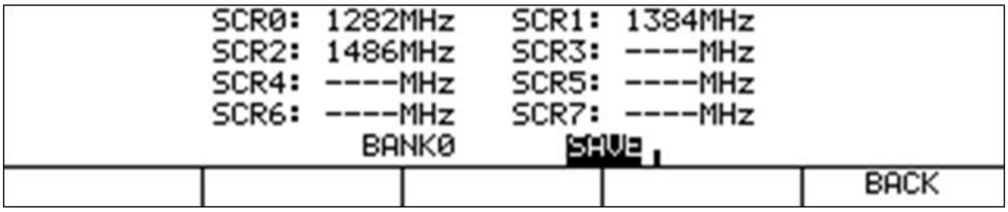
Note! **In the UNICABLE operating mode, the scan function is deactivated.**

6.4.4.3 Reading UB slot frequencies from CSS

As an alternative to manually entering the UB slot frequencies, the instrument can automatically read the parameters of a connected UNICABLE multi-switch (CSS: Channel Stacking Switch) from a connected multi-switch. The instrument uses the procedure described in EN 50494. While UNICABLE control is active, open the LNB menu using the **LNB** key.



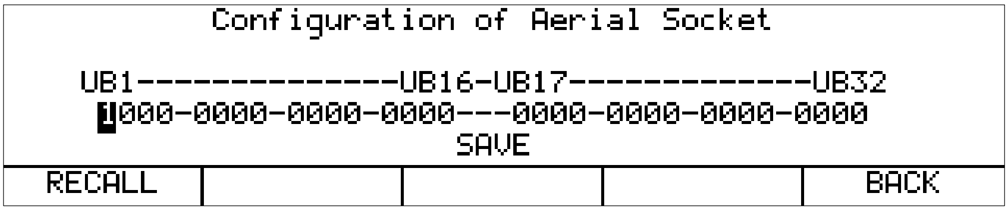
The UB slots are determined using the menu items **ADVANCED** -> **READ CSS**. This may take approximately 10 s. All the UB slots found then appear on the display along with their center frequencies.



A new name (e.g. the name of the multi-switch) can also be assigned for the set SCR-ADR bank. Select the **SAVE** option and confirm using the **ENTER** key to save this UB setting in the current bank.

6.4.4.4 Programming aerial sockets

A disadvantage of UNICABLE is that subscribers can cause each other interference when they are set to the same UB slot. This can occur in housing blocks with high tenant turnover, for example. To prevent this, aerial sockets are available which are only "permeable" for a certain UB slot. In other words, they can be programmed so that only UNICABLE commands that correspond to the assigned UB address are forwarded to the multi-switch. The measuring receiver allows such sockets to be programmed. First the instrument must be connected to the subscriber terminal of the socket. The LNB menu must be opened to begin programming. Selecting the menu items **ADVANCED** -> **PROG.ASOC.** reads the current configuration of the connected socket.



Selecting the **RECALL** menu item reads the configuration again. As shown in the figure, up to 32 UB slots can be programmed.

Note! **Under the UNICABLE EN 50494 standard, only the first 8 UB slots can be controlled. Also see "Chapter 6.4.5 - JESS".**

The UB mask is seen here in binary form. A "1" means that the UB slot is enabled, while a "0" means that the UB slot is locked. Using the ← or → arrow keys, you can move the cursor to the desired UB slot. You can enter "0" or "1" using the corresponding keys to change a particular bit position. Press the **ENTER** key to apply the entry. Move the cursor to SAVE and press the **ENTER** key to complete the programming of the socket. A message appears if the action was successful.

6.4.5 JESS (EN 50607)

JESS (Jultec Enhanced Stacking System) is an expansion on the EN 50494 standard (UNICABLE). The following additions to UNICABLE have been incorporated:

- Up to 32 UB slots are supported (8 with UNICABLE).
- Up to 8 satellite positions can be controlled (2 with UNICABLE).
- The frequency of the JESS converter can be set in 1 MHz increments (in 4 MHz increments with UNICABLE).

6.4.5.1 Activation and configuration

JESS control is activated by selecting **LNB** -> **DiSEqC** -> **JESS**.

A menu is then displayed which can be used to edit the relationship between the satellite channel router (SCR) address and the center frequency of the user band (UB) bandpass slot that the measuring receiver is to use.

These parameters can be obtained from the data sheet of the JESS unit being used or, more simply, read directly from the JESS unit using a DiSEqC command. The name of the bank can also be edited. The user-defined name for the bank then appears in the menu for selecting the bank. The bank labels are independent of the UNICABLE settings. As shown in the figure below, JESS supports up to 32 UB slots. The further UB slots are on an additional page, which can be called by **>>>** .However, most JESS components do not use all possible slots. The UB slots marked with "**----**" have no function.

```
UB01: 974MHz UB02:1076MHz UB03:1178MHz UB04:1280MHz
UB05:1382MHz UB06:1484MHz UB07:1586MHz UB08:1688MHz
UB09:1790MHz UB10:1892MHz UB11:1994MHz UB12:2096MHz
UB13:----MHz UB14:----MHz UB15:----MHz UB16:----MHz
         BANK0      STARTUP: 500ms   APPLY
```

BANK0	BANK1	<<<	>>>	BACK

Entering the center frequency of the UB slot:

The slot frequency is entered in the same way as for UNICABLE. Entering a frequency of “0” deletes the selected UB slot.

Entering a name for the bank:

Here you can assign a specific name to the bank. For example, you could enter the name of the manufacturer of the JESS component. Using the ← or → arrow keys, you can move the cursor to the desired position in the label. With the numeric keypad, you can enter or edit a name up to 10 digits in length.
Confirming and saving the entry:
If the cursor is on ACCEPT, pressing the **ENTER** key closes the input menu and stores the values in non-volatile memory. From here on, the measuring receiver operates with JESS control.

Entering a startup time for the bank

Here you can assign a specific startup time to the bank. The starup time is the time, needed by the multi-switch to come up after a power on. The default time is 700ms. It must be increased, if the mulit-switch does not operate correctly after switching on the remote supply, e.g. after recalling from station mem.

Confirming and saving the entry

If the cursor is on ACCEPT, pressing the **ENTER** key closes the input menu is and stores the values in non-volatile memory. The measuring receiver now operates with JESS control.

SCR-ADR bank:

Not all JESS components use the same UB configuration. To simplify the procedure for the user, the instrument offers a feature that enables switching between 2 SCR address banks. The UB center frequencies can be changed within the 2 banks as described above. The set bank is non-volatile. That means that the next time the device is switched on, it will operate again with these SCR-ADR ↔ UB center frequency relationships. In addition, the bank setting is stored in the tuning memory. This makes it possible for you to combine memory locations with Bank0 and Bank1 as desired. You can switch between the banks using **LNB** -> **SCR-ADR-Bk** -> **BANK0** or **BANK1**. The menu item names “BANK0” and “BANK1” are used in place of the user-defined bank designations.

6.4.5.2 Operation

JESS can be used to convert a max. of SAT-IF layers in a max. of 32 UB slots. These are further divided into 8 satellite positions with 4 SAT-IF layers each. Each connected receiver (max. 32) operates using a dedicated UB slot. This is defined via the SCR address.
These JESS parameters are set via **LNB** -> **LAYER**, -> **POSITION** and -> **SCR-ADR**.
The measuring receiver is tuned as described in the "Chapter 6.1 - Frequency input". The difference when using JESS control is that the desired transponder frequency is converted to the center frequency of a UB slot in the JESS unit. That means that the measuring receiver must send the transponder frequency to the JESS unit as a JESS command and then tune itself to the correct UB slot center frequency.
Whenever there is a new tuning process, the entire JESS control command is sent to the CSS (Channel Stacking Switch) again.

Note! **In the JESS operating mode, the scan function is deactivated. In general, JESS components are backwards compatible and can also understand conventional EN50494 commands. If the expanded features of JESS are not required, UNICABLE control can also be used.**

Note! **The possibility to control 16 or 32 UB slots depends on the hardware.**

6.4.5.3 Reading UB slot frequencies from CCS

In contrast to UNICABLE, where the UB configuration is indirectly determined using a scan function, JESS allows the number and center frequencies of the available UB slots to be read out from the CSS unit using DiSEqC commands. This makes the process significantly faster.
With JESS control active, open the LNB menu.
Select the menu items **ADVANCED** -> **READ CSS** and the instrument will begin reading the configuration from the JESS unit. A list of all possible UB slots then appears on the display.

In the following example, you can see that this particular CSS unit only has 3 UB slots available. The others are deactivated.

```
UB01:1280MHz UB02:1382MHz UB03:1484MHz UB04:----MHz
UB05:----MHz UB06:----MHz UB07:----MHz UB08:----MHz
UB09:----MHz UB10:----MHz UB11:----MHz UB12:----MHz
UB13:----MHz UB14:----MHz UB15:----MHz UB16:----MHz
               BANK0      SAVE
```

		<<<	>>>	BACK

You can also assign a custom label for the set SCR-ADR bank. The settings are saved when you move the cursor to the **SAVE** option and then press the **ENTER** key.

6.4.5.4 Programing aerial sockets

Also see the "Chapter 6.4.4.4 - Programming aerial sockets".
Selecting the menu items **ADVANCED** -> **PROG.ANTD.** reads the current configuration of the connected socket.

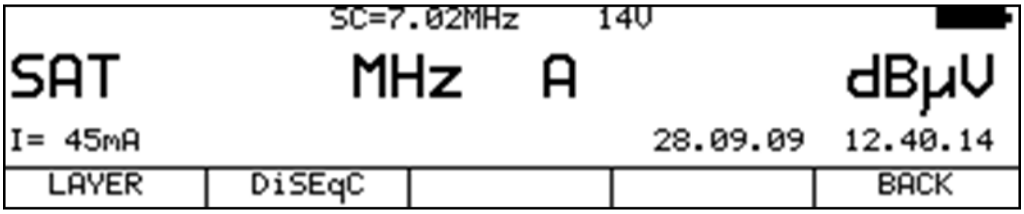
```
          Configuration of Aerial Socket

   UB1--------------UB16-UB17-------------UB32
    1000-0000-0000-0000---0000-0000-0000-0000
                      SAVE
```

RECALL				BACK

Selecting the **RECALL** menu item reads the configuration again.
The UB mask is seen here in binary form. A “1” means that the UB slot is enable, while a “0” means that the UB slot is locked. Using the ← or → arrow keys, you can move the cursor to the desired UB slot. You can enter “0” or “1” using the corresponding keys to change a particular bit position. Press the **ENTER** key to apply the entry. Move the cursor to SAVE and press the **ENTER** key to complete the programming of the socket. A message appears if the action was successful.

6.4.6 LNB current measurement

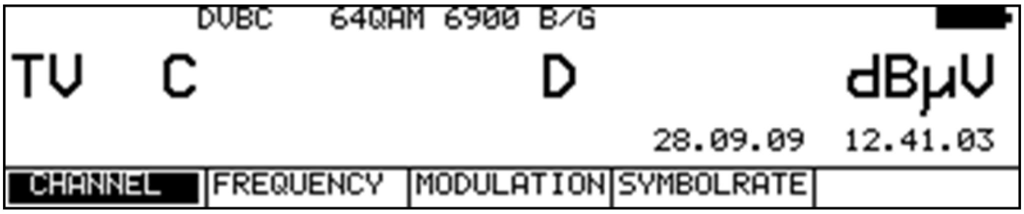
For this, you must bring the measuring instrument into the default status of the SAT measuring range. You can do this by pressing the **HOME** key. If an LNB supply is activated, the measuring receiver measures the amount of DC current flowing from the RF input socket (e.g. to supply an LNB) and displays the amperage in mA on the left edge of the LCD. The measuring range spans from 0 - 500 mA with a resolution of 1 mA.



In the above example, a current of 45 mA is measured with a 14 V LNB supply.
If the measuring receiver is tuned, the current indicator disappears from the LCD.

Chapter 7 TV Measuring Range

You access the TV range via **RANGE** -> TV.



7.1 Switching between frequency and channel input

The instrument can be tuned by entering the channel center frequency (DVB-C, DOCSIS and DVB-T), the video carrier frequency (ATV) or by entering the channel. You switch between modes using the menu items **CHANNEL** or **FREQUENCY**. After selection, the corresponding menu item is displayed inverted.

7.1.1 Frequency input

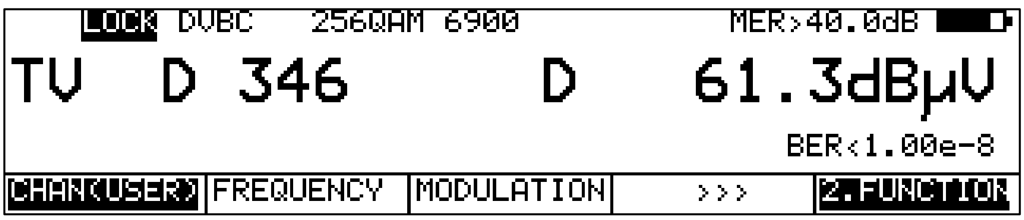
You can enter the frequency using the numeric keypad.
Here the smallest frequency resolution is 0.05 MHz (50 kHz). You use the **ENTER** key to confirm the entry. Invalid entries are ignored.

Frequency detuning
If the measuring receiver is tuned, you can carry out a frequency detuning in the 50 kHz grid using the ← and → keys.

7.1.2 Channel input

The basis for the channel input is a channel table stored in the instrument. It corresponds to the TV standard that has been set (BG, I, L, etc.). The table contains the center frequency and the video carrier frequency (ATV) for every channel. Within the channel table, there are “normal” channels (C channels) and special channels (S channels). You can switch the instrument from C to S channel input by pressing the **F1** key (**CHANNEL**).

There is the possibility to load user defined channel tables into the device, see "Chapter 20.14 - User-defined channel table for TV". In these modifiable tables standard C and S channels plus D channels can be used. For D channels the channel number is derived from the center frequency.



You can enter the desired channel number using the numeric keypad. Invalid entries are ignored.

If the measuring receiver is tuned, you can set the previous or next channel using the ← and → keys. In this way, you can key in the channels one by one.

7.2 Selection of the operating mode

Using the **ANA/DIG** key, you can select the operating mode of the measuring instrument in the TV range. An “A” on the display stands for analog mode, while a “D” indicates digital operating mode.

7.2.1 ANALOG (ATV) operating mode

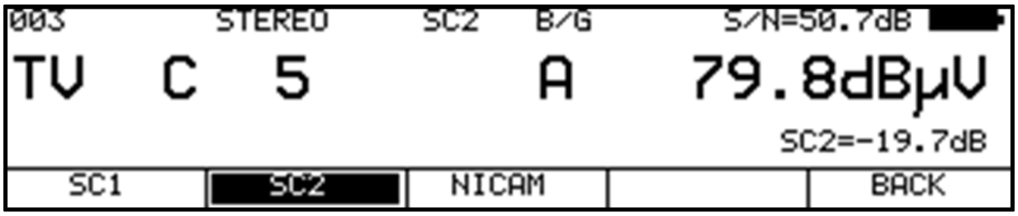
Analog-modulated TV signals can be received and measured here.
The instrument supports the B/G, M/N, I, D/K and L TV standards as well as the PAL, SECAM and NTSC color standards.

7.2.1.1 Selecting the TV standard

You can set a new TV standard via **MODE** > **SETTINGS** -> **TV-STAND.** -> **B/G**, **M/N**, **I**, **D/K** or **L**. The setting is stored in non-volatile memory. The TV standard is also incorporated in the tuning memory. The default setting is B/G.
The TV standard that is currently set is shown in the top line of the display.
The channel table is also changed when the instrument is switched to another TV standard.

7.2.1.2 Sound carrier

Audio signals are transmitted on modulated sound carriers. Depending on the TV standard, the two sound carriers have different frequency distances from the video carrier frequency.
The sound information can transmit MONO, STEREO or DUAL SOUND (bilingual). The instrument can demodulate both sound carriers at the same time. The type of source signal transmission (MONO, STEREO or DUAL SOUND) is shown on the display.



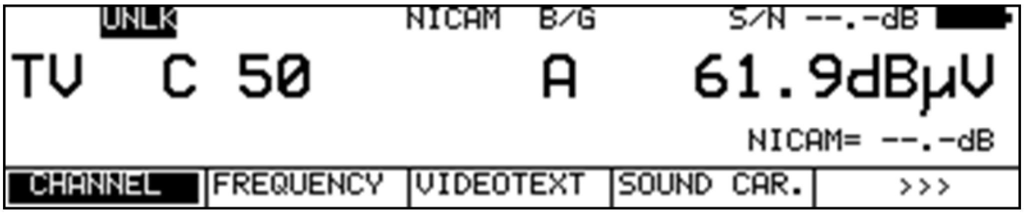
You can select the desired sound carrier with **SOUND CAR.** -> **SC1** or **SC2**. The sound carrier level that is measured relative to the video carrier is displayed in dB. At the same time, the loudspeaker outputs the demodulated sound signal of the set sound carrier. Both audio signals (L and R) are always present at the SCART socket, however.

Using **ABSOLUTE** the sound carrier is displayed as absolute instead of relative value. This setting is non-volatile.

7.2.1.3 NICAM decoder

The measuring receiver is equipped for the demodulation of the NICAM-728 digital transmission system. NICAM-728 is the abbreviation for “Near Instantaneously Companded Audio Multiplexing” with a data rate of 728 kbit/s.
This transmission system was developed in the United Kingdom to eliminate crosstalk problems that can occur in conventional transmission methods. This method transmits sound using a QPSK (Quadrature Phase Shift Keying) modulated subcarrier.
NICAM-728 allows terrestrially broadcasting television companies, in accordance with PAL B/G and I, SECAM D/K or SECAM L standards, to transmit digitally-coded hi-fi stereo/dual channel sound with the quality one expects from a compact disc.
The distance between video carrier and digital audio carrier is 5.85 MHz in the B/G, D/K and L standards and 6.552 MHz in the I standard.
NICAM can be transmitted together with an analog sound carrier. This means that a total of 3 (1x analog und 2x digital) sound channels are available. The system is set up so that if the bit error rate is too high, leading to unpleasant crackling in the audio signal, the decoder automatically switches to the analog sound channel. This is not implemented in the measuring receiver, however.

NICAM-728 operates with a sample rate of 32 kHz with 14 bit resolution. For transmission, the signal is compressed to 10 bits, however. This technology is called NIC (Near Instantaneous Companding).



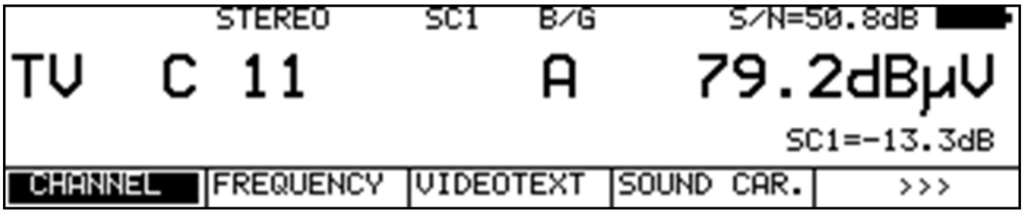
To activate the NICAM decoder, select the menu item **NICAM** under **SOUND CAR**.

The decoder then attempts to synchronize with the signal that is present. LOCK in the top line of the display indicates that a NICAM signal is present.
At the same time, the bit error rate of the digital data stream is displayed. Next to this, as with analog sound carriers, the relative level of the NICAM sound carrier is displayed.
As mentioned, the sound transmission can occur in MONO, STEREO or DUAL SOUND.
The type of transmission is displayed in the top line of the display.

7.2.1.4 Scan

You can use this function to scan the entire TV range for analog TV signals. For this, the instrument must operate in channel input mode.
You start the scan by first tuning the measuring receiver to a channel at which the scan should begin.
Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.

7.2.1.5 S/N measurement



The S/N (Signal/Noise) measurement is used with analog television for quality assessment of the video signal received. The measuring receiver measures the assessed signal to noise ratio of the demodulated video signal. For this, the noise signal of an empty video line is fed through an evaluation filter written in CCIR569. The displayed S/N value is calculated from the ratio of the nominal video signal limit (700 mVpp) to the assessed noise level. The measuring range spans 40 to 55 dB with a resolution of 0.1 dB. A video signal with an assessed S/N of more than 46.5 dB can be considered noise-free.
The default setting is to use video line 6 for the measurement of the noise signal. With **MODE** -> **SETTINGS** -> **S/N-LINE**, lines 5 and 7 are available as alternative settings. With the **SCOPE** function, you can check whether the relevant video line has no content (is empty).

7.2.1.6 Videotext decoder

By selecting the menu item **VIDEOTEXT**, you can access the videotext of the current program. For more, see "Chapter 14 - Videotext".

7.2.1.7 Scope (optional)

The line oscilloscope function is under the menu item **SCOPE**. Here you can oscillographically display individual video lines of the current program. Additional notes can be found in the "Chapter 13 - SCOPE".

7.2.1.8 Picture and sound check

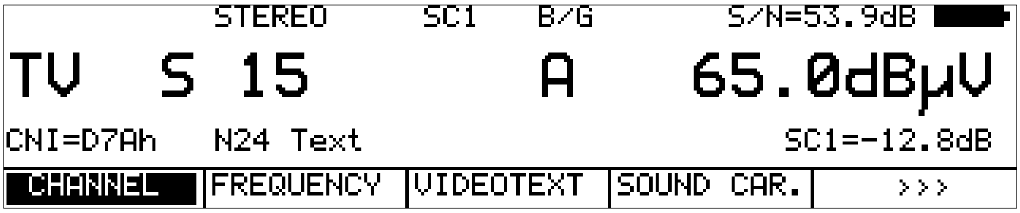
As soon as the measuring receiver is tuned, the TFT screen shows the demodulated video image. At the same time, the internal loudspeaker of the instrument outputs the demodulated audio signal. Video and audio signals are also available on the SCART socket.

7.2.1.9 CNI code (Country Network Identification)

The CNI code is the country and network identification of a TV channel. This code is part of the VPS (Video Programming System) line. The VPS signal is transmitted in TV line 16. Video recorders use this code for recording control. It is used as unique identification for the current program.
Once the measuring instrument has been tuned, it evaluates the VPS line and shows the CNI code in hexadecimal form in the display.

7.2.1.10 Program Identification

To identify the running program, the name is extracted from the head line of the videotext and displayed near the CNI.



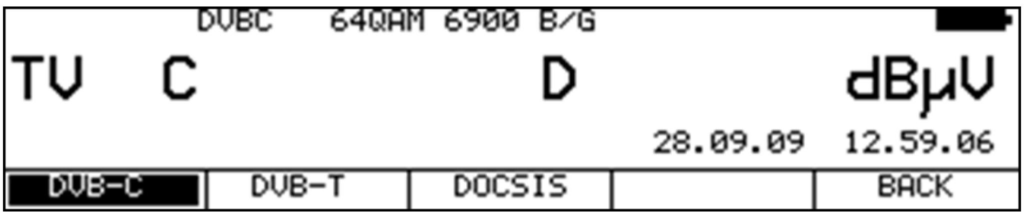
This program name can be called by remote over SNMP. Like this it is possible to control the content of the running program by remote.

7.2.2 DIGITAL (DVB-C, DVB-T/T2, DOCSIS, DTMB) Operation Mode

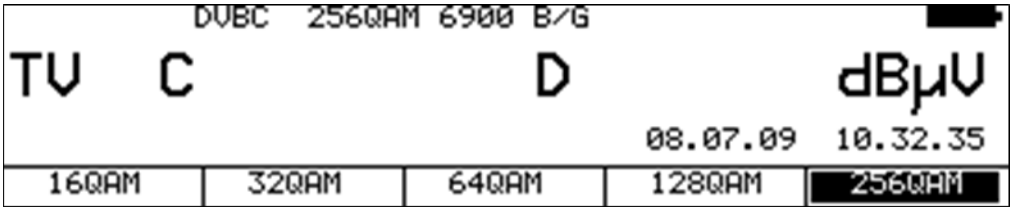
Here you can receive the digitally modulated DVB-C, DVB-T/T2 , DOCSIS or DTMB signals and measure their signal quality.

7.2.2.1 DVB-C

The DVB-C receiver of the measuring instrument is activated via the menu item **MODULATION** -> **DVB-C**.



You enter the modulation scheme for DVB-C in another menu.



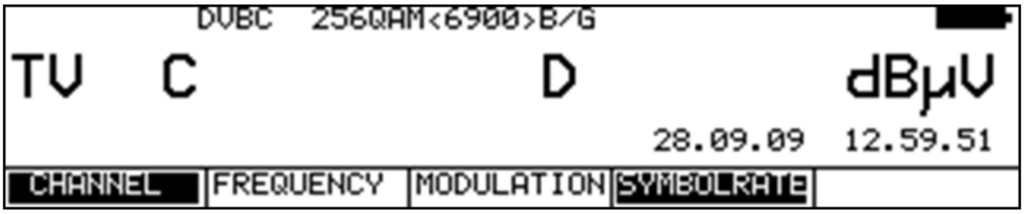
The selections **16QAM**, **32QAM**, **64QAM**, **128QAM** and **256QAM** are also available.
QAM means Quadrature Amplitude Modulation. That is the modulation method with DVB-C.

Automatic detection of the modulation schemes:

The measuring receiver uses the modulation scheme that was just selected as the starting point for automatic detection of the modulation scheme. As soon as you enter a channel, the receiver attempts to demodulate the signal that is present. If that is not successful with the set modulation scheme, the receiver attempts additionally with 64QAM, 128QAM and 256QAM. The modulation scheme of the DVB-C signal received is shown on the display.

7.2.2.1.1 Symbol rate input

You must set the corresponding symbol rate before a DVB-C (QAM) signal can be received.



First select menu item **SYMBOLRATE**. The symbol rate indicator then appears in brackets.

You can now enter the new symbol rate in kBd using the numeric keypad. Press **ENTER** to store this setting.

For reference: 6,900 kBd = 6,900 kSym/s = 6.9 MBd = 6.9 MSym/s

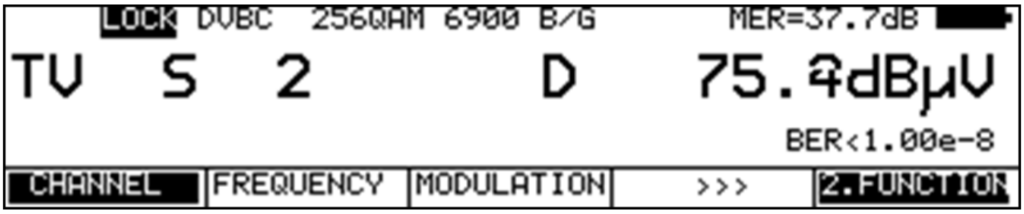
The symbol rate can be set in the range 500 kBd to 7,200 kBd.

Automatic symbol rate detection:

The measuring receiver uses the set symbol rate as the starting point for automatic detection. As soon as you enter a new channel, the receiver attempts to use the set symbol rate to demodulate the signal that is present. If this is not successful, it uses the symbol rates 6,111 kBd, 6,875 kBd or 6,900 kBd for additional attempts.

7.2.2.1.2 Scan

You can use this function to scan the entire TV range for DVB-C signals.
For this, you must switch the instrument to channel input mode.
The scan function includes automatic detection of modulation schemes and symbol rates.
That means that the instrument scans every channel with 64QAM, 128QAM and 256QAM and the symbol rates 6,111 kBd, 6,875 kBd and 6,900 kBd.



In the digital operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted. That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.

The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.

7.2.2.1.3 DVB-C parameters

As soon as the receiver has completed the synchronisation process, several parameters are shown on the display. When LOCK appears, it means that the digital receiver is receiving a valid data stream.

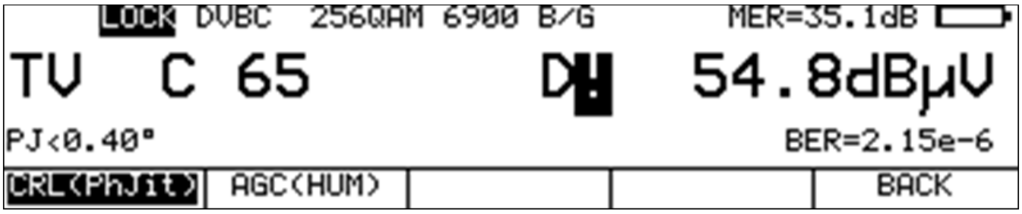
In contrast, UNLK means that either the quality of the signal that is present is insufficient, or that the parameters of the receiver do not agree, or that no DVB-C signal can be received at this frequency.

Once the receiver has synchronised, the set modulation scheme and the associated symbol rate is shown on the display.

7.2.2.1.4 Special receiver settings

The instrument allows certain parameters in the DVB-C to be changed.

This can done in the **REC.SETTG.** menu item. If the measuring instrument is working with modified receiver settings, an inverted “!” symbol appears on the display.



These settings are volatile. This means that after the device has been switched off and on or the range has been changed, the measuring receiver switches back to the standard settings. However, the settings are accounted for in the tuning memory. For automatic measurements, a notice about the modified receiver settings will follow the measurement results.

7.2.2.1.4.1 Carrier control bandwidth (CRL Carrier Recovery Loop)

A large bandwidth is set in the standard settings. This means that carrier control happens quickly. Carrier control can work with a small bandwidth using the menu item **REC.SETTG.** -> **CRL(PhJit)**. This makes the receiver react sensitively to phase jitter.

7.2.2.1.4.2 AGC bandwidth

A large bandwidth is set in the standard settings. This means that amplitude control happens quickly. Amplitude control can work with a very small bandwidth using the menu item **REC.SETTG.** -> **AGC(Hum)**. This makes the receiver react sensitively to hum modulation.

7.2.2.1.4.3 Turning off the VHF block filter

As standard, the measuring receiver places a VHF block filter in the frequency range from 112 MHz to 122 MHz before the receiver itself. This improves reception on channels S2/S3 due to the higher definition. Using the menu item **REC.SETTG.** -> **FM-FLTbyp** the filter can be manually switched off.

7.2.2.1.4.4 Turning off the Equalizer

In the standard setting, the equalizer of the QAM receiver is switched on. The equalizer can compensate for short echoes, known as micro-reflections, in the transmission link. Using the menu item **REC.SETTG.** -> **EQUAL. byp** the Equalizer can be manually switched off.

7.2.2.1.5 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the determination of the quality of a DVB signal.
To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction and the number of corrected bits is determined from that.
This number is placed in a ratio to the total throughput of bits and the BER is calculated based on that. For DVB-C, there is only one error protection mechanism (Reed-Solomon), i.e., there is only one bit error rate (BER) here.
The BER is shown on the display in exponential form. The measuring depth can set between $1 \cdot 10^8$ and $1 \cdot 10^9$ bits. To change the measuring depth, first press the **HOME** key. The depth of the bit error rate measurement can then be set to 10^9 (1 billion) bits using the menu item **MEAS.SETTG.** -> **BER** -> **e-9**. Accessing this menu item a second time resets the measuring depth to the default setting of 10^8. This setting is non-volatile. In monitoring mode and DATAGRABBER operating mode, the bit error rate is generally measured with a depth of 10^8 bits.

7.2.2.1.6 MER measurement (Modulation Error Rate)

In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290. MER is calculated from the constellation points.
It is the counterpart to S/N measurement with analog transmission methods. The measuring range goes up to 40 dB with a resolution of 0.1 dB.

7.2.2.1.7 PJ measurement (Phase jitter)

The measuring instrument can measure the phase jitter in a QAM signal. The principle of measurement is explained in ETR290. The measurement is in degrees, with a measuring range from 0.40° to 5.00° and a resolution of 0.01°. The instrument shows the phase jitter on the display as soon as the receiver is working with slower carrier control. See "Chapter 7.2.2.5.2.1 - Carrier control bandwidth (CRL Carrier Recovery Loop)".

7.2.2.1.8 HUM measurement (amplitude hum)

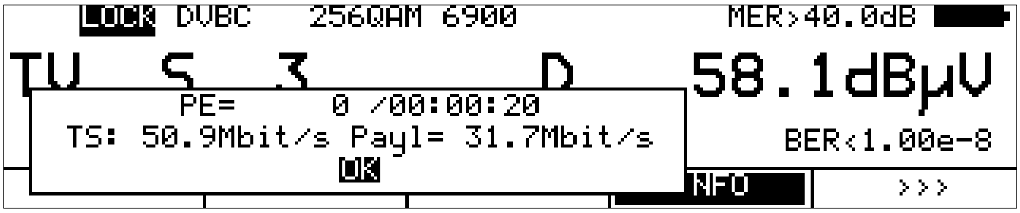
The measuring instrument can measure the amplitude hum in a QAM signal. The principle of measurement is explained in ETR290. The measurement is specified as a percentage. The measuring range extends from 0.5 to 5.00% with a resolution of 0.1%. The instrument shows the amplitude hum on the display as soon as the receiver is working with a slower AGC. See "chapter 7.2.2.5.2.2 - AGC bandwidth".

7.2.2.1.9 Constellation diagram

If the measuring receiver is tuned, you can access the constellation diagram via the menu item **CONST**. Additional information can be found in the "Chapter 12 - Constellation diagram".

7.2.2.1.10 PE measurement (Packet Error)

Short interruptions in the DVB-C signal usually cannot be detected using MER and BER measurement. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can lead to short picture freezes or sound that crackles.
The extent of this depends largely on the receiver hardware.
The measuring receiver has a function with which corrupt transport stream packets are summed from the point in time of entry of a new channel.
This function runs in the background constantly. An additional window can be shown on the display using the menu item **INFO**. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed. Press **ENTER** to close the window again.



7.2.2.1.11 Data rate measurement

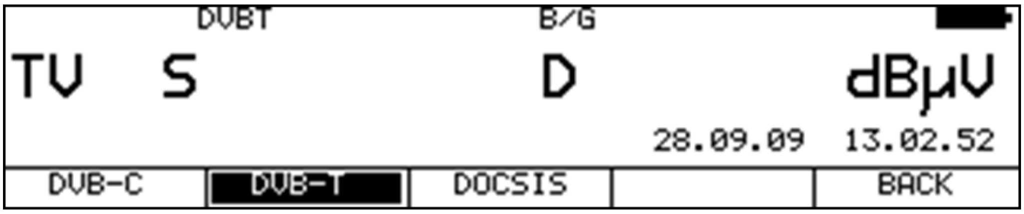
Herein the device measures the data rate of the transport stream. On the one hand it measures the gross data rate (all transmitted packets including the null packets are measured) and on the other hand is measures the payload data rate (all transmitted packets with PID other than null PID are measured). This informations are displayed together with the packet errors in an additional window. This window can be shown using the menu item **INFO**.
In the example above, the gross data rate of the transport stream is 50.9 Mbit/s and the payload data rate is 31.7 Mbit/s.
Press **ENTER** to close the window.

7.2.2.1.12 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
For more, see "Chapter 11 - MPEG Decoder".

7.2.2.2 DVB-T

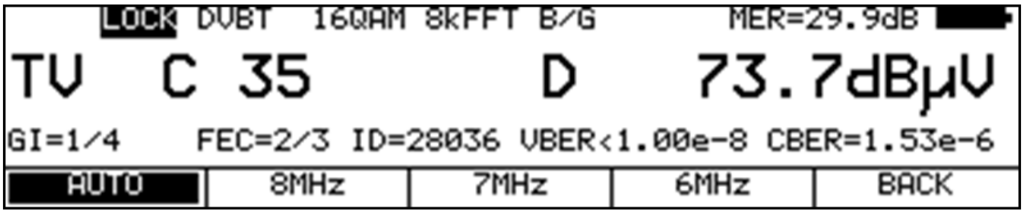
The DVB-T receiver of the measuring instrument is activated via the menu item **MODULATION** -> **DVB-T**.



The modulation method with DVB-T is COFDM (Coded Orthogonal Frequency Division Multiplex). It involves a very robust digital transmission method that is optimized in particular for transmission channels with multipath reception.

7.2.2.2.1 Selection of the COFDM bandwidth (channel bandwidth)

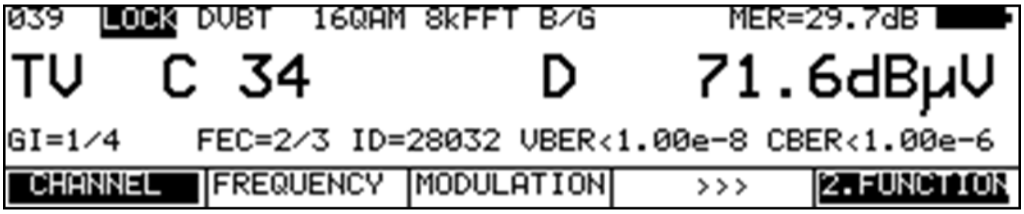
The DVB-T standard provides for transmission in 6, 7 or 8 MHz channels.



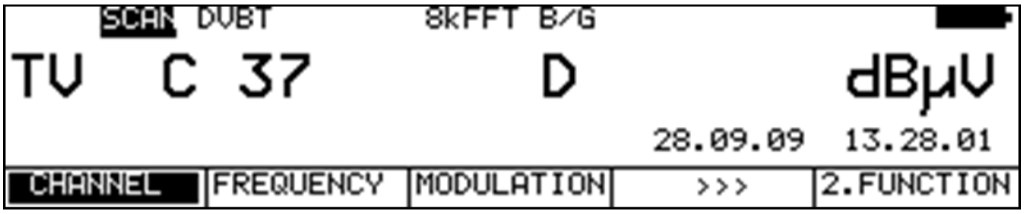
The bandwidth of the COFDM signal is set via **BANDWIDTH** -> **AUTO**, **8MHz**, **7MHz** or **6MHz**. In the AUTO setting, which is also the default setting, the measuring instrument uses the channel bandwidth that is stored in the respective channel table.
This setting is non-volatile and is also incorporated in the tuning memory.

7.2.2.2.2 Scan

You can use this function to scan the entire TV range for DVB-T signals.
For this, you must switch the instrument to channel input mode.

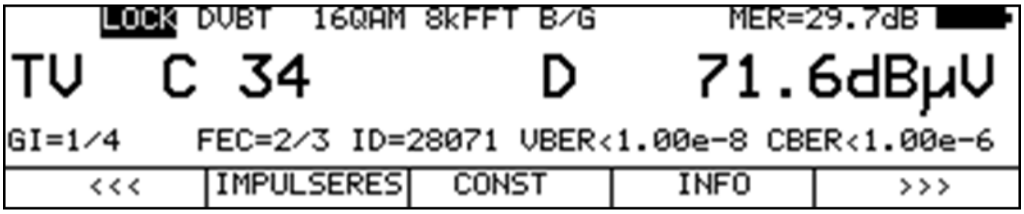


In the digital operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted. That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.
The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.



7.2.2.2.3 DVB-T parameters

As soon as the receiver has completed the synchronization process, several parameters are shown on the display. When LOCK appears, it means that the digital receiver is receiving a valid data stream. In contrast, UNLK means that either the quality of the signal that is present is insufficient, or that the parameters of the receiver do not agree, or that no DVB-T signal can be received at this frequency.



Once the receiver is synchronized, the following additional parameters are shown on the display. The DVB-T receiver determines these automatically.
With COFDM, a multi-carrier method is involved. The single carriers within the DVB-T signal are either QPSK, 16QAM or 64QAM modulated. In the above example, a transmission with the modulation scheme 16QAM is involved.
The DVB-T standard specified 2 FFT modes (2k or 8k). In the top line, you can see the currently determined FFT mode.
Additional parameters are the Guard Interval (GI), FEC (Forward Error Correction) and the network identification number (ID). These are displayed in the line above the menu bar.
The DVB-T standard is suitable for transmission in Single Frequency Networks (SFN). In a single frequency network, the involved stations operate synchronously on the same frequency. In order to take into account differing transit times with simultaneous effect on the receiving location, the DVB-T signal contains a so-called “guard interval”. The size of the guard interval tells you something about the maximum station distance within a single frequency network.
The FEC value expresses the ratio between usable bits and transmitted bits. In this example, there are 2 usable bits for every 3 transmitted bits.
Every single frequency network has its own identification number (ID). This number does not indicate from which station within the SFN the signal is being received.

7.2.2.2.4 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the determination of the quality of a DVB signal.
To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction and the number of corrected bits is determined from that. This number is placed in a ratio to the total throughput of bits and the BER is calculated based on that.
For DVB-T, two independent error protection mechanisms work together. So-called internal error protection (after the demodulator) is called Viterbi (named after the Viterbi algorithm) with DVB-T.

External error protection operates after that. With DVB-T, it is called Reed-Solomon.

For DVB-T, the bit error rates are measured before Viterbi (CBER) and after Viterbi (VBER).
Both values are shown on the display in exponential form.

The depth of measurement for the CBER is 1•10^6 bits, for the VBER is 1•10^8 bits.

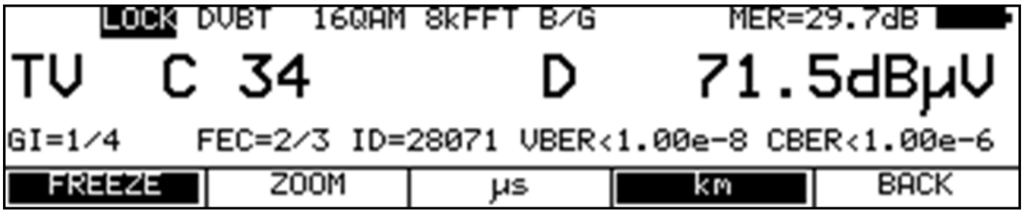
7.2.2.2.5 MER measurement (Modulation Error Rate)

In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290. MER is calculated from the constellation points.
It is the counterpart to S/N measurement with analog transmission methods. The measuring range goes up to 35 dB with a resolution of 0.1 dB.

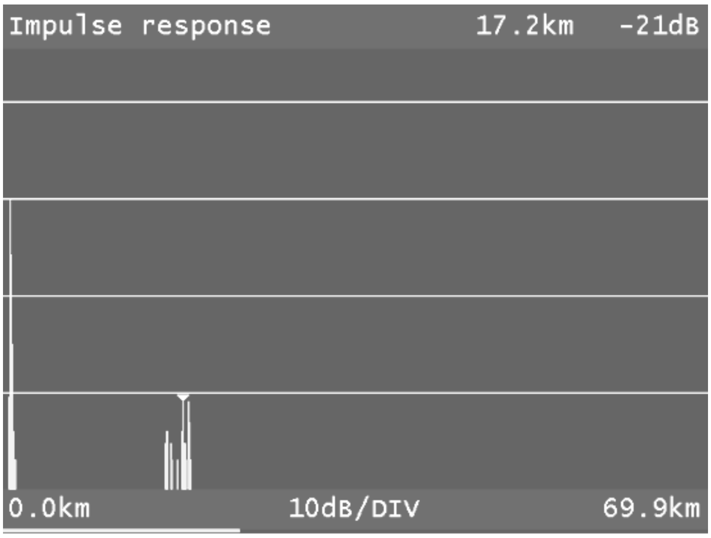
7.2.2.2.6 Impulse response

It is helpful to measure the impulse response for DVB-T for setting up a receiving antenna - especially in situations where reception is difficult and signals are received simultaneously from several stations in the SFN. If a receiving antenna receives the DVB-T signal from multiple directions with differing transit times and differing field strengths, the individual signals superimpose upon each other to form a sum signal.
Because DVB-T is made up of several narrow-band single carriers (COFDM), individual carriers may occasionally be notably attenuated through superimposition. Because information is distributed among all carriers with respect to time, the DVB-T system can process this to a certain degree without any problem. However, the impulse response can be used to detect this scenario before it causes problems in reception. The basis for measuring the impulse response is information in the channel transmission function. The DVB-T channel decoder acquires this from the pilot carriers that are transmitted with DVB-T. Through calculation of the IFFT, you can obtain the impulse response from the channel transmission function.
The measuring receiver must receive a DVB-T signal in order to display the impulse response. The instrument should be tuned to an appropriate channel to do this.

To show the impulse response on the TFT of the measuring instrument, select the menu item **IMPULSERES**. A menu for additional settings will then appear.



You can “freeze” the picture using **FREEZE**. You can expand the impulse response in the horizontal direction using **ZOOM**. You can then see more details near the primary impulse. You can define the unit of the x-axis with **µs** or **km**. Time and length are related via the speed of light, c: =3•10^8 m/s. You can end the display of the impulse response via the menu item **BACK**.



The printed example shows an impulse response with a primary impulse (left picture edge) and several secondary impulses at a distance of approximately 17 km from the primary impulse.

You can move the cursor (small triangle) left and right using the ← and → keys. At the top right edge of the picture, the distance of the secondary impulses and their attenuation (-21 dB) in relation to the primary impulse is displayed.

Peak-Search Function

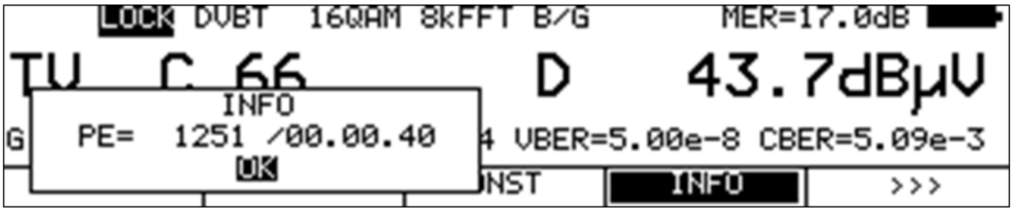
While the impulse response is built up, the instrument determines the four highest secondary impulses apart from the main impulse. If there are echoes, the cursor moves to the highest secondary impulse after the second cycle. By pressing the keys ↑ and ↓ the cursor may be moved to further echoes cyclically one after the other. The distance and/or the delay as compared to the main impulse may be taking taken from the readings in the header of the diagram.

7.2.2.2.7 Constellation diagram

If the measuring receiver is tuned, you can access the constellation diagram via the menu item **CONST**. Additional information can be found in the "Chapter 12 - Constellation diagram".

7.2.2.2.8 PE measurement (Packet Error)

Short interruptions in the DVB-T signal usually cannot be detected using MER and BER measurement. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can lead to short picture freezes or sound that crackles.
The extent of this depends largely on the receiver hardware.
The measuring receiver has a function with which corrupt transport stream packets are summed from the point in time of entry of a new channel. This function runs in the background constantly. An additional window can be shown on the display using the menu item **INFO**. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed. Press **ENTER** to close the window again.



7.2.2.2.9 Data rate measurement

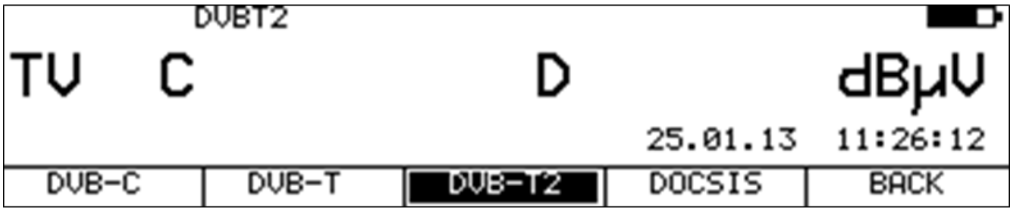
Herein the device measures the data rate of the transport stream. On the one hand it measures the gross data rate (all transmitted packets including the null packets are measured) and on the other hand is measures the payload data rate (all transmitted packets with PID other than null PID are measured). This informations are displayed together with the packet errors in an additional window. This window can be shown using the menu item **INFO**. Press **ENTER** to close the window.

7.2.2.2.10 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
For more, see "Chapter 11 - MPEG Decoder".

7.2.2.3 DVB-T2

The DVB-T receiver of the measuring instrument is activated via the menu item **MODULATION** -> **DVB-T2**.



The modulation method for DVB-T2 is COFDM (Coded Orthogonal Frequency Division Multiplex). It involves a very robust digital transmission method that is optimized in particular for transmission channels with multipath reception. DVB-T2 is a very flexible standard for terrestrial transmission of digital TV. OFDM transmission parameters can be optimally adapted to the topographic conditions. The main improvement over DVB-T is the considerably more efficient FEC (LDPC and BCH), with which the transmission capacity can be increased by up to 30% at the same channel quality.

7.2.2.3.1 Selecting of the COFDM bandwidth (channel bandwidth)

The DVB-T2 standard provides for transmission in 1.7, 5, 6, 7 or 8 MHz channels.
The bandwidths 1.7 MHz and 5 MHz are not supported by the instrument.

The bandwidth of the COFDM signal is set via **BANDWIDTH** -> **AUTO**, **8MHz**, **7MHz** or **6MHz**. In the AUTO setting, which is also the default setting, the measuring instrument uses the channel bandwidth that is stored in the respective channel table.
This setting is non-volatile and is also incorporated in the tuning memory.

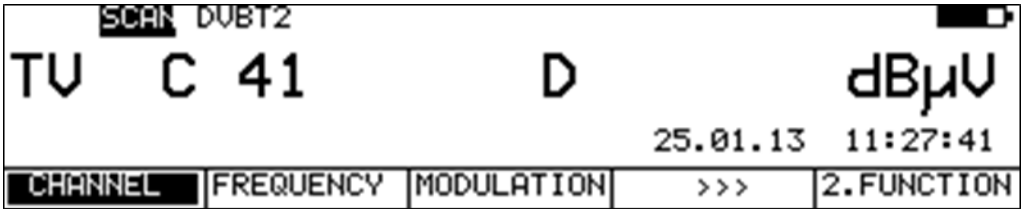
7.2.2.3.2 Scan

You can use this function to scan the entire TV range for DVB-T2 signals.
To do this, you must switch the instrument to channel input mode.

In the digital operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted.

That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.

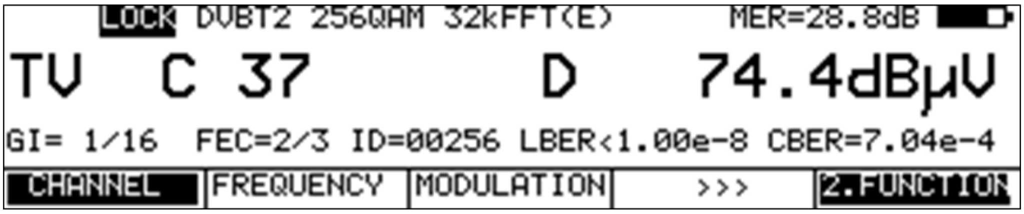
The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.



7.2.2.3.3 DVB-T2 parameters

As soon as the receiver has completed the synchronization process, several parameters are shown on the display. When LOCK appears, it means that the digital receiver is receiving a valid data stream.

In contrast, UNLK means that either the quality of the signal that is present is insufficient, or that the parameters of the receiver do not match, or that no DVB-T2 signal can be received at this frequency.

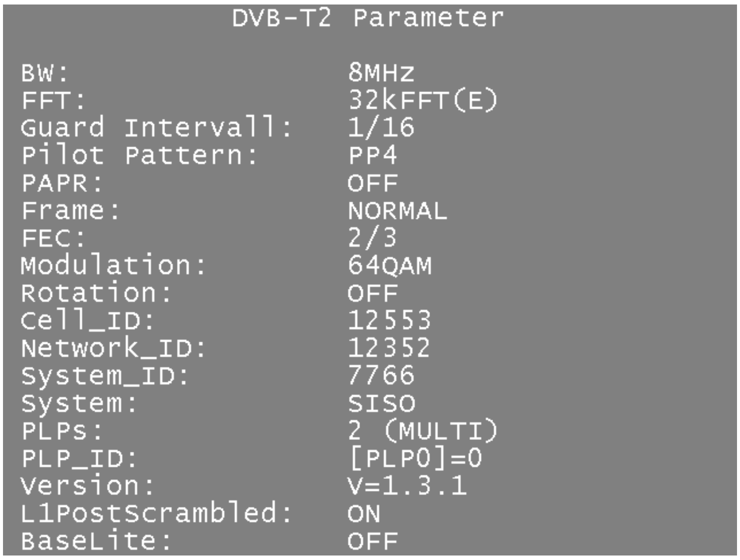


Once the receiver is synchronized, additional parameters are shown on the display. The DVB-T2 receiver determines these automatically.

In the figure above, the equipment receives a DVB-T2-signal with the following parameters:

- FFT order: 32k(E). (E) means “Extended Carrier Mode”, i.e. bandwidth utilization is higher in this mode as additional OFDM single carriers are used.
- Modulation scheme: 256QAM, Guard Interval (GI): 1/16, FEC: 2/3, Cell ID: 256.

The **PARAMETERS** menu item can be used to display a window in which additional DVB-T2 parameters are listed. This window is displayed on the TFT-display of the device. It consists of two pages which can be selected with the keys <- and ->. It is possible to make a hardcopy of this screen on the internal printer and to a bmp-file to the USB-stick.



Explanations:
This parameters are the most important L1-Pre Signaling Data, which are explained in ETSI EN 302 755.

7.2.2.3.4 Selecting of the PLP (Physical Layer Pipe)

On feature at DVB-T2 is the possibility of simultaneously transmitting more independent transport streams, which can be sent with separated FEC parameters.
If more than one PLP is transmitted than “MPLP” (Multi PLP) is displayed one line above the menu line. Then you can select one of the PLP´s by using the menu item **SET PLP** . Afterwards the MPEG-Decoder starts a new scan on the changed transport stream.
After retuning the DVB-T2 receiver the device automatically switches to the PLP with the PLP_ID=0.

7.2.2.3.5 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the determination of the quality of a DVB-T2 signal.

To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction and the number of corrected bits is determined from that. This number is placed in a ration to the total throughput of bits and the BER is calculated based on that.
For DVB-T2, two independent error protection mechanisms work together. LDPC (Low Density Parity Check) is used for internal error protection, BCH (Bose Chaudhuri Hocquenghem) is used for external error protection.

The equipment measures the bit error rates before LDPC (CBER) and after LDPC (LBER).
Both values are shown on the display in exponential form.
The depth of measurement for the CBER is$1 \cdot 10^6$ bits, for the LBER it is $1 \cdot 10^8$ bits.

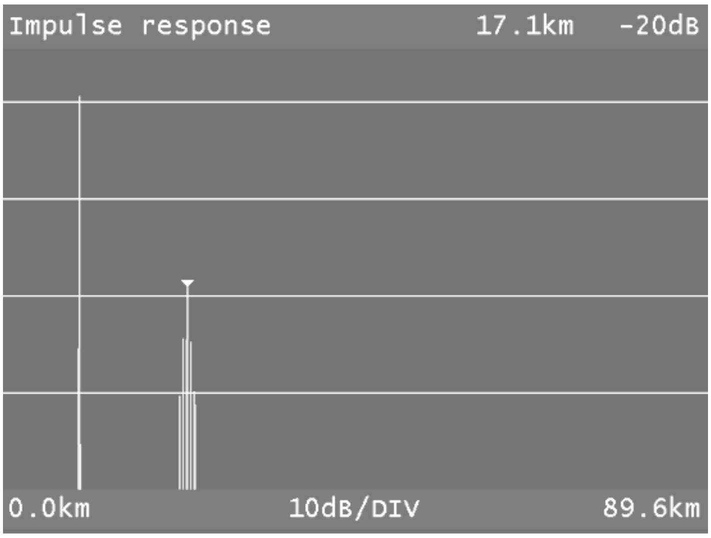
7.2.2.3.6 MER Measurement (Modulation Error Rate)

In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290. MER is calculated from the constellation points.
It is the counterpart to S/N measurement with analog transmission methods. The measuring range goes up to 35 dB with a resolution of 0.1 dB.

7.2.2.3.7 Impulse response

As with DVB-T, DVB-T2 is intended for operation in a single frequency network. This means several transmitters transmit on the same frequency.
The transmitters involved must operate synchronously on the same frequency.
The maximum transmitter distance depends on the Guard Interval used.
At the receiving location, the signals from individual transmitters superimpose on each other to form a sum signal.
The result can be constructive or destructive depending on the transit time difference and the received field strength. The impulse response graphically represents attenuation and transit time difference of the individual signals.
In order to calculate the channel impulse response, the DVB-T2 receiver requires information on the channel transmission function. The demodulator obtains this information by evaluating the pilot carrier in the OFDM signal.
The measuring receiver must receive a DVB-T2 signal in order to measure the impulse response. The instrument should be tuned to an appropriate channel to do this.
The instrument displays the impulse response on the screen when the **IMPULSERES** menu item is selected. A menu for additional settings will appear at the same time.

You can “freeze” the picture using **STOP**. You can expand the impulse response in the horizontal direction using **ZOOM**. You can define the unit of the x-axis with **µs** or **km**. Time and length are related via the speed of light, $c := 3 \cdot 10^8$ m/s. You can end the display of the impulse response via the menu item **BACK**.



The printed example shows an impulse response with a primary impulse (left picture edge) and several secondary impulses at a distance of approximately 17 km from the primary impulse.

You can move the cursor (small triangle) left and right using the ← and → keys. At the top right edge of the picture, the transit time difference and attenuation in relation to the primary impulse is displayed at the cursor position.

Peak-Search Function
While the impulse response is built up, the instrument determines the four highest secondary impulses apart from the main impulse. If there are echoes, the cursor moves to the highest secondary impulse after the second cycle. By pressing the keys ↑ and ↓ the cursor may be moved to further echoes cyclically one after the other. The distance and/or the delay as compared to the main impulse may be taking taken from the readings in the header of the diagram.

7.2.2.3.8 PE measurement (Packet Error)

Short interruptions in the DVB-T2 signal usually cannot be detected using MER and BER measurement. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can cause the picture to freeze temporarily or the sound to crackle.
The measuring receiver has a function with which corrupt transport stream packets are summed from the point in time of entry of a new channel. This function runs in the background constantly. An additional window can be shown on the display using the menu item **INFO**. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed. Press **ENTER** to close the window.

7.2.2.3.9 Data rate measurement

Herein the device measures the data rate of the transport stream. On the one hand it measures the gross data rate (all transmitted packets including the null packets are measured) and on the other hand is measures the payload data rate (all transmitted packets with PID other than null PID are measured). This informations are displayed together with the packet errors in an additional window. This window can be shown using the menu item **INFO**. Press **ENTER** to close the window.

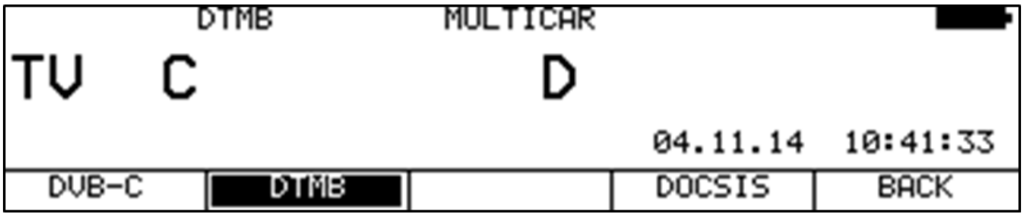
7.2.2.3.10 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
See "Chapter 11 - MPEG Decoder".

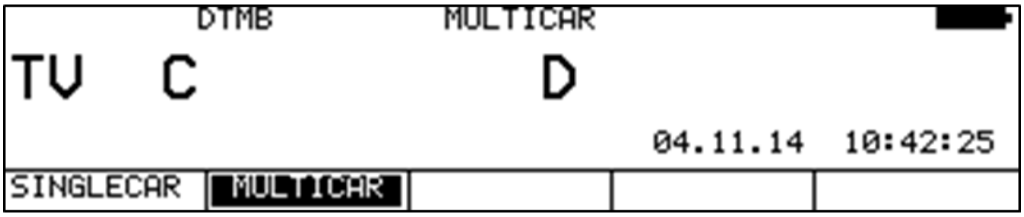
7.2.2.4 DTMB

DTMB (Digital Terrestrial Multimedia Broadcasting) is a Chinese standard for digital TV and radio program transmission. DTMB was developed in 2007 out of the two drafts of DMB-T and ADTB-T. DMB-T, which was developed at the University of Beijing, is a multiple carrier standard similar to the European DVB-T/T2. ADTB-T (single carrier) was derived from the American standard ATSC and was further developed at the University of Shanghai. Parts of the specification of DTMB, which supports a single and a multi-carrier mode, are written down in GB20600-2006. Like DVB-T2, DTMB uses as an internal error correction LDPC (Low Density Parity Check) and BCH (Bose Chaudhuri Hocguenghem) as an external error correction. Thus the transmission standard is very robust, which makes it suitable for mobile TV reception. In addition DTMB can be used in single frequency networks.

The DTMB receiver is activated via the menu items **MODULATION** -> **DTMB**.



As a result a new menu will appear where the DTMB mode can be adjusted.



The single carrier mode (C1) is activated via **SINGLECAR** whereas the receiver is set to multi carrier mode (C3780) via **MULTICAR**.

Automatic mode detection:

The measuring receiver uses the set mode as the starting point for automatic mode detection. As soon as you enter a new frequency, the receiver attempts to demodulate the signal that is present. If it is not successful in the set mode, the other mode is automatically used. The mode of the signal received is shown on the display.

7.2.2.4.1 Scan

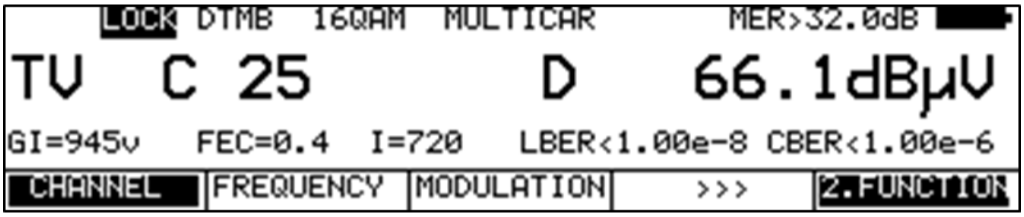
You can use this function to scan the entire TV range for DTMB signals. To do this, you must switch the instrument to channel input mode.
In the digital operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted.

That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.

The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.

7.2.2.4.2 DTMB parameters

As soon as the receiver has completed the synchronization process, several parameters are shown on the display. When LOCK appears, it means that the digital receiver is receiving a valid data stream. In contrast, UNLK means that either the quality of the signal that is present is insufficient, or that the parameters of the receiver do not match, or that no DTMB signal can be received at this frequency.



Once the receiver is synchronized, additional parameters are shown on the display. The DTMB receiver determines these automatically.

In the figure shown above, the instrument receives a DTMB-Signal with the following parameters:

Multi carrier modulation	MULTICAR (C3780)
Modulation scheme	16QAM
Guard interval(GI)	PN945variable (equivalent 125 µs)
FEC	0.4
Time interleaver	M_720

7.2.2.4.3 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the determination of the quality of a DTMB signal.

To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction and the number of corrected bits is determined from that. This number is placed in a ration to the total throughput of bits and the BER is calculated based on that.

With DTMB there are two independent error protections that work together. The inner error protection comes from LDPC (Low Density Parity Check), the external error protection uses BCH (Bose Chaudhuri Hocguenghem).

The instrument measures the Bit Error Rate before LDPC (CBER) and after LDPC (LBER). Both results will be shown on the display in exponential form. The measurement depth is for CBER 1•10^6 Bits. For the LBER 1•10^8 Bits.

7.2.2.4.4 MER measurement (Modulation Error Rate)

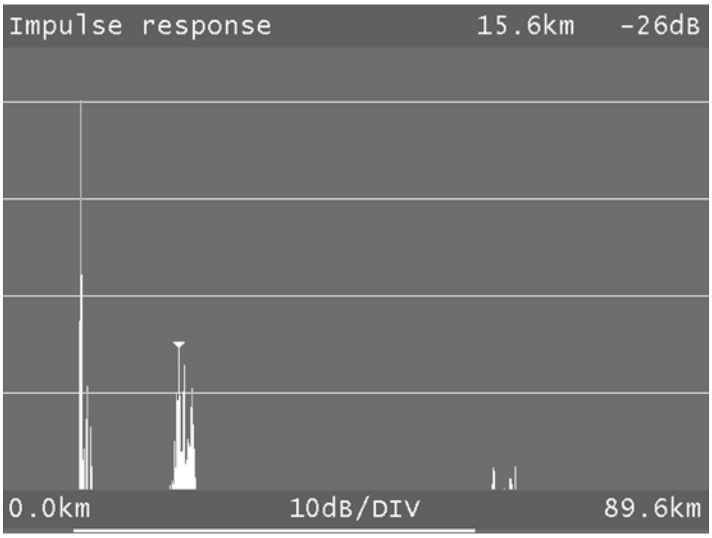
In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290. MER is calculated from the constellation points. It is the counterpart to S/N measurement with analog transmission methods. The measuring range goes up to 32 dB with a resolution of 0.1 dB.

7.2.2.4.5 Impulse response

For the measurement of the impulse response, the measuring instrument must receive a DTMB signal. For this, you must adjust the instrument to the appropriate channel.

By selecting the menu point **IMPULSERES** the instrument will show the impulse response on the display. Simultaneously you will see a further menu for adjustments.

With **FREEZE** you can freeze the picture. With **ZOOM** the impulse response can be spread horizontally. You can define the unit of x-axis with **µs** or **km**.Time and length values are related via the speed of light c:=3•10^8 m/s. Via the menu point **BACK** you can end the display of the impulse response.



The example above shows an impulse response with a primary impulse (left picture edge) and several secondary impulses at a distance of approximately 16km to the primary impulse.

You can move the cursor (small triangle) left and right using the ← and → keys. At the top right edge of the picture, the run time difference (or path difference respectively) and attenuation in relation to the primary impulse is displayed at the cursor position.

-Peak-Search Function
While the impulse response is built up, the instrument determines the four highest secondary impulses apart from the main impulse. If there are echoes, the cursor moves to the highest secondary impulse after the second cycle. By pressing the keys ↑ and ↓ the cursor may be moved to further echoes, cyclically one after the other. The distance and/or the delay as compared to the main impulse may be taking taken from the readings in the header of the diagram.

7.2.2.4.6 Constellation diagram

If the measuring receiver is tuned, you can access the constellation diagram via the menu item **CONST**.
For more, see Chapter 12 - Constellation diagram".

7.2.2.4.7 PE measurement (Packet Error)

Short interruptions in the DTMB signal usually cannot be detected using MER and BER measurement. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can cause the picture to freeze temporarily or the sound to crackle.
The measuring receiver has a function with which corrupt transport stream packets are summed from the point in time of entry of a new channel. This function runs in the background constantly.
An additional window can be shown on the display using the menu item **INFO**. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed. Press **ENTER** to close the window.

7.2.2.4.8 Data rate measurement

Herein the device measures the data rate of the transport stream. On the one hand it measures the gross data rate (all transmitted packets including the null packets are measured) and on the other hand is measures the payload data rate (all transmitted packets with PID other than null PID are measured). This informations are displayed together with the packet errors in an additional window. This window can be shown using the menu item **INFO**. Press **ENTER** to close the window.

7.2.2.4.9 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder. See "Chapter 11 - MPEG Decoder".

7.2.2.5 ScQAM DOCSIS (downstream)

DOCSIS (Data Over Cable Service Interface Specification) is the standard for the transmission of data in interactive cable networks. DOCSIS includes a downstream and an upstream.
Up to DOCSIS version 3.0, only single-carrier QAM (ScQAM) is used as the modulation method. DOCSIS differentiates between US-DOCSIS (transmission in 6 MHz channels) and Euro-DOCSIS (transmission in 8 MHz channels).

Similarities and differences in the upstream:

	US-DOCSIS	**EURO-DOCSIS**
Modulation type	64-QAM, 256-QAM	64-QAM, 256-QAM
Symbol rate	5057 and 5361	6952
FEC	J.83/B	DVB-C
Channel bandwidth	6 MHz	8 MHz
Transmission frequency range	50…862 MHz	112…862 MHz

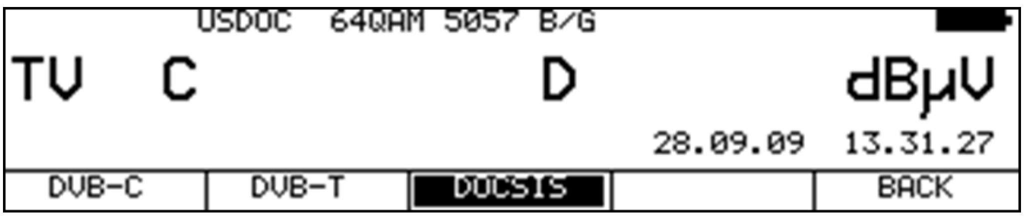
Differences in the downstream:

	US-DOCSIS	**EURO-DOCSIS**
Transmission frequency range	5…42 MHz	5…65 MHz

As you can see in the comparison, you can use a DVB-C receiver for the reception of a Euro-DOCSIS downstream signal. It is only necessary to set the symbol rate to 6.952 kBd. For US-DOCSIS, a receiver according to ITU J.83/B is required.

The measuring receiver has a common receiver for both DOCSIS variants.

You can activate the DOCSIS receiver of the measuring instrument via the menu item **MODULATION** -> **DOCSIS**.



You select the modulation scheme for the DOCSIS variant in another menu.

The associated symbol rate is automatically set.

Automatic scan with DOCSIS:

If you enter a new channel, the receiver attempts to synchronize with the current settings (DOCSIS variants, modulation schemes). If this is not successful, the instrument alternatively uses the other settings **EUDOC64**, **EUDOC256**, **USDOC64** or **USDOC256** to receive the signal that is present.

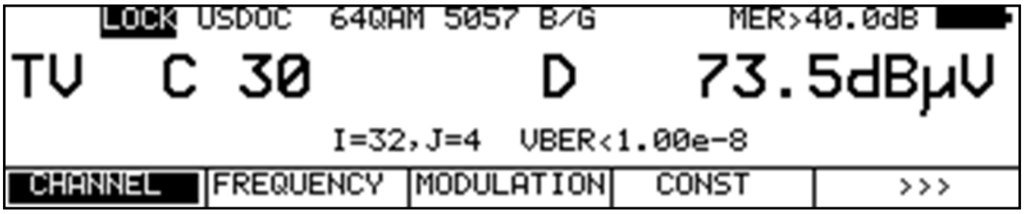
7.2.2.5.1 DOCSIS parameters

As soon as the receiver has completed the synchronization process, several parameters are shown on the display.

When LOCK appears, it means that the digital receiver is receiving a valid data stream. In contrast, UNLK means that either the quality of the signal that is present is insufficient, or that the parameters of the receiver do not agree, or that no DOCSIS signal can be received at this frequency.

Once the receiver has synchronized, the set modulation scheme and the associated symbol rate is shown on the display.

In the case of a US-DOCSIS signal, the automatically detected deinterleaver depths are also shown in the LCD. The variable deinterleaver is part of the J83B specification (in the case of DVB-C and EURO-DOCSIS, the deinterleaver is fixed with I = 12 / J = 17).



7.2.2.5.2 Special receiver settings

The instrument allows certain parameters in the DOCSIS receiver to be changed.
This can done in the **REC.SETTG.** menu item. If the measuring instrument is working with modified receiver settings an inverted “!” symbol appears on the display.
These settings are volatile. This means that after the device has been switched off and on or the range has been changed, the measuring receiver switches back to the standard settings.
However, the settings are accounted for in the tuning memory. For automatic measurements, a notice about the modified receiver settings will follow the measurement results.

7.2.2.5.2.1 Carrier control bandwidth (CRL Carrier Recovery Loop)

A large bandwidth is set in the standard settings. This means that carrier control happens quickly. Carrier control can work with a small bandwidth using the menu item **REC.SETTG.** -> **CRL(PhJit)**. This makes the receiver react sensitively to phase jitter.

7.2.2.5.2.2 AGC bandwidth

A large bandwidth is set in the standard settings. This means that amplitude control happens quickly. Amplitude control can work with a very small bandwidth using the menu item **REC.SETTG.** -> **AGC(Hum)**. This makes the receiver react sensitively to hum modulation.

7.2.2.5.2.3 Turning off the Equalizer

In the standard setting, the equalizer of the QAM receiver is switched on. The equalizer can compensate for short echoes, known as micro-reflections, in the transmission link. Using the menu item **REC.SETTG.** -> **EQUAL. byp** the Equalizer can be manually switched off.

7.2.2.5.3 Scan

With this function, you can scan the entire TV range for DOCSIS signals.
For this, you must switch the instrument to channel input mode.

In the DOCSIS operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted.
That means that the DOCSIS analyzer can be operated with the arrow keys. To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.

The scan function includes the automatic scan of the DOCSIS variants as described above. That means that the instrument scans every channel with EUDOC64, EUDOC256, USDOC64 and USDOC256.
The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction.
When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.

7.2.2.5.4 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the determination of the quality of a DVB signal.
To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction and the number of corrected bits is determined from that. This number is placed in a ratio to the total throughput of bits and the BER is calculated based on that. With Euro-DOCSIS, there is only one error protection mechanism (Reed-Solomon). That means that there is only one bit error rate (BER) here.
With US-DOCSIS, in contrast, there is an internal error protection (Viterbi) and an external error protection (Reed-Solomon) as with DVB-S and DVB-T. For technical reasons, the measuring instrument can measure only the bit error rate according to Viterbi (VBER) with US-DOCSIS.
The BER is displayed in exponential form. For US-DOCSIS the measuring depth is generally $1 \cdot 10^8$ bits. For EURO-DOCSIS the measuring depth can be set to $1 \cdot 10^8$ or $1 \cdot 10^9$ bits. See BER measurement for DVB-C.

7.2.2.5.5 MER measurement (Modulation Error Rate)

In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290. MER is calculated from the constellation points. It is the counterpart to S/N measurement with analog transmission methods. The measuring range goes up to 40dB with a resolution of 0.1dB.

7.2.2.5.6 Primary/secondary downstream signaling

As soon as the receiver has evaluated the DOCSIS packets in the transport stream, the message "Primary" or "Secondary" appears in the bottom line of the display. For Primary, the downstream channel contains all the information needed for a cable modem to log in through this channel.

7.2.2.5.7 PJ measurement (Phasejitter)

The measuring instrument can measure the phase jitter in a QAM signal. The principle of measurement is explained in ETR290. The parameter is defined in degree. The measurement range starts from 0.40° to 5.00° with a resolution of 0.01°. The instrument shows the phase jitter in the LCD display as soon the receiver operates with the slow carrier control (see Chapter 7.2.2.5.2.1 - Carrier control bandwidth (CRL Carrier Recovery Loop)).

7.2.2.5.8 HUM measurement (amplitude hum)

The measuring instrument can measure the amplitude hum in a QAM signal. The principle of measurement is explained in ETR290. The measurement is specified as a percentage. The measuring range extends from 0.5 to 5.00% with a resolution of 0.1%. The instrument shows the amplitude hum on the display as soon as the receiver is working with a slower AGC. See "chapter 7.2.2.5.2.2 - AGC bandwidth".

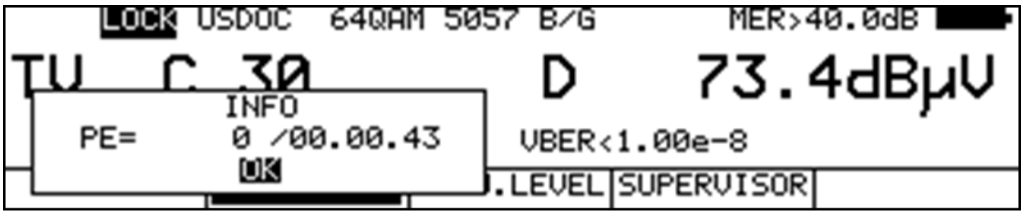
7.2.2.5.9 Constellation diagram

If the measuring receiver is tuned, you can access the constellation diagram via the menu item **CONST**. Additional information can be found in the "Chapter 12 - Constellation diagram".

7.2.2.5.10 PE measurement (Packet Error)

Short interruptions in the DOCSIS signal usually cannot be detected using MER and BER measurement. They can make entire packets in the transport stream unusable, however. The measuring receiver has a function with which corrupt transport stream packets are summed from the point in time of entry of a new channel. This function runs in the background constantly.
An additional window can be shown on the display using the menu item **INFO**.

The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed.
Press **ENTER** to close the window again.



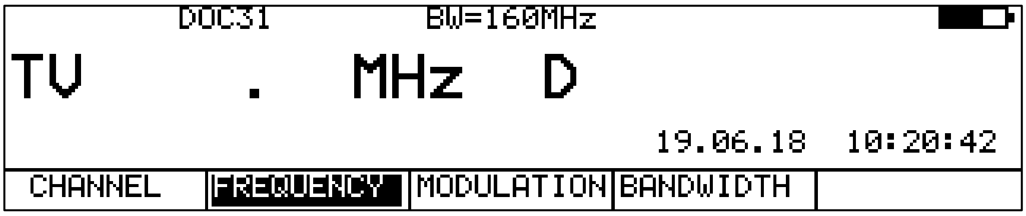
7.2.2.6 OFDM-DOCSIS (Downstream)

With start of DOCSIS Version 3.1, in addition to single-carrier QAM (ScQAM), OFDM is used as a further modulation method. In addition, the more efficient error protection LDPC / BCH is used. Furthermore the data is scrambled both in the frequency domain and in the time domain. This makes the transmission extremely robust against narrowband and short term interferers. For ScQAM transmissions, narrowband interferers affect the entire 8MHz channel, while in OFDM only single carriers around the interferer are affected.

7.2.2.6.1 FPGA-Demodulator

The meter has an FPGA-based OFDM demodulator for receiving OFDM-modulated DOCSIS downstream signals. This allows the channel spectrum, constellation diagram and impulse response to be displayed in real time.

The menu item **MODULATION** -> **DOCSIS** -> **OFDM** activates the DOCSIS OFDM downstream receiver of the measuring device.



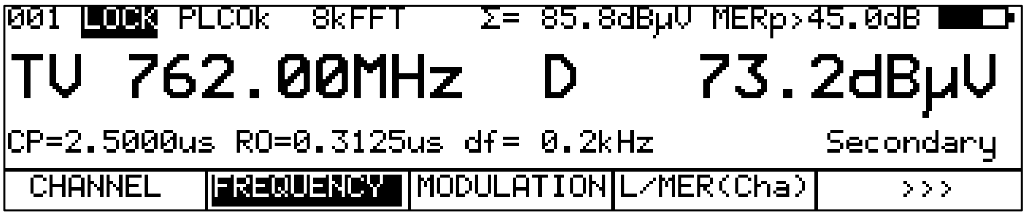
Setting the OFDM channel bandwidth
DOCSIS3.1 OFDM downstream channels can have channel bandwidths between 24MHz and 192MHz. The bandwidth of the OFDM channel to be measured is entered via the menu item **BANDWIDTH**. This is necessary so that the channel filter of the receiver is switched correctly.

Tuning of the OFDM receiver
To tune the receiver, set the center frequency of the OFDM downstream channel (not the PLC frequency) via the frequency input mode. Alternatively, the corresponding D channel (D center frequency [MHz]) can be entered via a user-defined channel table.

If the receiver module was previously off, the FPGA of the module has to be configured after tuning. This takes a few seconds and can be followed by a progress bar in the graphic display.
Upon completion of the initialization, the real-time spectrum of the OFDM channel appears on the graphics screen.

OFDM-Parameter
As soon as the receiver has finished the synchronization process, the OFDM parameters FFT-order, Cyclic-Prefic (CP) (corresponding to the guard interval) and roll-off factor (RO) are shown in the display. The hint LOCK means that the demodulator has found all parameters, recognized the position of the PLC (Physical-Layer-Channel) and detected the preamble inside the PLC.

PLC-Decodierung
If the receiver is locked (LOCK), then the PLC data are evaluated. After a successful decoding of the PLC, the text "DOC31" in the top line of the display changes to "PLCOk". Now the receiver has all the information for the complete demodulation of the OFDM downstream channel.



7.2.2.6.2 Level measurement

PLC Level

The second display line (73.2 dBµV in the upper figure) shows the level of the PLC.
In this case, the power of all OFDM carriers in a 6 MHz window, where the PLC carriers are in the middle of that window, are summarized within the OFDM channel.
If no PLC is found (UNLK), the unit will display the level of a 6MHz window with it's center frequency is the centre frequency of the OFDM channel.

Channellevel

In the upper display line, the channel level appears next to the sum sign. When determining this measurement value, the power of all active OFDM carriers within the channel bandwidth is added.

7.2.2.6.3 MER measurement (Modulation Error Rate)

PLC-MER (MERp)

The OFDM carriers of the PLC are generally 16QAM modulated. In 4kFFT, the PLC consists of 8 ODFM carriers while in 8kFFT 16 carriers are used in the PLC. When measuring the MER, all data carriers of the PLC are used. For clarity, the display will show a "p" after "MER".

MER of single carriers and groups of carriers (MERc)

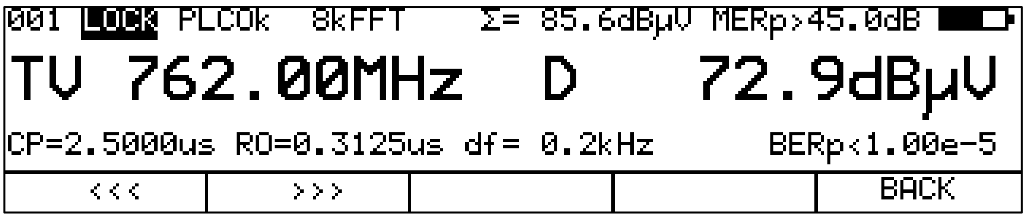
By entering a start and a stop index, the MER can be measured of individual carriers or carrier groups. A carrier group can comprise a maximum of 160 carriers at 4kFFT and 320 carriers at 8kFFT . This means the MER can be measured within a frequency window of 8MHz. This measurement is done in the mode constellation diagram.
See also the chapter 7.2.2.6.8 - Constellation diagram.

7.2.2.6.4 PLC-BER measurement (Bit Error Rate)

The data of the PLC (Physical Layer Channel) are encoded during transmission with the robust error protection LDPC (Low Density Parity Check). In addition there is a temporal scrambling of the bits.

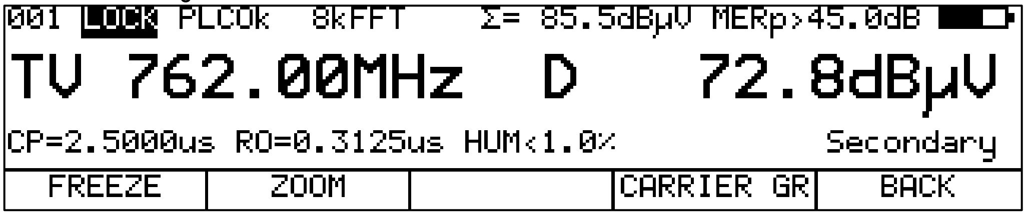
The receiver determines the bit error rate by comparing the bits before and after the error protection (LDPC) during PLC decoding.

The meter displays the bit error rate before LDPC (CBER) for the PLC, while the PLC information is displayed on the graphics screen. See chapter 7.2.2.6.12 - PLC-Info.



7.2.2.6.5 HUM measurement (amplitude hum)

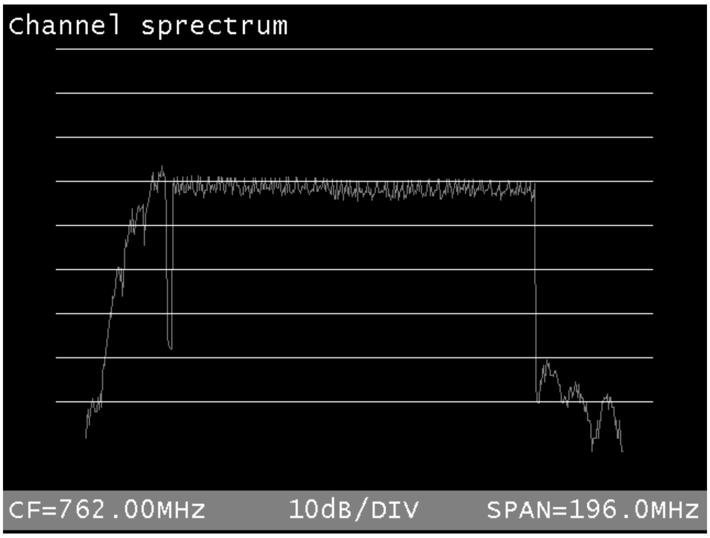
The meter can measure the amplitude HUM of the OFDM downstream signal. The measuring principle is explained in ETR290. The information is given in percent. The measuring range is from 1.0% to 5.0% with a resolution of 0.1%. The device displays the amplitude HUM in the display as soon as the constellation diagram of the PLC carrier group is called up. See chapter 7.2.2.6.8 - Constellation diagram.



7.2.2.6.6 Channel spectrum

After tuning to a new frequency, the meter displays the spectrum of the OFDM channel in real time. If the receiver can synchronize to a DOCSIS downstream OFDM signal, the area of the PLC is highlighted in green. As soon as the other PLC informations has been evaluated ("PLCOk" in the display), the device knows the exact channel bandwidth and excluded areas, if exists, in the spectrum (exclusion bands). These invalid carriers in the OFDM signal are displayed red in the spectrum. On the slopes of the channel filter, any existing adjacent ScQAM channels or OFDM channels can be recognized. See also figure below.

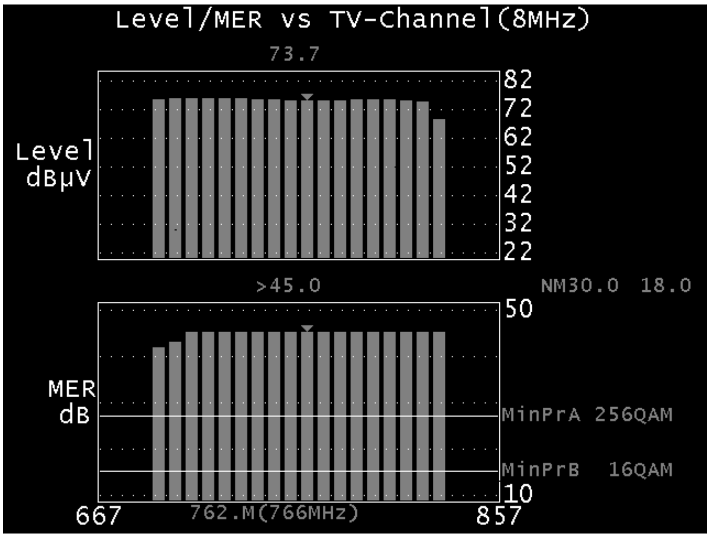
With **SPECTRUM** -> **FREEZE** the spectrum can be "frozen".



7.2.2.6.7 Level and MER over 8MHz channels

Since up to now mainly 8MHz channels (DVB-C, EuDOCSIS) have been used in the cable, the meter has a function in which the complete OFDM channel is divided into imaginary 8MHz channels. For each of the imaginary 8MHz channels, the device determines the level and the MER. This makes it easy to compare the single carrier QAM modulated channels with the rest of the cable spectrum. The graphics screen shows two bar graphs. In the upper diagram, the level is plotted in red and the MER on the lower one in green. The diagrams are updated cyclically. The data carriers of the OFDM channel can be individually modulated with up to 4096QAM (4kQAM). Each modulation scheme requires a minimum MER to properly decode the data after error protection. The unit displays the distance in dB (Noise-Margin NM) between the currently measured value and the threshold at the cursor.

This function is called up via the menu item **L/MER(Cha)**. Use the arrow keys ← or → to move the cursor between the 8MHz channels. The imaginary 8MHz channels are denoted by the center frequency of the OFDM channel in MHz as a prefix and followed by the letters A-X (e.g., 762.M (766MHz)). Behind it is still in parentheses the center frequency of the imaginary 8MHz channel itself. The transmission of the data in the DOCSIS3.1 downstream takes place via different profiles. These profiles determine which modulation scheme is used by the individual carriers of the OFDM signal. If the device has evaluated the PLC data, then the profiles and their modulations are known. The device supplements the MER diagram in the following picture with the corresponding thresholds. "MinPrB 1kQAM" means that in profile B a modulation scheme of 1024QAM is transmitted. The MER threshold at 1kQAM is 34dB. At the cursor position a reserve (Noise Margin NM) of 11dB can be seen.



7.2.2.6.8 Constellation diagram

Via the menu item CONST the constellation diagram is called up. As with DVB-C, this is a real-time representation.
The first call displays the constellation diagram of the PLC carriers. These are always modulated with 16QAM. At the same time, the MER of the PLC is determined and shown in the display after MERp. In this setting, the device additionally measures the hum on the OFDM signal. It´s measurement value is displayed as a percentual value.

As an alternative to the PLC carriers, the constellation diagram of all individual carriers or as a group of several individual carriers can be displayed within a frequency range of 8 MHz. For this, the start carrier index and the stop carrier index must be entered. The ↑/ ↓ arrow keys can be used to switch between the two input fields. Use the numeric keypad to enter a carrier index (e.g., 1000). In this setting, the device measures the MER via the set OFDM single carrier carriers. The measured value is shown in the display after MERc.

Via the menu item **CARRIER GR** -> **PLC** or **SELECT CAR** you can switch between the display PLC and single carrier.

Additional information can be found in the "Chapter 12 - Constellation diagram".

7.2.2.6.9 Impulse response

The Echo Display is called up via the menu item **IMPULSERES**. This is a real-time representation. The meter uses the Scattered Pilots to determine the channel frequency response. The receiver uses an inverse fourier transformation to calculate the impulse response and displays it in the graphic display. This function can be used to easily identify any faults in the cable transmission (e.g. cable breakage, bad contact, missing matching…).

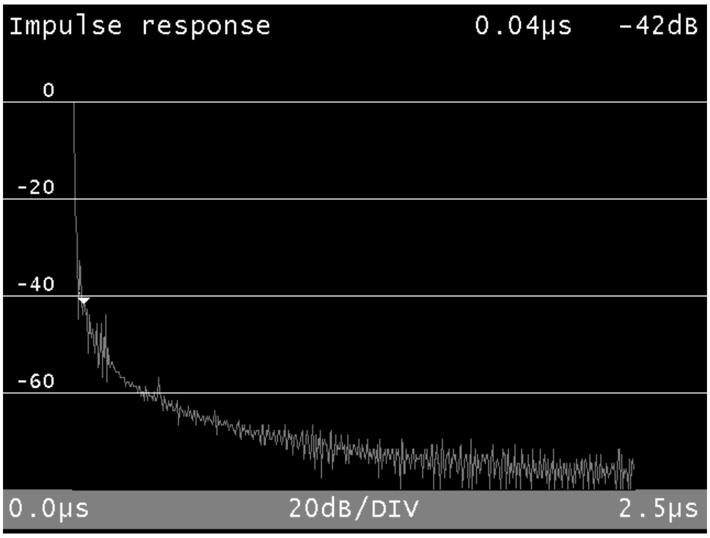
The area of the cyclic prefix (guard interval) is marked separately in the illustration.

You can “freeze” the picture using **FREEZE**. You can expand the impulse response in the horizontal direction using **ZOOM**. You can define the unit of the x-axis with **µs** or **km**. Time and length are related via the speed of light, c:=3•10^8 m/s and a medium (e.g. coax) depended shortening factor.
This shortening factor (Nominal Velocity of Propagation NVP) indicates the factor by which the electromagnetic wave propagates more slowly on a coaxial cable than in air. A value of 0.85 is set here by default. This can be changed by the user. To do this, select the menu item **UNIT**-> **NVP**.

The DOCSIS standard describes the permissible echoes for OFDM transmission. Using the **MASK** menu item you can display a step profile above the echo representation that describes these limits.

Peak-Search Function
While the impulse response is built up, the instrument determines the four highest secondary impulses apart from the main impulse. If there are echoes, the cursor moves to the highest secondary impulse after the second cycle. By pressing the keys ↑ and ↓ the cursor may be moved to further echoes cyclically one after the other. The distance and/or the delay compared to the main impulse can be taken from the readings in the header of the diagram.

With the keys ← or → the cursor can be moved continuously in x-direction.



You can end the display of the impulse response via the menu item **BACK**.

7.2.2.6.10 Frequency response

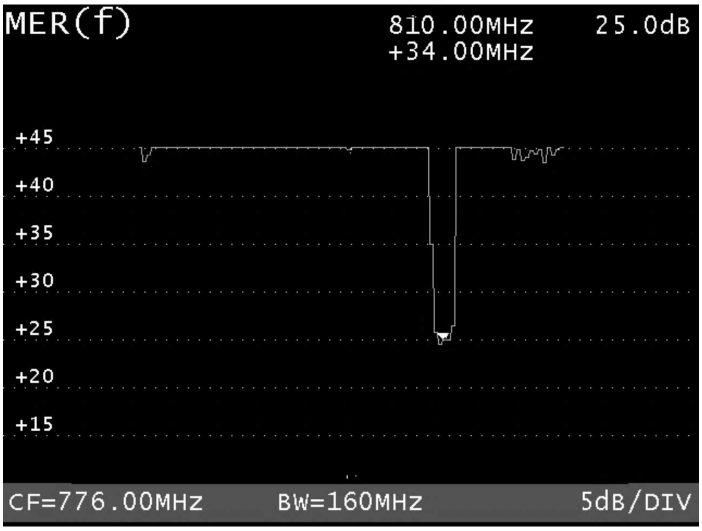
Via the menu item **FREQRESP**, the real-time representation of the amplitude frequency response of the OFDM spectrum is called. This makes it easy to determine tilt, undulations etc. Use the arrow keys ← and → to move the cursor within the channel bandwidth. At the cursor position, the relative amplitude deviation, the absolute frequency and the frequency relative to the channel center frequency are displayed.
You can “freeze” the picture using **FREEZE**. Via the menu point **BACK** you can end the display of the frequency response.

7.2.2.6.11 MER over frequency

This function is called up via the menu item **MER(f)** .In this representation, the MER is calculated for each OFDM single carrier and plotted against the frequency. This makes it possible to identify disturbers (ingress, for example, from LTE or DVB-T2). Where a disturber occurs, the MER breaks down.

Use the arrow keys ← or → to move the cursor within the channel bandwidth. The cursor position displays the MER, the absolute frequency and the frequency relative to the channel center frequency.

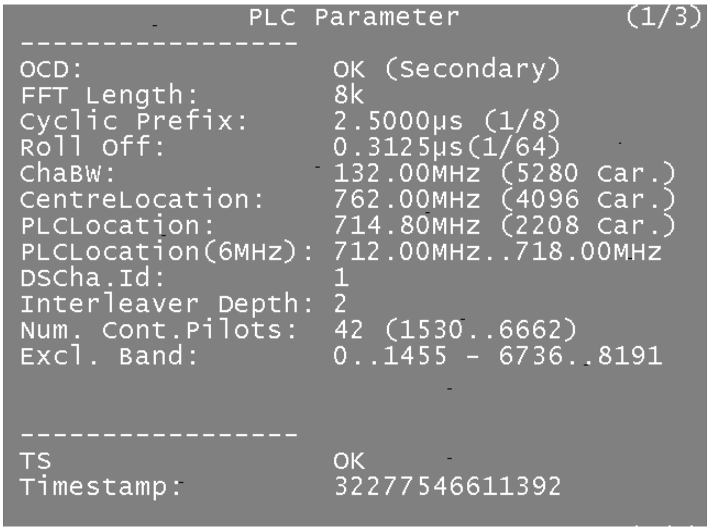
The following figure shows an MER (f) diagram in which a DVB-T2 transmitter interferes with the OFDM signal at 810 MHz due to ingress.



You can "freeze" the picture using **FREEZE**. Via the menu point **BACK** you can end the display of the MER over frequency.

7.2.2.6.12 PLC-Info

The measuring device decodes the data of the PLC (Physical-Layer-Channel) and displays the information separately according to OCD (OFDM Channel Descriptor), TS (Timestamp) and DPD (Downstream Profile Descriptor) on the graphic display. By selecting the menu item **PLC-INFO** the device displays the information on the graphics screen in the form of a list. The list comprises several pages, which can be changed with the ← or → keys.
The OCD information contains all the information the OFDM receiver needs to demodulate the signal. The timestamp is a 64-bit counter used for clock synchronization between CMTS and cable modem. The DPD messages contain information about the downstream profiles used. The meter evaluates the first 4 profiles.
Via the menu item **BACK** the display of the PLC parameters can be leaved.

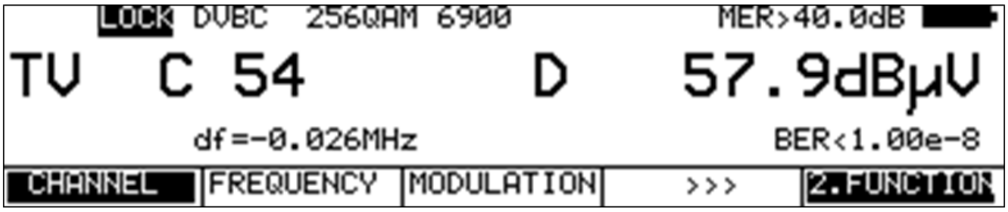


7.2.2.6.13 Primary/secondary downstream signaling

As soon as the receiver has evaluated the PLC information (PLCOk), the message "Primary" or "Secondary" appears in the bottom line of the display. For Primary, the downstream channel contains all the information needed for a cable modem to log in through this channel.

7.3 Measuring the frequency offset

The measuring instrument measures the frequency offset between the receiver and the received signal. It is displayed in MHz with a resolution of 10 kHz for ATV and 1 kHz for DVB-C, DVB-T/T2 and DOCSIS ScQAM. It is displayed in kHz with a resolution of 100Hz for DOCSIS OFDM downstream.
The user can choose not to have the frequency offset displayed. By default, the offset is not displayed. To activate it, the following steps must be performed.
First press the **HOME** key, then select the **MEAS.SETT.** menu item. The display of the frequency offset can be activated using the **FRQ.OFFSET** key.
The menu item is displayed inverted when active. The next time the receiver is tuned, the measuring instrument displays the frequency offset below the frequency/channel display.
The user can set whether to deactivate the display independently for ATV, DVB-C, DVB-T/T2 and DOCSIS. It must also be separately enabled for each individual reception mode.
In the case of remote control via SNMP, the frequency offset can be read out even if the display is deactivated.
The sign in front of the value is determined by the following relationship: $f_{IN} = f_{AMA} + df$.



In the example above, the measuring instrument receives a DVB-C signal with a carrier frequency that is 27 kHz below the normal center frequency of channel C54 (738 MHz).
The frequency offset is displayed inverted once the deviation is greater than 30 kHz.

Note! **This feature is only available with the appropriate hardware. If the instrument is not properly equipped, the FRQ.OFFSET menu item is absent.**

7.4 Level measurement

After the measuring receiver is tuned, the automatic attenuation control and level measurement starts.
The level measured is indicated on the right side of the display in dBµV with 0.1 dB resolution.
The measuring range spans from 20 to 120 dBµV. The measuring bandwidth is adjusted to the channel bandwidth of the signal measured. The measurement repetition rate is approx. 3 Hz.

7.4.1 Acoustic level trend

If when lining up an antenna, for example, no line of sight exists to the measuring instrument, you can switch on an acoustic level trend signal. A sound signal is emitted from the loudspeaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and vice versa. The measurement repetition rate is approx. 10 Hz.
The sound signal can be switched on and off via the menu item **ACOU. LEVEL**.
When the sound signal is switched on, the menu item is displayed inverted.

7.4.2 Level measurement with analog TV (ATV)

With ATV, the peak value of the video carrier is measured. This coincides in time with the line sync pulse.
The level of the currently set sound carrier (see above) is measured and displayed relative to the video carrier level (e.g. –13.0 dB).

7.4.3 Level measurement with DVB-C, DVB-T/T2 or DOCSIS

With DVB-C, DVB-T and DOCSIS, the spectra of the signals have characteristics similar to noise. The signal energy is spread over the entire channel bandwidth. The measuring receiver uses its measuring bandwidth to measure the level in the channel center and extrapolates the channel bandwidth using the bandwidth formula.
The measuring bandwidth is adjusted to the current channel bandwidth.

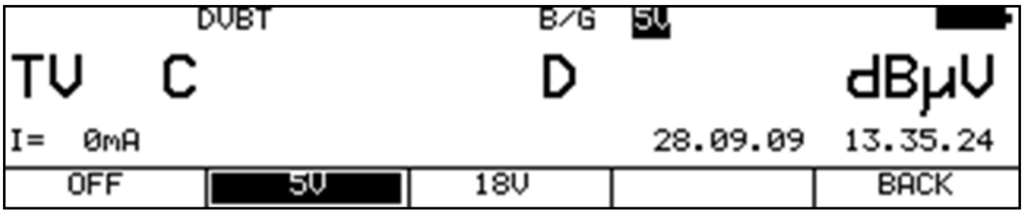
7.5 Remote supply

The measuring receiver can provide a remote power supply via the RF input socket; this can provide power for an active receiving antenna, for example. You may choose between 5 V, 18 V and no remote supply. The supply is short circuit-proof and provides a maximum current of 500 mA. The instrument automatically switches off the remote supply if there is a short circuit or if the current is too high.
The red LED on the RF input socket lights up as soon as the remote supply is active.

Important! **Before switching on a remote supply, always check the compatibility of the connected system with the selected remote supply. Otherwise, terminating resistors may be overloaded or active components may be destroyed.**

7.5.1 Setting the remote supply

Press **LNB** to open the selection menu. You may select the available voltages (0V, 5 V and 18 V) using the function keys **F1**, **F2** and **F3**.



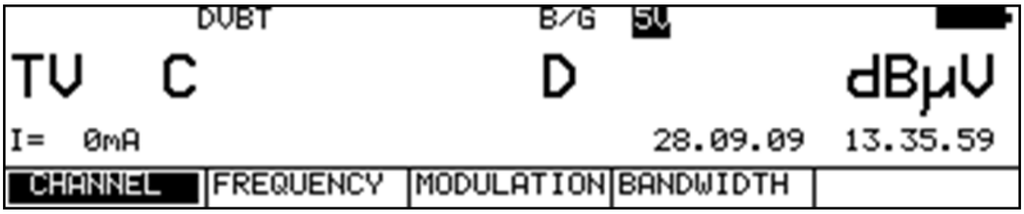
7.5.2 Changing the fixed remote supply voltages

Two fixed voltages (5 V and 18 V) are set ex-works for the remote supply.

In order to adjust the voltage according to the requirements of the active components that are supplied, each of the two voltages can be changed independently of one another from 5 V to 20 V. For this, one of the two voltages must first be activated. By pressing the LNB key again, the instrument can be set to the state as shown above.
The voltage can be changed here in 1 V increments using the ↑ and ↓ keys. The setting is non-volatile.

7.5.3 Measuring the remote supply current

For this, you must bring the measuring instrument into the default status in the TV range. You can do this by pressing the **HOME** key. If an LNB supply is activated, the measuring receiver measures the amount of DC current flowing from the RF input socket (e.g. to supply an active antenna) and displays the amperage in mA on the left edge of the display. The measuring range spans from 0 500 mA with a resolution of 1 mA.



In the above example, a current of 0 mA is measured with a 5 V remote supply.
If the measuring receiver is tuned, the current indicator disappears from the display.

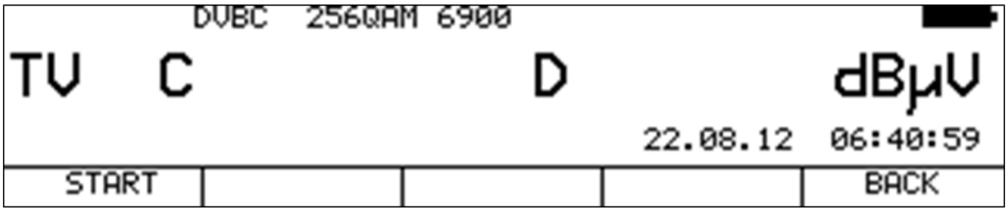
7.6 Blind Scan

This function can be used to determine the channel configuration in an unknown cable network. The measuring receiver scans the specified frequency range for ATV, DVB-C and DOCSIS signals. The instrument creates a channel list, which is displayed on the TFT during the scan. Once the function is complete, the list can be printed, saved as a CSV file or exported as a CHA file. The latter file format can then be further edited in the PC software AMA Remote and imported into the instrument as a user-defined channel table.

Note! This feature is only available with appropriate hardware.

7.6.1 Starting a new scan

Via **MODE** -> **BLINDSCAN** you can access the following menu.



Selecting the **START** menu item brings up the following entry field.

Here you can set the parameters for the scan.

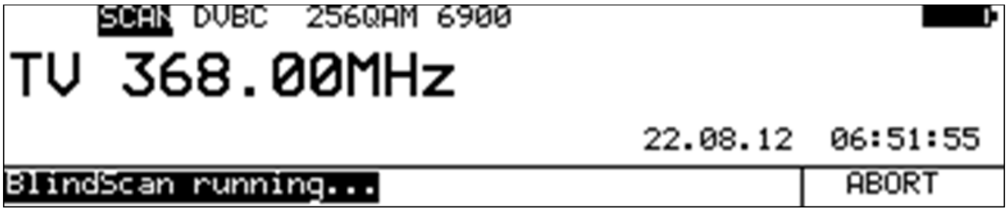
You can move the cursor to the individual entry fields using the ← and → keys. You can specify the upper and lower limits for the scan next to the fields **Starting at** and **Stopping at**. The entire TV range can be used.
Using the **F1**-**F4** soft keys, you can select which signals to include in the scan. To start the function, move the cursor to “APPLY” and then press the **ENTER** key.

In the figure above, the instrument is set to perform a scan from 109 to 868 MHz. The minimum measurement increment is always 250 kHz. The measuring receiver will search for analog TV programs and for DVB-C, EURO and USDOCSIS channels.

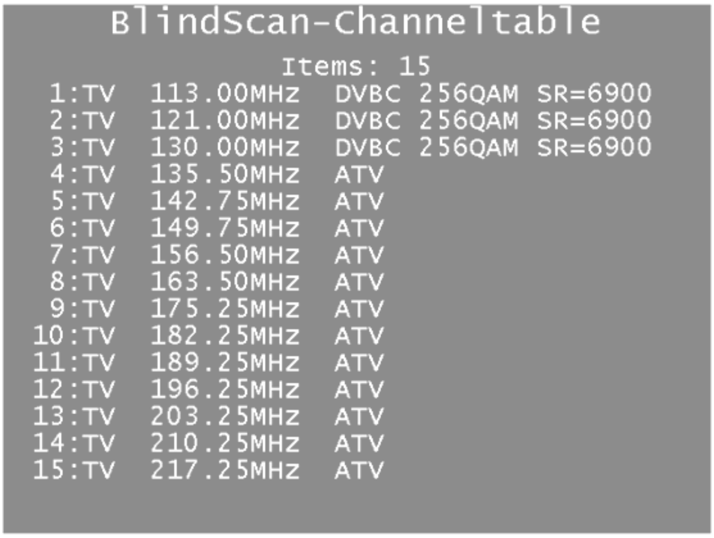
For DVB-C, the common symbol rates of 6,875 kBd and 6,900 kBd are measured with the modulation schemes 64QAM and 256QAM. For DOCSIS, 64QAM and 256QAM are used. The symbol rate is permanently coupled to the modulation.

7.6.2 Aborting a scan manually

You can follow the progress as the instrument carries out the function.



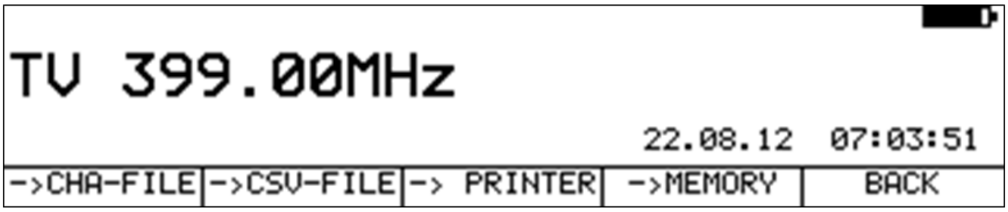
The scan can be aborted at any time using the **F5** key. After a manual abort, the channel list determined up to that point remains available for further processing.
The following figure shows a list as it is displayed on the TFT of the instrument.



7.6.3 Exporting the channel list

Once the function is ended (either regularly or manually), the list determined by the instrument is available for further processing. The instrument presents you with the options below.

Selecting the **EXPORT** menu item displays the following menu.



The **->CHA-FILE** menu item allows the list to be exported as a user-defined channel list (see "Chapter 20.14 - User-defined channel table for TV"). The instrument numbers the channels consecutively starting with C1. This can be easily adjusted using the “AMA Remote” PC software. This channel table can then be re-imported into the instrument.
This is particularly useful when a cable system has a frequency configuration that does not correspond to a standard channel table. This is necessary because special functions, such as the TILT measurement, require a suitable channel table.

The **->CSV-FILE** menu item allows the list to be saved in CSV format. This is primarily used for documentation purposes.

The **->PRINTER** menu item causes the instrument to print the list of channels on the instrument’s internal printer.

Chapter 8 FM (VHF) Measuring Range

You activate the FM (VHF) range via **RANGE** -> FM. The measuring receiver has its own VHF tuner. This features better performance in relation to definition and intermodulation in comparison with measuring instruments that use the TV tuner for VHF reception.
The frequency range spans 87.4 - 108.2 MHz.

8.1 Frequency input

You can enter a frequency between 87.40 and 108.20 MHz using the numeric keypad.
Here the smallest frequency resolution is 0.01 MHz (10 kHz). You use the **ENTER** key to confirm the entry. Invalid entries are ignored.

Frequency detuning
If the measuring receiver is tuned, you can carry out a frequency detuning in the 10 kHz grid using the ← and → keys.

8.2 Sound reproduction

The measuring instrument's VHF stereo receiver demodulates a received VHF signal and reproduces the audio signal using the built-in loudspeaker. In the case of stereo transmission, the signal of the left sound path is output on the loudspeaker. Both sound paths (L and R) are always present at the SCART socket.

8.3 Stereo indicator

The stereo decoder of the VHF receiver evaluates the 19 kHz pilot signal. If a pilot is present, **STEREO** appears in the top line; **MONO** is otherwise displayed.

8.4 RDS (Radio Data System)

RDS is the counterpart to videotext for TV. In addition to audio signals, additional data are transmitted. These are modulated up to a 57 kHz subcarrier in PSK (Phase Shift Keying). The RDS specification comes from the standard EN50067.
These data are sent in what are referred to as groups. Every group transmits different information.

The repetition rate of every group also differs.
The measuring receiver evaluates only the groups of type 0A, 0B, 2A and 2B. Groups 0A or 0B make up approx. 40% of the total data. The proportion with groups 2A and 2B is only 15%. Among other data, the program name is transmitted with a maximum of 8 characters in groups 0A and 0B. Groups 2A and 2B transmit the radiotext with up to 64 characters.

The program name (“Bayern 3” [Bavaria 3]) is shown in the top line of the display. In addition to the program name, the PI (Program Identification) code is shown in the top line of the display. The PI code is used as unique identification of the radio program.
The radiotext (“Internet: www.bayern3.de”) appears as scrolling text in the line above the menu bar.

8.5 Scan

You can use this function to scan the entire range (87.40 - 108.20 MHz) for VHF broadcast signals. You start the scan by first tuning the measuring receiver to a frequency at which the scan should begin.

Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.

8.6 Level measurement

As soon as the instrument is tuned to a frequency, it begins to measure the level and displays the measured value in dBμV. The measuring range is from 20 to 120 dBμV with a resolution of 0.1 dB. The measuring rate for the numerical level value is approx. 3 Hz.

8.6.1 Acoustic level trend

When no line of sight to the measuring instrument exists while lining up an antenna, an acoustic level trend signal can be switched on. A sound signal is emitted from the loudspeaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and vice versa. The measurement repetition rate is approx. 10Hz.
The sound signal can be switched on and off via the menu item **ACOU. LEVEL**.
When the sound signal is switched on, the menu item is displayed inverted.

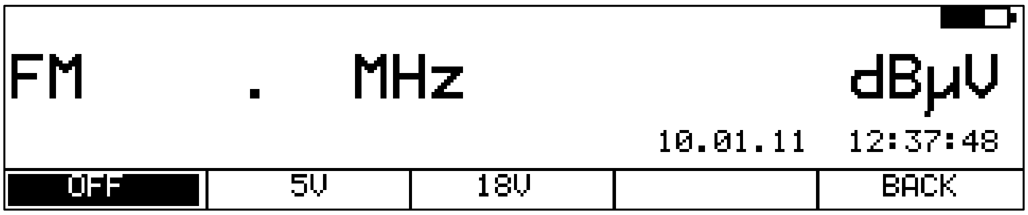
8.7 Remote supply

The measuring receiver can provide a remote power supply via the RF input socket; this can provide power for an active receiving antenna, for example. You may choose between 5 V, 18 V and no remote supply. The supply is short circuit-proof and provides a maximum current of 500 mA. The instrument automatically switches off the remote supply if there is a short circuit or if the current is too high.
The red LED on the RF input socket lights up as soon as the remote supply is active.

Important! Before switching on a remote supply, always check the compatibility of the connected system with the selected remote supply. Otherwise, terminating resistors may be overloaded or active components may be destroyed.

8.7.1 Setting the remote supply

Press **LNB** to open the selection menu. You may select the available voltages (0 V, 5 V and 18 V) using the function keys **F1**, **F2** and **F3**.



8.7.2 Changing the fixed remote supply voltages

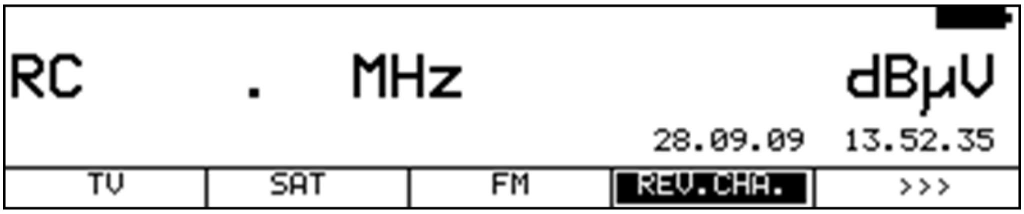
Two fixed voltages (5 V and 18 V) are set ex-works for the remote supply.
In order to adjust the voltage according to the requirements of the active components that are supplied, each of the two voltages can be changed independently of one another from 5 V to 20 V.
For this, one of the two voltages must first be activated. By pressing the **LNB** key again, the instrument can be set to the state as shown above.
The voltage can be changed here in 1V increments using the ↑ and ↓ keys. The setting is non-volatile.

8.7.3 Measuring the remote supply current

For this, you must bring the measuring instrument into the default status in the TV range. You can do this by pressing the **HOME** key. If an LNB supply is activated, the measuring receiver measures the amount of DC current flowing from the RF input socket (e.g. to supply an active antenna) and displays the amperage in mA on the left edge of the display. The measuring range spans from 0 - 500 mA with a resolution of 1 mA.

Chapter 9 RC (Return Channel) Measuring Range

You access the RC range via **RANGE** -> **REV.CHA.**.



9.1 Frequency input

You can enter a frequency between 5.00 and 65.00 MHz using the numeric keypad.
Here the smallest frequency resolution is 0.05 MHz (50 kHz). You use the **ENTER** key to confirm the entry. Invalid entries are ignored.

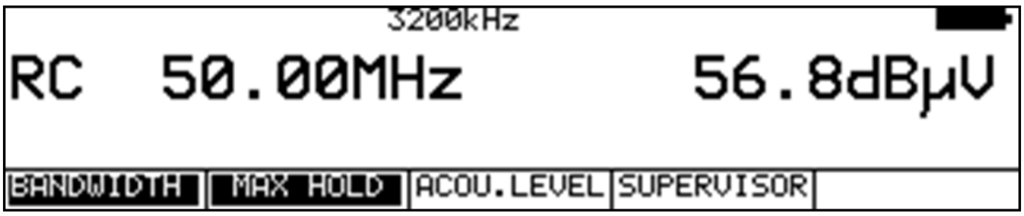
Frequency detuning
If the measuring receiver is tuned, you can carry out a frequency detuning in the 50 kHz grid using the ← and → keys.

9.2 Level measurement

As soon as the instrument is tuned to a frequency, it begins to measure the level and displays the measured value in dBµV. The measuring range is from 20 to 110 dBµV with a resolution of 0.1 dB. The measuring rate for the numerical level value is approx. 3 Hz.

9.2.1 Max hold function

The usable signal on the return path of a cable system is generated by the active (online) cable modem. According to the cluster size of a network, the cable modem can transmit more or fewer frequencies. The registered cable modem may only transmit in certain short time slots. Therefore, the maximum level for a frequency may only be present for a short amount of time.
For this reason, a max hold function can be switched on in the measuring instrument. Here the maximum level is saved, starting from the point in time of activation. This indicator only changes when an even higher level exists temporarily. This function can be switched on and off via the menu item **MAX HOLD**. If the max hold function is active the menu item is displayed inverted.

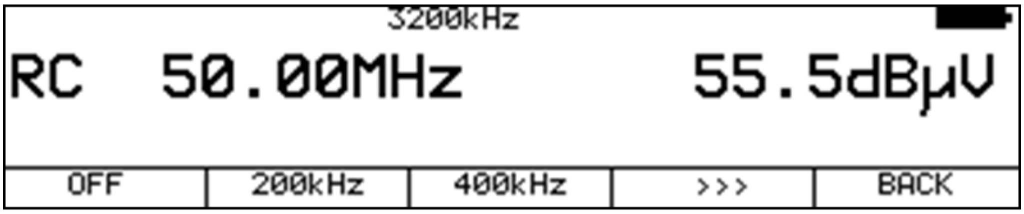


9.2.2 Setting the channel bandwidth

Cable modems transmit in bursts with the modulation types QPSK or QAM. Because every active cable modem is assigned to only certain time slots, it can only transmit briefly. This means that a short burst is generated in QPSK or QAM.

In order to precisely measure the level in the return path, the measuring instrument must know the channel bandwidth of the return path signal. In the DOCSIS standard, Bandwidths are set to 200 kHz, 400 kHz, 800 kHz, 1.6 MHz, 3.2 MHz and 6.4 MHz. They correspond to the symbol rates used: 160 kBd, 320 kBd, 640 kBd, 1,280 kBd, 2,560 kBd and 5,120 kBd. This setting can be carried out via the menu item **BANDWIDTH**.

If one of the bandwidths is activated, the instrument adjusts its measuring bandwidth to the channel bandwidth automatically. It also carries out a level correction in relation to the set channel bandwidth.



Using the menu item **BANDWIDTH** -> **OFF**, you can switch off adjustment to the channel bandwidth. Now the instrument measures with a measuring bandwidth of 1 MHz. This setting should be implemented if a comb generator (sinusoidal signal) or a noise generator is used as the signal source. This is also the instrument's default setting. The channel bandwidth setting is stored in non-volatile memory. This position is also incorporated in the tuning memory.

9.2.3 Setting reception mode (only with the relevant hardware configuration)

This feature can be used to switch the measuring instrument to DVB-C, J83B or PRBS modes in the return channel range. The measuring options available for the forward path are also available in this case. The instrument evaluates MER, BER, Phase jitter (PJ), amplitude hum (HUM) and PE (packet error). The constellation diagram can also be opened. Monitoring and recording modes (DATAGRABBER) can also be activated. In PRBS mode, the instrument operates in conjunction with the upstream generator from the manufacturer. This generates a QAM signal with a pseudorandom data sequence. It is not possible to evaluate packet errors (PE) here.

With the factory settings, the frequency offset will not be displayed. To activate it, the following steps must be performed. First press the **HOME** key, then select the **MEAS.SETT.** menu item. The display of the frequency offset can then be activated using the **FRQ.OFFSET** key (see also "Chapter 0 - ").

You can activate measurement of the phase jitter and hum by adjusting the receiver's settings. Use the **REC.SETTG** menu item to change these settings. More information is available under "Chapter 7.2.2.1 - DVB-C" in the TV measuring range section.

When using these operating modes, it is possible to test the return path under real conditions (cable modems send QAM signals on the return path) with the aid of an upstream modulator (QAM modulator). Ingress can be seen in the MER, BER and the constellation diagram. The DATAGRABBER can also be used to take long-term measurements. For more information, see the application note "AN005 – Return path measurement with upstream generator". You can find this on the homepage of www.kws-electronic.de under "SUPPORT" –> "Application notes".

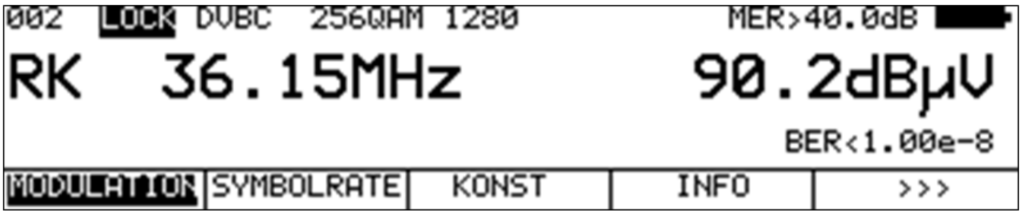
The four settings with which the receiver can be operated in the return path are listed again below:

- Modulation off: In this mode, the instrument behaves in the same way as for the "Bandwidth OFF" setting (see "Chapter 9.2.2 - Setting the channel bandwidth"). This setting should be implemented if a comb generator (sinusoidal signal) or a noise generator is used as the signal source.

- DVB-C: The receiver operates in DVB-C mode. Symbol rates and modulation schemes can be set in the same manner as for the forward path. A DVB-C generator is required as the signal source.
- J83B: The receiver operates in J83B mode. The parameters can be changed in the same manner as for USDOCSIS in the forward path. A QAM modulator with J83B FEC is required for this.
- PRBS: The receiver operates in PRBS mode. Symbol rates and modulation schemes can be set in accordance with the generator settings.

In PRBS operating mode, the depth of the bit error rate measurement is set between $1.00 \cdot 10^{-6}$ and $1.00 \cdot 10^{-8}$ depending on the data rate (i.e. depending on the QAM mode and symbol rate) so that the measurement time (and therefore the update rate) is no greater than 2 seconds.

Use the menu items **MODULATION** -> **OFF**, **DVB-C**, **J83-B** or **PRBS** to set the relevant operating mode.



The bandwidth settings, as described in the "Chapter 9.2.2 - Setting the channel bandwidth", can be made by setting the instrument to DVB-C reception and entering the symbol rate that corresponds to the bandwidth.

9.2.4 Acoustic level trend

When no line of sight to the measuring instrument exists during line-up, an acoustic level trend signal can be switched on. A sound signal is emitted from the loudspeaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and vice versa. The measurement repetition rate is approx. 10 Hz.
The sound signal can be switched on and off via the menu item **ACOU. LEVEL**.
When the sound signal is switched on, the menu item is displayed inverted.

9.3 Remote supply

The measuring receiver can provide a remote power supply via the RF input socket; this can provide power for a receiving antenna, for example. You may choose between 5 V, 18 V and no remote supply. The supply is short circuit-proof and provides a maximum current of 500 mA. The instrument automatically switches off the remote supply if there is a short circuit or if the current is too high.
The red LED on the RF input socket lights up as soon as the remote supply is active.

Important! **Before switching on a remote supply, always check the compatibility of the connected system with the selected remote supply. Otherwise, terminating resistors may be overloaded or active components may be destroyed.**

9.3.1 Setting the remote supply

Press **LNB** to open the selection menu. You may select the available voltages (0 V, 5 V and 18 V) using the function keys **F1**, **F2** and **F3**.

9.3.2 Changing the fixed remote supply voltages

Two fixed voltages (14 V and18 V) are set ex-works for the remote supply.
In order to adjust the voltage according to the requirements of the active components that are supplied, each of the two voltages can be changed independently of one another from 5 V to 20 V. For this, one of the two voltages must first be activated. By pressing the **LNB** key again, the menu for setting the supplies is called up again.
The voltage can now be changed in 1 V increments using the ↑ and ↓ keys. The setting is non-volatile.

9.3.3 Measuring the remote supply current

For this, you must bring the measuring instrument into the default status in the TV range. You can do this by pressing the **HOME** key. If an LNB supply is activated, the measuring receiver measures the amount of DC current flowing from the RF input socket (e.g. to supply an amplifier) and displays the amperage in mA on the left edge of the display. The measuring range spans from 0 - 500 mA with a resolution of 1 mA.

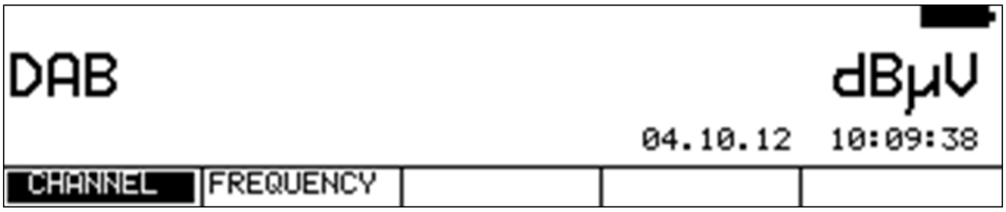
9.4 Headend Mode

This operating mode includes several features that are designed for stationary operation of the instrument at a head end. In receiver mode, the contents of the display are also shown on the graphics screen.
This provides the option of transmitting the video signal of the graphic to an analog or digital modulator via SCART and then feeding it into the cable system on the forward path. The manufacturer's upstream generator can be set to transmit on the return path and allow the instrument's graphics screen to be shown at the head end. This means that the return path to the head end can be measured at the subscriber socket. Users can view the results of the measurement and the real-time constellation diagram "live" on the screen of the upstream generator.
The graphics screen of the RC analyzer features 4 markers, which can, for example, be set on the four possible upstream frequencies for the upstream generator. If the frequencies are evenly distributed throughout the RC range, they can be used to make a tilt analysis of the transmission link from the subscriber terminal to the head end.

This approach can also be used to "level" the return amplifier.
The marker setting process is described in the "Chapter 19 - Spectrum Analyzer".
Use the **HEADENDMOD** menu item to switch the instrument to head end mode. The setting is non-volatile.

Chapter 10 DAB Measuring Range

DAB stands for “Digital Audio Broadcasting”. The measuring receiver can demodulate both DAB and DAB+ modulated signals and decode the FIC (Fast Information Channel) and MSC (Main Service Channel) information contained within.
You access the DAB range via **RANGE** -> **DAB**.
This range spans the frequency range from 170.00 to 250.00 MHz.



10.1 Switching between frequency and channel input

The instrument can be tuned by entering the channel center frequency or by entering the channel. You can switch between modes using the menu items **CHANNEL** or **FREQUENCY**. After selection, the corresponding menu item is displayed inverted.

10.1.1 Frequency input

Using the numeric keypad, you can enter a frequency between 170.00 and 250.00 MHz. The smallest frequency resolution is 0.05 MHz (50 kHz). Use the **ENTER** key to confirm the entry. Invalid entries are ignored.

Frequency detuning:

If the measuring receiver is tuned, you can carry out frequency detuning in 50 kHz increments using the ← and → keys.

10.1.2 Channel input

A channel table stored in the instrument serves as the basis for channel input. The table contains a center frequency for each channel.
The DAB channel grid is derived from the original TV channel grid in the VHF range.
A DAB channel has a bandwidth of 1.75 MHz. A maximum of 4 DAB channels can therefore share an original 7 MHz channel. This fact must be taken into account in the numbering of DAB channels in the VHF range (mode I). The channel with the lowest frequency receives a channel number with the index “A”, and the next 3 channels receive the indices “B”, “C” and “D”. Channel 13 is a special case, where the DAB channels are defined as 13E and 13F. The complete channel table is provided in the appendix of these instructions.

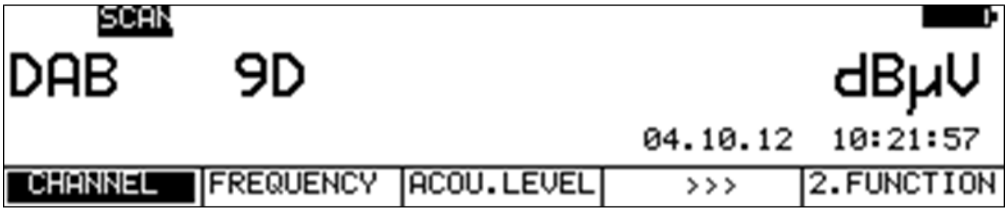
You can enter the desired channel number using the numeric keypad. The channel index (“A”-“F”) can be entered using keys 1 (for “A”) to 6 (for “F”). Use the **ENTER** key to confirm the entry. Invalid entries are ignored.

If the measuring receiver is tuned, you can set the previous or next channel using the ← and → keys. In this way, you can key in the channels one by one.

10.2 Scan

You can use this function to scan the entire range for DAB/DAB+ signals. For this, you must switch the instrument to channel input mode.
In the DAB operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted.
That means that the MPEG decoder can be operated with the arrow keys.
To start the scan, first press the **F5** key in order to activate the first function of the arrow keys.

The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the ↑ key to start the scan in the positive direction. Press the ↓ key to do the same in the negative direction. When the band limit is reached, the scan continues at the other end of the range. You can end the scan at any time by pressing **ENTER**. “SCAN” is shown on the display while the scan takes place.



10.3 Level measurement

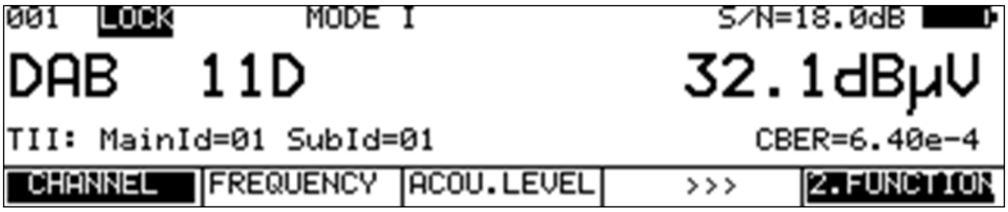
After the measuring receiver is tuned, the automatic attenuation control and level measurement starts.
The spectra of the signals for DAB have characteristics similar to noise.
The signal energy is spread over the entire channel bandwidth. The measuring receiver uses its measuring bandwidth to measure the level in the channel center and extrapolates the channel bandwidth using the bandwidth formula.
The level measured is indicated on the right side of the display in dBμV with 0.1 dB resolution.
The measuring range extends from 20 to 120 dBμV. The measuring bandwidth is adjusted to the channel bandwidth of the signal measured. The measurement repetition rate is approx. 3 Hz.

10.3.1 Acoustic level trend

When no line of sight to the measuring instrument exists while lining up an antenna, an acoustic level trend signal can be switched on. In this case, an acoustic signal is emitted from the speaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and vice versa. The measurement repetition rate is approx. 10 Hz.
The acoustic signal can be switched on and off via the menu item **ACOU.LEVEL**.
When the acoustic signal is switched on, the menu item is displayed inverted.

10.4 DAB parameters

As soon as the receiver has completed the synchronization process, several parameters are shown on the display. When LOCK appears, it means that the digital receiver is receiving a valid data stream. In contrast, UNLK means that either the quality of the signal that is present is insufficient or that no DAB signal is received at this frequency.



Once the receiver is synchronized, additional parameters are shown on the display. The DAB receiver determines these automatically.

4 different modes are defined for DAB. Mode I is intended for transmission in the VHF range. The other 3 modes are reserved for transmission in the L band.

Station ID: A station ID is also transmitted in DAB. This
TII (Transmitter Identification Information) is transmitted in the first DAB symbol (zero symbol).
Each DAB station transmits its own unique Main ID and Sub ID. These numbers allow a station to be uniquely identified in a single-frequency network. This is unlike in DVB-T, where each station in a cluster transmits the same station ID.

10.5 BER measurement (Bit Error Rate)

The measurement of the bit error rate aids in the determination of the quality of a DAB signal.
To determine the bit error rate, the error correction mechanisms in the digital receiver are used. The data stream is compared before and after correction, and the number of corrected bits is determined from this. This number is placed in a ratio to the total throughput of bits, and the BER is calculated based on this.

In DAB, the FEC (Forward Error Correction) consists of convolutional coding. In the DAB receiver, the decoding is performed by a Viterbi decoder. In DAB, the various symbols in the DAB frame can be protected against errors in different ways. In this way, information components can be transmitted more or less robustly.

To determine the bit error rate, the measuring receiver evaluates the corrected bits in the MSC (Main Service Channel).
Once the receiver has locked in on a DAB signal, the BER is shown on the display in exponential form. The displayed CBER is the BER before Viterbi of the MSC. This is the channel bit error rate.
The depth of measurement is $1 \cdot 10^6$ bits.

10.6 Subchannel BER measurement on DAB+

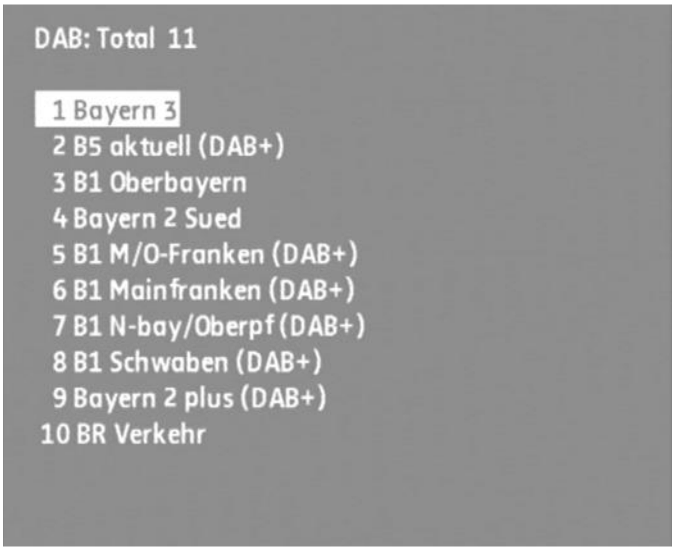
DAB services are transmitted on subchannels within the MSC (Main Service Channel). On DAB+ audio is coded with HE-AAC and each service is additionally protected with a Reed Solomon block code. The DAB+ receiver can measure the bits corrected by the Reed Solomon decoder and calculates the VBER (BER after Viterbi). As each subchannel (service) has its own block code the VBER can only be measured for the service actually running. So before you can measure the VBER of a subchannel you have to select one service in the program list (see “Chapter 10.9 MSC Decoding and audio playback).
The depth of measurement is $1 \cdot 10^5$ bits.

10.7 MER measurement (Modulation Error Rate)

In addition to measurement of the bit error rate, it is established practice with digital transmission to also measure MER. It is defined in ETR290, e.g. for DVB-T, and can be applied to DAB in a similar manner. MER is calculated from the DQPSK constellation points.
It is the counterpart to S/N measurement with analog transmission methods. The measuring range extends up to 25 dB with a resolution of 0.1 dB.

10.8 FIC decoding

Once the measuring receiver has locked in on a DAB signal, the DAB frame is analyzed. The data of the FIC (Fast Information Channel) are then analyzed. This contains information on the composition of the ensemble. For DVB, this corresponds to evaluation of PAT, PMT and SDT. The instrument then creates a program list and displays this on the TFT. This is performed in a similar manner as for DVB (see "Chapter 11 - MPEG Decoder").



The decoder lists the names of all audio programs contained in the ensemble.
Pure data streams are not included. DAB+ programs receive an additional label. If the list comprises multiple pages, you can switch between pages of the program list using the ← and → keys.

10.9 MSC decoding and audio playback

You can play a program from the list by moving the cursor onto the desired program name using the ↑ and ↓ keys.

When **ENTER** is pressed once, the decoder lists the corresponding program details.

This includes the program name, program provider, service ID, DAB type and the audio data rate of the particular program. The example above is for a DAB+ program with 80 kbit/s.
Pressing **ENTER** again starts audio playback and the sound can be monitored using the internal speakers or the headphone jack. Pressing **ENTER** again stops playback of the current program, and the program list again appears on the screen.

10.10 Remote supply

The measuring receiver can provide a remote power supply via the RF input; for example, this may provide power for an active receiving antenna. You may choose between 5 V, 18 V and no remote supply.
The supply is short circuit-proof and provides a maximum current of 500 mA. The instrument automatically switches off the remote supply if there is a short circuit or if the current is too high. The red LED on the RF input lights up as soon as the remote supply is active.

Important! Always check that the connected system is compatible with the selected remote supply before switching on the remote supply. Otherwise, terminating resistors may be overloaded or active components may be destroyed.

10.10.1 Setting the remote supply

Press **LNB** to open the selection menu. You may select from the available voltages (0V, 5V and 18V) using the function keys **F1**, **F2** and **F3**.

10.10.2 Changing the fixed remote supply voltages

Two fixed voltages (5 V and 18 V) are set ex-works for the remote supply.
In order to adjust the voltage according to the requirements of the active components to be supplied, each of the two voltages can be changed independently from 5 V to 20 V.
For this, one of the two voltages must first be activated. By pressing the **LNB** key again, the instrument can be set to the state as shown above.
The voltage can be changed here in 1 V increments using the ↑ and ↓ keys. The setting is non-volatile.

10.10.3 Measuring the remote supply current

For this, you must the measuring instrument into the default status in the DAB range. You can do this by pressing the **HOME** key. If remote supply is activated, the measuring receiver measures the amount of DC current flowing from the RF input socket (e.g. to supply an active antenna) and displays the amperage in mA on the left edge of the display. The measuring range extends from 0 - 500 mA with a resolution of 1 mA.

Chapter 11 MPEG Decoder

11.1 Introduction

11.1.1 DVB and MPEG-2

Digital television transmission is based on the DVB project. DVB uses the methods established in the MPEG-2 standard for coding video and audio sources.

Source coding and multiplexing
In order to be able to transmit the high data rates that occur with the digitalization of video and audio signals in a cost-effective way, the volume of data must be reduced using special compression methods.

MPEG-2 video source coding (ISO/IEC 13818-2)
Simply put, the video compression method works according to the following principle:
The complete picture information is only transmitted after x number of pictures. In the meantime, only changes from one picture to the next are transmitted. This can be accomplished due to complex computational algorithms.

MPEG-1/2 Layer II audio source coding (ISO/IEC 13818-3)
The audio data reduction works according to the psychoacoustic model of the human ear, whereby the sensitivity of hearing perception is distributed in a spectral manner. The volume of data can be significantly reduced with little loss of quality by using special algorithms.

Multiplexing
Video and audio data from one or more programs are transmitted in the MPEG transport stream (TS) in time division multiplexing. In addition, the transport stream contains service information for the receiver in order to demultiplex programs as well as teletext and other data services.

Satellite, cable and terrestrial transmission of SDTV (Standard Definition TV)
In order to transmit digital TV via satellite, cable and terrestrial media, the DVB-S transmission method has been developed for satellite, while DVB-C serves cable and DVB-T serves terrestrial transmission. Each respectively has the task of transporting the MPEG multiplex (transport stream) from the transmitter to the receiver.

Encryption
Pay TV providers encrypt their programs at the transport stream level. Current methods include e.g. BetaCrypt, Irdeto, Viacess, Conax, Cryptoworks, etc. A CA (conditional access) module must be integrated into the receiver for decryption to work. The module can then unscramble the transport stream again with a corresponding Smart Card.

MPEG decoder
The MPEG decoder has the task of demultiplexing the transport stream and making the data available to the respective audio and video decoders. Furthermore, it ensures synchronicity between the audio and video signal.

Service Information (SI)
The transport stream (TS) generally contains several programs. These programs are sent in packets one after the other. Each packet is assigned a number or PID (Packet Identify). The TS is managed by special tables that are part of the multiplex.

The most important table is the PAT (Program Association Table), which always has PID 0 and includes information about the number of programs contained in the multiplex. The PAT refers to further tables, the PMTs (Program Map Tables).
They contain the PIDs of the elementary streams for video and audio. With these tables, the MPEG decoder can filter out an individual program in the TS and undertake MPEG-2 decoding.

Picture and sound quality
While the transmission quality of analog TV goes hand in hand with the quality of picture and sound, the situation with digital transmission is fundamentally different.
Although the quality of transmission deteriorates, the picture and sound quality remains unchanged over long distances. This is ensured by efficient error protection mechanisms which correct bit errors that arise. Picture and sound suddenly cut out only when the reception quality is such that the corrective algorithms can no longer function (Brick Wall Effect). Shortly before that, typical “blocking” can be seen in the picture, while the sound drops out several times. The external error protection is identical with DVB-S, DVB-C and DVB-T (Reed-Solomon). A bit error rate of $5 \cdot 10^{-3}$ with the Reed-Solomon decoder leads to this “blocking” effect, while reception is virtually perfect with an error rate of $2 \cdot 10^{-4}$.

11.1.2 HDTV and MPEG-4

HDTV (High Definition TV)
While SDTV (Standard Definition TV) such as PAL, NTSC and SECAM transmits TV pictures with a resolution of 720x576i or 720x480i, the resolution with HDTV programs can be up to 1920x1080p. With “i = interlaced”, the pictures are transmitted with the lines interlaced. With “p = progressive”, the complete images are transmitted. The established HDTV resolutions are currently 1920x1080i and 1280x720p. While 1920x1080i offers greater spatial resolution, 1280x720p offers advantages during quickly changing scenes (e.g. sports transmissions). The transmission of HDTV requires considerably higher data rates.
The development of a more efficient video compression method (MPEG-4 AVC) has led to a further reduction in data rates in comparison to MPEG-2 and has thus enabled cost-effective transmission of HDTV for the first time.

MPEG-4 AVC (Advanced Video Coding)
MPEG-4 AVC is a highly efficient video compression standard. It is used within DVB for the digital transmission of high-resolution television (HDTV). In comparison to MPEG-2, MPEG-4 AVC leads to a further data reduction by a factor of 2-3 and improved picture quality. The necessary computational processing also increases by a factor of 3, however. The fundamental principle of MPEG-4 is based on MPEG-2. The details were further refined and improved, however. MPEG-4 programs are transmitted in the DVB transport stream like MPEG-2 programs. MPEG-2 and MPEG 4 programs can thus be combined in any way and transmitted in a transport stream.
More efficient and higher quality compression methods in comparison to MPEG-1/2 Layer II are also utilized in the transmission of audio signals.

Dolby Digital AC-3 (Adaptive Transform Coder 3)
AC-3 is increasingly used as the audio coding method with HDTV programs. Here version 5.1 offers a multi-channel sound system with 6 channels.

MPEG-2/4 AAC (Advanced Audio Coding), HE-AAC (High Efficient AAC)
Multi-channel sound systems developed by Fraunhofer IIS, similar to AC-3.
HE-AAC is currently the most effective audio coding method. It is being used increasingly for transmitting HDTV programs via DVB-T.

Satellite, cable and terrestrial transmission of HDTV
Within DVB, three different transmission standards have been developed for satellite, cable and terrestrial transmission media. These are DVB-S, DVB-C and DVB-T.
In order to further increase bandwidth efficiency, improved transmission methods have been or are being developed that stand out due to their increased efficiency in error protection (FEC = Forward Error Correction). DVB-S2 transmission via satellite is already in routine use. The DVB-C2 and DVB-T2 next-generation standards for cable and terrestrial are still in the development phase.

11.1.3 UHDTV and HEVC (MPEG-H)

-UHDTV (Ultra High Definition TV) is the next generation of high definition TV. The video resolution is two times of full HD, so we have 3840x2160 pixels. Because one picture in UHD has four times the number of pixels compared to full HD, the data rate to be transmitted increases with factor four. So, transmitting UHD content on DVB on an economical way is only possible if we can reduce the data rates. Therefore more efficient video codecs are necessary.

-HEVC (High Efficient Video Coding) is an advanced development of the predecessor standard AVC (MPEG-4). With this codec the coding efficiency is increased by two. So only 50% of data rate is necessary to transmit the same content compared to AVC. These improvements could be reached by further optimizations in the differential coding and division of macro blocks. But the algorithms get more and more complex, so the encoder and decoder chips have to be faster and higher integrated.

11.1.4 AVS/AVS+

AVS (Audio Video Standard) is video codec developed in china.
The AVS Jizhum Baseline Profile AVS1-P2 has a similar coding efficiency compared to H.264/AVC, but needs fewer resources in the encoder and decoder chips.
The AVS Guangbo Profile AVS1-P16 is an advanced development of the predecessor AVS1-P2 and has improved coding efficiency. This codec is used more and more for TV broadcast in china.

11.2 Operation

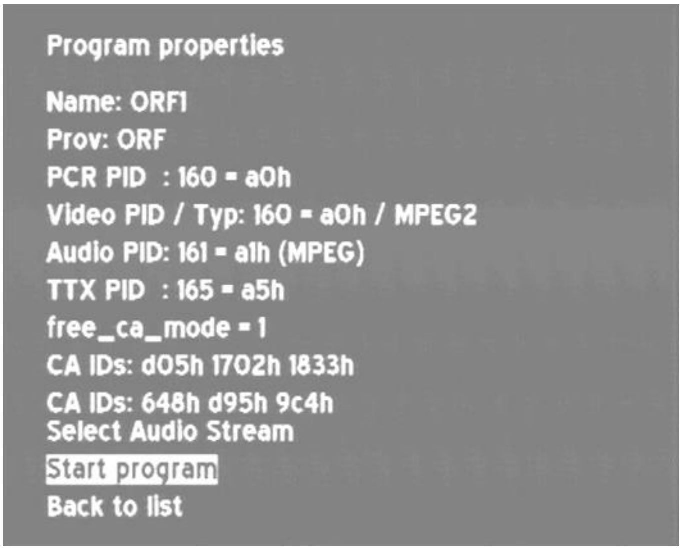
The decoder is operated using the keypad on the instrument. All messages from the decoder appear on screen via the decoder’s OSD (On-Screen Display).
As soon as the measuring receiver is tuned to a digital channel or digital frequency, the MPEG decoder is activated.

It requires some time for its “booting procedure”, which can be tracked via a progress bar. When the range is changed or during analyzer mode, the MPEG decoder will switch off in order to increase battery life. As a result, the “booting procedure” is repeated when the decoder is activated again.

As soon as the decoder is ready, it analyses the transport stream present and constructs the program lists for video and audio programs and pure data services. If the decoder is unable to find a valid transport stream, a **WAITING FOR TS** message appears. In this case, the corresponding digital demodulator (e.g. DVB-C) is not receiving a signal and the receiver displays an “**unlocked**” message.

After the decoder has acquired the program lists from the transport stream, it displays the video program list on the OSD. If there are more than eight video programs, the remaining entries can be found on additional pages.

Use the ← and → keys to scroll through the pages. If the program name is displayed as “????”, the name cannot be displayed, because this information is missing (e.g. error in the SDT).
An “ * ” before the program name denotes an encrypted program.
By selecting **Display audio only** from the menu, the program list of audio programs is displayed. By selecting **Display data only** from the menu, all pure data services (e.g. SkyDSL) are listed separately. By selecting **Display video only** from the menu, the list of TV programs is again made available.



Select a program from the list by moving the cursor onto the desired program name using the ↑ and ↓ keys. When **ENTER** is pressed once, the MPEG decoder lists the corresponding program details.
This includes the program name, program provider, service ID and the PIDs for PCR (Program Clock Reference), video, audio and videotext (TTX). As with analog television, most program providers supply videotext. This can be seen if a PID is entered at the TTX position. As explained in the "Chapter 14 - Videotext", information is transmitted using elementary text streams in the MPEG transport stream. The MPEG decoder decodes the pages.
Consult the "Chapter 14 - Videotext" for details on how to access the pages.

The PIDs are displayed in decimal and hexadecimal form. Some TV programs are broadcast with several audio streams. These can be various languages or a combination of MPEG, AAC and AC-3 audio streams. By choosing **Select audio stream** from the menu, the desired audio stream can be selected. Now start the selected program by pressing **ENTER**. Audio streams encoded in AC-3 and AAC format can be played only using an MPEG-4 decoder.

The decoder now tries to decode the picture and sound. A message will appear accordingly if the selected program is in an encrypted format. Press the **ENTER** key again to return to the program list.

MPEG-4 AVC H.264 programs and MPEG-2 decoder
The MPEG-2 decoder cannot decode MPEG-4 programs. If transmitted in AC-3 or AAC, the accompanying audio streams also cannot be played.
However, these HDTV programs are also entered in the program list by the MPEG-2 decoder. Additional information appears in the program details (H.264 and AC-3 or AAC).

11.3 Dynamic PMT

Some program providers divide their programming into regional content at specific times.
This means that, for example, 4 programs may appear in the MPEG program list which have the same content at certain times and different content at other times. The program map table (PMT) in the data stream therefore changes over time. In this way, the station can prompt the receiver to use different packet identities (PIDs).
In the standard setting, the MPEG decoder of the instrument uses the PMT that was sent at the time of the last program search. In other words a static PMT.
However, the user can activate the dynamic PMT update function for a specific program. To do so, press the → key while the program details are displayed on the screen. The text **dyn.PMT** then appears on the screen.
If you start the program now, the decoder continually searches for a new PMT version. If the device detects a change in the PMT, the current program is stopped and then restarted with the updated PIDs.

11.4 Displaying the MPEG video parameters

As soon as a live picture can be seen, the MPEG decoder displays the following parameters in a window at the bottom right of the screen.

- Profile and level: e.g. MP @ ML
- Chroma format: e.g. 4:2:0
- Video resolution: e.g. 720x576
- LetterBoxFormat: 4:3 or 16:9

Press the ← and → keys at any time to show or hide the parameter window.

11.5 Measurement and display of the video bit rate

The decoder can measure the current bit rate of the video stream being transmitted while a live picture is played. This is shown in the unit [Mbit/s] in the window described in the "Chapter 11.4 - Displaying the MPEG video parameters". A time window of 1s is used for measurement.

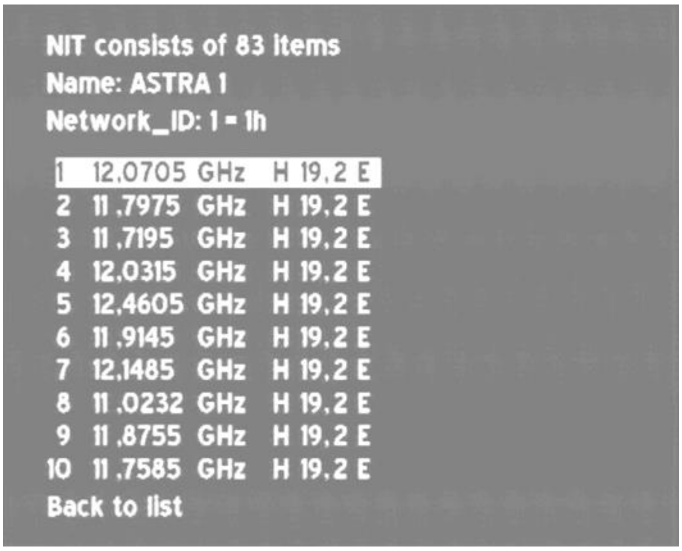
11.6 Network Information Table (NIT)

NIT (Network Information Table) is part of the Service Information (SI) range that is transmitted in multiplex in the transport stream along with video and audio programs.
Each transport stream has a separate NIT. The NIT contains information that can be used for navigation (program search) in set-top boxes (STB). Its precise structure is defined in EN 300 468.
The NIT information depends on the reception mode chosen (DVB-S, DVB-S2, DVB-C or DVB-T).
NIT evaluation can be initiated by selecting the NIT menu item below the program list and then pressing **ENTER**.

The OSD reports on the NIT search and the reception of individual sections of the **NIT**. If the entire NIT is received, the instrument puts together a NIT list. If the transport stream does not contain a NIT, then the search is cancelled after a period of time and a corresponding message appears. You can also stop the NIT search manually by pressing **ENTER**.

After the NIT has been imported, the list can also be printed out or copied into a text file. For more information, see “Chapter 17 - Printer” and “Chapter 18 - File Output” sections.

The following example shows a NIT from an ASTRA transponder:

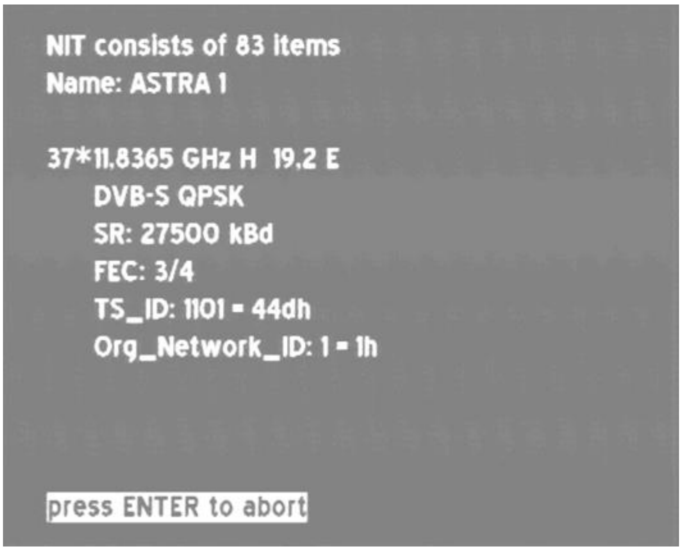


10 entries are displayed per page. Use the ← and → keys to scroll through the entries. An entry consists of the serial number, transponder frequency, polarization and orbital position.

An “ * ” after the serial number indicates that the current transport stream originates from this transponder/channel. You can move the yellow bars up and down with the ↑ and ↓ keys.
Press **ENTER** for more details on the NIT entry highlighted in yellow.

11.6.1 Delivery System Descriptor

The information contained in the delivery system descriptor differs according to the transmission medium (cable, satellite, terrestrial). The descriptor contains information about the transmission parameters.
The decoder displays this information when the **Delivery System Descriptor** menu item is selected. The following example shows the contents of a SAT delivery system descriptor.

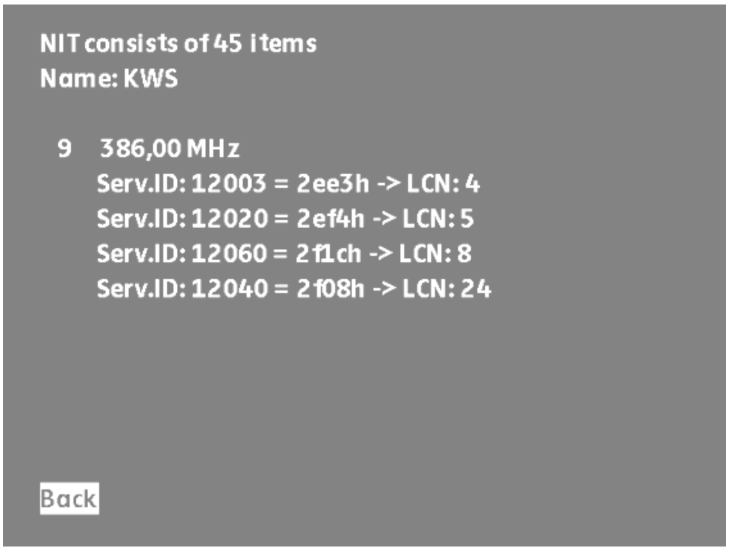


The transport stream with the number 1056 (TS_ID) is transmitted at a transponder frequency of 11.8365 GHz at an orbital position of 19.2° East with horizontal polarization.

Transmission occurs in the DVB-S2 standard with 8PSK. The symbol rate is 22,000 kBd, the FEC is 2/3 and the original network number (Org. Network_ID) is 1. All IDs are displayed in decimal and hexadecimal form. Press **ENTER** to return to the NIT list. The information provided depends on the reception mode (DVB-S, DVB-S2, DVB-C or DVB-T).
If a transport stream is converted from satellite to cable, then generally the NIT in the header must be adjusted accordingly. If this is not done or only partially done, the cable box may not be able to find certain programs, since the navigation is based on information provided by the NIT.

11.6.2 Logical Channel Descriptor (LCD)

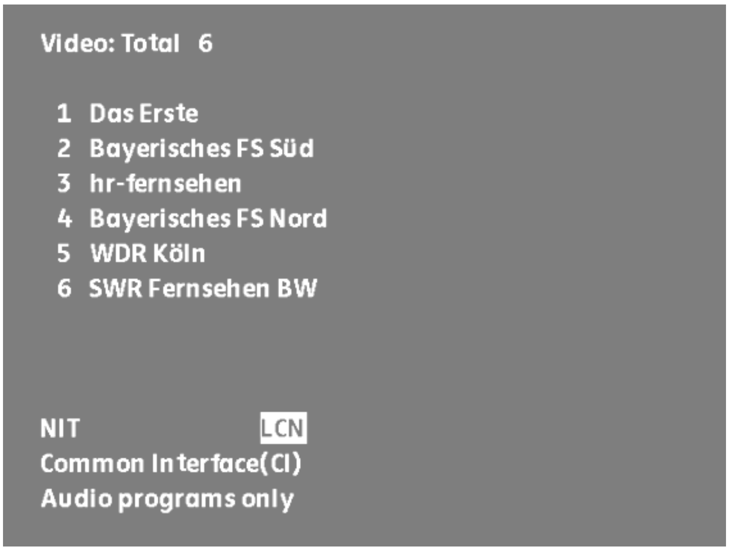
For a suitable receiver, the order of the stations can be controlled using the logical channel descriptor (LCD) which is transmitted within the NIT. This means that the network operator can determine which program receives which memory location number in the receiver. This can be useful in places such as hotels or hospitals in order to ensure that the memory locations are identical for all receivers.
In the LCD, a specific memory location number (logical channel number – LCN) is assigned to each service ID (TV program).
If the **Logical Channel Descriptor** menu item is selected, the MPEG decoder lists the relationships between the service IDs and LCNs for the selected transponder/channel within the NIT. Press **ENTER** to return to the NIT list.



Another way of displaying the LCNs is described in the "Chapter 11.7 - Logical Channel Numbering (LCN-Liste)".

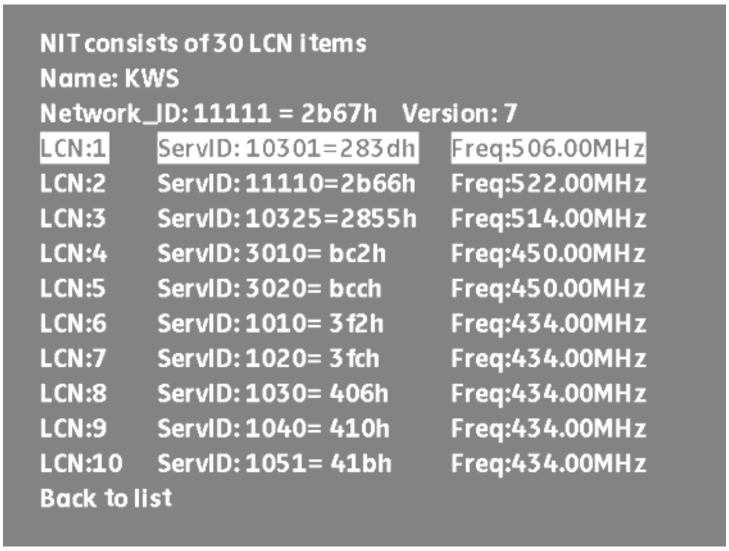
11.7 Logical Channel Numbering (LCN-Liste)

NIT evaluation, like specified in the chapter above, can be initiated by selecting the LCN menu item below the program list.



If the NIT contains information about LCN, the instrument puts together a sorted LCN list. Otherwise a corresponding message appears.

After the NIT has been imported, the LCN list can also be printed out or copied into a text file. For more information, see “Chapter 17 - Printer” and “Chapter 18 - File Output”.



Per page 10 entries are displayed. Use the ← and → keys to scroll through the entries. An entry consists of the LCN, service ID and transponder frequency.

An “ * ” after the LCN indicates that the current transport stream originates from this transponder/channel. You can move the yellow bars up and down with the ↑ and ↓ keys

Chapter 12 Constellation diagram

12.1 Introduction

The constellation diagram is a graphical representation of the states of a digitally modulated signal in a two dimensional coordinate system. Individual signal states can be viewed as source vectors with I (inphase, horizontal axis) and Q (quadrature, vertical axis) components. Only the peaks of the vectors are shown in diagram, however. Depending on modulation method, there is a varying number of decision fields within the two dimensional field (e.g. 256 with 256QAM). These decision fields are assigned to a fixed bit combination.

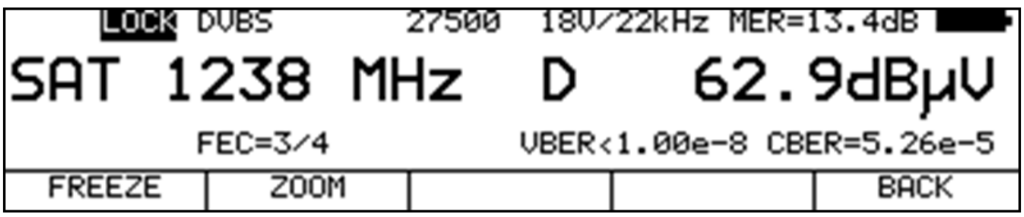
In the ideal case, all signal states are in the center of the decision fields. A real signal is exposed to variable interferences, however. If you view these interferences as vectors that are superimposed on the ideal signal states, the peaks of the sum vectors depict the deviation from the ideal state. The worse the signal quality is, the larger the distribution in the two-dimensional state space. It is possible for you to draw conclusions about the type of signal interference based on the form of the constellation diagram. This is explained later using examples.

The mean between two ideal states is designated as the decision limit (indicated in the diagram by horizontal and vertical lines). A signal with enough interference to move several signal states beyond the decision limit will result in bit errors. This means: The better all signal states center on the ideal states (the smaller the signal clouds are), the better the signal.

The measuring receiver shows the constellation diagram in real time for the digital standards (DVB S/S2, DVB-C, DVB-T and DOCSIS). With a symbol rate of e.g. 6,900 kBd with 256QAM, the diagram is updated approx. 50x per second.
65,536 symbols are recorded, analyzed and displayed in color on the TFT according to an analysis of frequency of occurrence. The color gradation provides information about the distribution of the occurrence frequency of the signal states. Blue, green, yellow and red represent increasing frequency. This gives the constellation diagram a three dimensional appearance.

12.2 Operation

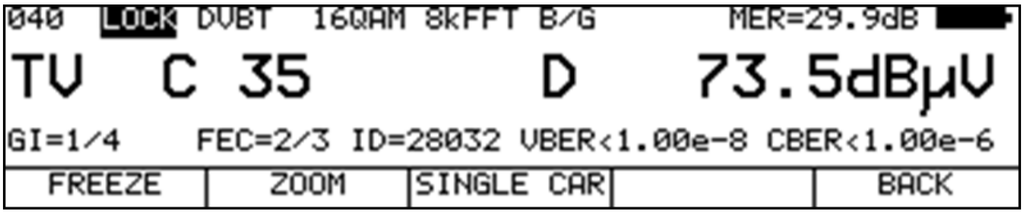
As previously mentioned, you can show the constellation diagram for all digital standards (DVB S/S2, DVB-C, DVB-T and DOCSIS). You must first tune the measuring receiver in a digital range. You can then access the constellation diagram via the menu item **CONST**. At the same time, a submenu opens through which you can access additional functions.



The diagram can be frozen via the menu item **FREEZE**. When you access **ZOOM**, another menu appears in which every individual quadrant of the constellation diagram can be enlarged to the full screen size.

12.2.1 Displaying single carriers with DVB-T

With DVB-T, you can display the constellation diagram for all single carriers and for certain single carriers.

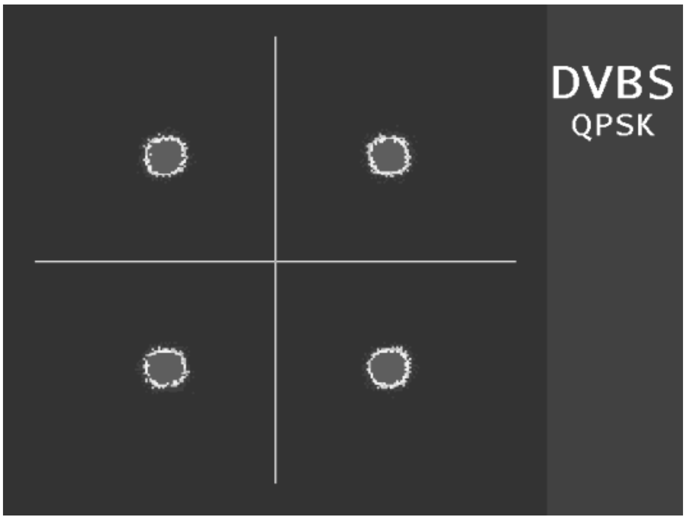


If you access the menu item **SINGLE CAR**, you can enter the number of a single carrier within the COFDM spectrum using the numeric keypad. You confirm the entry by pressing **ENTER**. The constellation diagram of the desired single carrier is then displayed. Due to the fact that a single carrier is only transmitted approx. every 1ms, the repetition cycle of the display is lengthened. Using this function, you can view pilot carriers, TPS carriers or data carriers separately. With 2kFFT, single carriers can be shown from 0...1704. With 8kFFT, single carriers from 0...6817 can be shown.

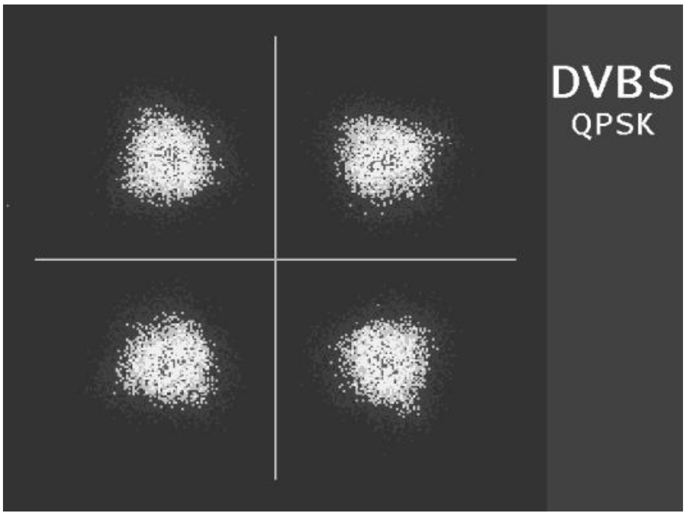
12.3 Examples

The following figures show images of constellation diagrams. Next to the images, possible errors and their causes are explained.

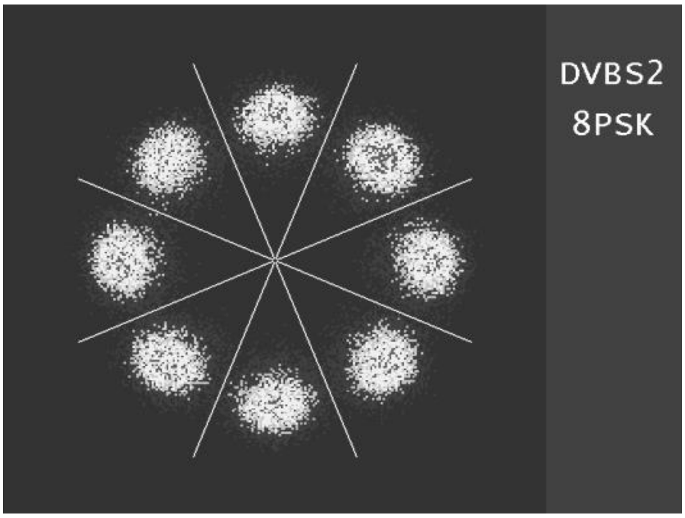
12.3.1 DVB-S/S2



Ideal constellation diagram -> signal source SFU (Rohde & Schwarz)

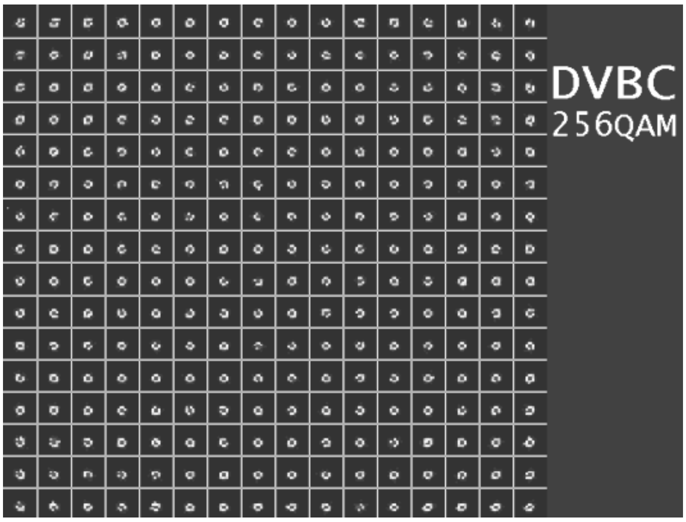


Error: Uncorrelated interference
Cause: Bad cross-polarization decoupling



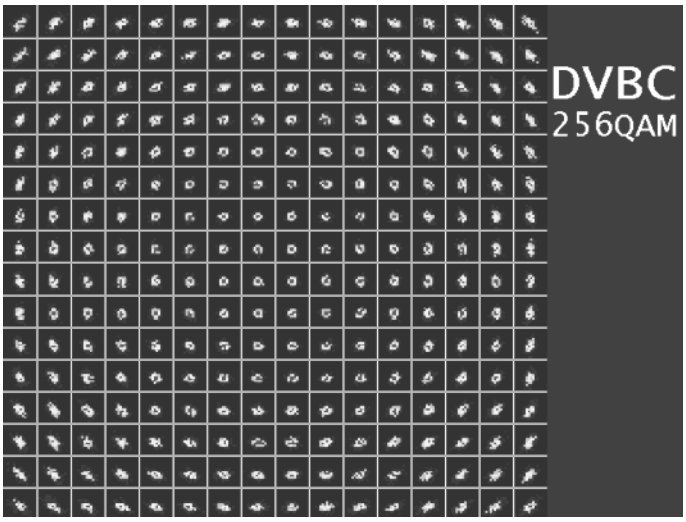
Real 8PSK signal with MER = 14dB.

12.3.2 DVB-C/DOCSIS(ScQAM)



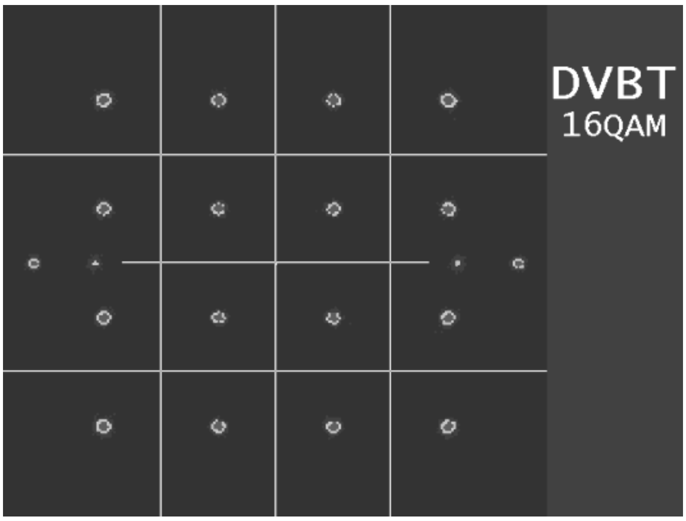
Ideal constellation diagram -> signal source SFU (Rohde & Schwarz)

Error: Noisy signal
Cause: Bad C/N -> level possibly too low

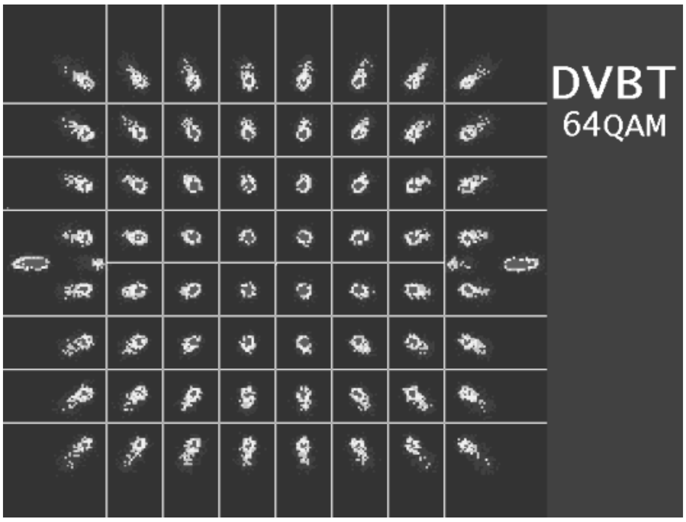


Error: Phase jitter (a low-frequency frequency modulation is impinging on the carrier)

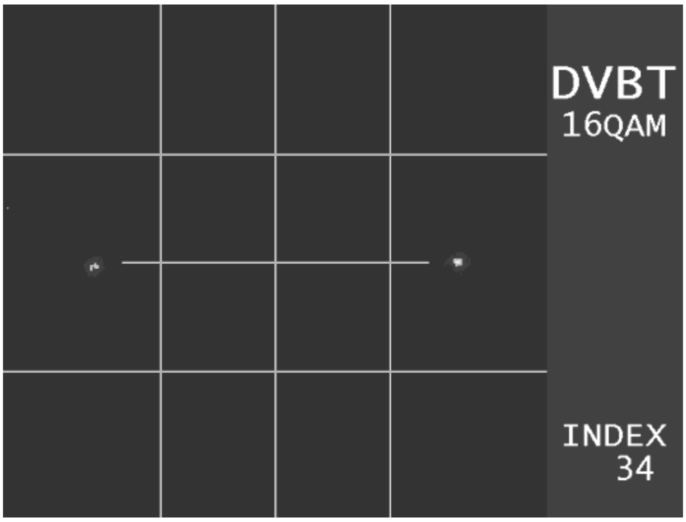
12.3.3 DVB-T



Ideal constellation diagram -> signal source SFU (Rohde & Schwarz)

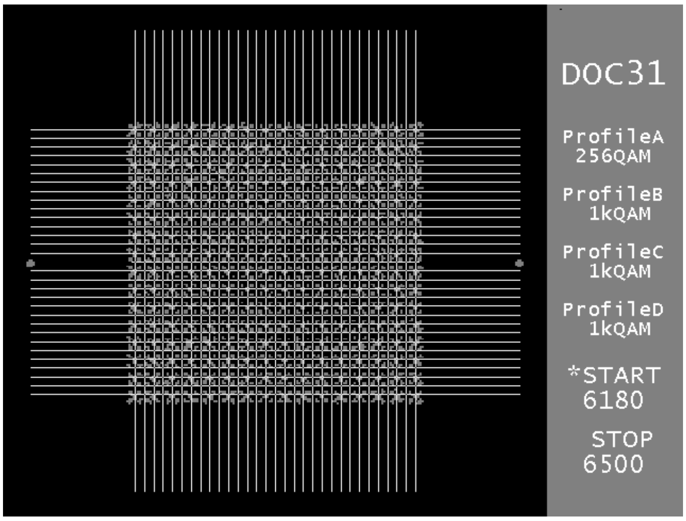


Error: Amplitude hum (a low-frequency amplitude modulation is impinging on the carrier)
Cause: Defective amplifier (dried out electrolytic capacitor in the power supply unit)



Single carrier display: TPS carriers (Index 34) are illustrated here

12.3.4 DOCSIS(OFDM)



Carrier Group 6180 to 6500 in a 8kFFT OFDM signal modulated with 256 QAM in Profile A and 1024QAM (1kQAM) in Profile B to D. The clouds on the left and the right edges are the OFDM-Pilots

Chapter 13 SCOPE

With the Scope (line oscilloscope) function, you can display individual lines in the FBAS signal (video signal) oscillographically. The video signal has test lines added to it that allow you to draw conclusions about the quality of the analog video signal during operation. The test lines are defined internationally in the specification ITU-T J.63.
The most important test lines are lines 17, 18, 330 and 331. With the help of these and with correct interpretation, linear and nonlinear distortions in the transmission links can be detected.

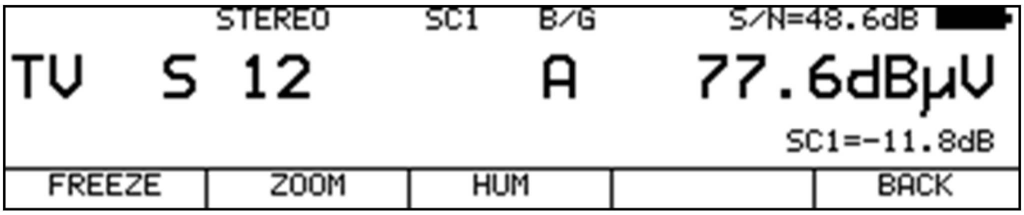
In combination with S/N measurement, you can check whether the line being used for measurement (6) is actually empty. If necessary, you must switch to either line 5 or 7.

The dotted grid lines are shown in the oscillogram at 100%, 30% and 0%. With these, the deviation from the nominal value of the measured video amplitude can be measured. With TV, the video is modulated up using a vestigial sideband amplification modulation.
The measuring instrument is adjusted so that with a residual carrier of 10% (standard value), a video amplitude of 100% is displayed. For a larger video amplitude, there is a smaller residual carrier; for a smaller amplitude, there is a correspondingly larger one. With a residual carrier of 10%, a video amplitude of 1Vpp is present on the SCART socket when terminated with 75 ohm.

In the SAT range, a frequency modulation is used for the analog picture transmission. Here the nominal value of the frequency deviation that generates 100% video amplitude is 16 MHz/V.

13.1 Operation

As previously mentioned, you can access the line oscilloscope in the analog operating modes for satellite and TV. You can also test the video signal present on the SCART socket. For satellite and TV, the measuring receiver must first be tuned to an analog carrier. You can then activate the line oscilloscope via the menu item **SCOPE**. At the same time, a submenu opens through which you can access additional functions.

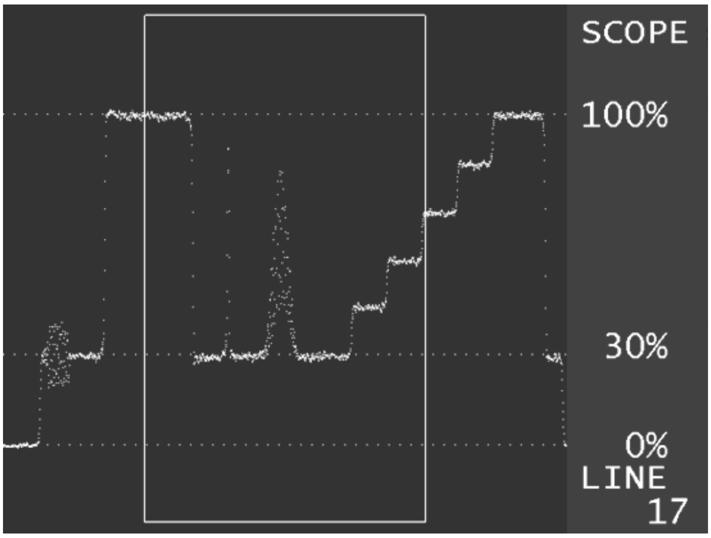


You can enter a line number from 1 to 625 using the numeric keypad. During entry, a cursor appears on the right edge of the TFT screen. You confirm the entry by pressing **ENTER**. SCOPE then displays the desired video line.

You can freeze the diagram via the menu item **FREEZE**.

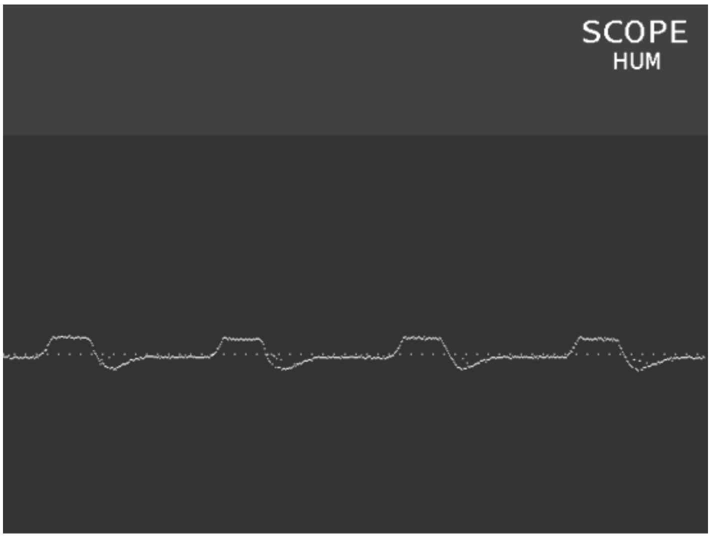
You can enlarge a section of the line by accessing the **ZOOM** function. You can show or hide a white frame in the diagram by pressing **ENTER** (see the following figure). This frame marks the section that should be enlarged. You can enlarge and shrink this window using the ↑ or ↓ keys, which change the zoom factor.

You can also move the oscillogram to the left or right with the ← and → keys. This makes it possible to move any section of a video line into the range of the white frame and enlarge it with the menu item **ZOOM**.



13.2 Hum measurement

You can access the hum measurement function via the menu item **HUM**.
Low frequency amplitude fluctuations of the video signal are shown here within a temporal excerpt of 40 ms (1 complete picture). Transmission is susceptible to amplitude fluctuation of the RF carrier due to the vestigial sideband amplitude modulation used with analog TV. Due to defective amplifier power supply units, low-frequency amplitude fluctuations can develop at multiples of the mains frequency (50 Hz). This so-called hum produces a dark bar that runs through the video image vertically. You can freeze the diagram via the menu item **FREEZE**. The following figure shows a strong mains hum in the video signal caused by a defective distribution amplifier.



Chapter 14 Videotext

14.1 Videotext on ATV

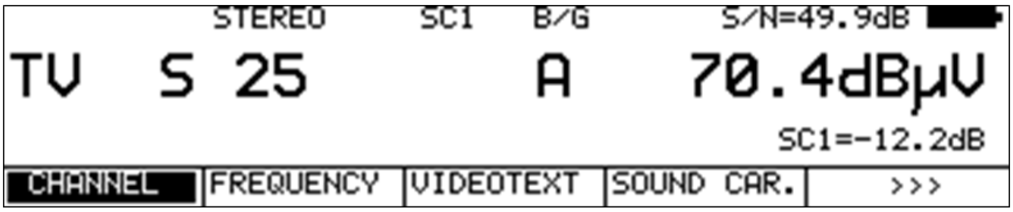
Videotext (or teletext) was introduced at the start of the 1980s as a means of transmitting data. Information is broadcast in the vertical blanking interval between image frames in a broadcast television signal. The bit stream is then modulated onto the corresponding video lines using NRZ encoding (non-return-to-zero). The complete information pool is then divided into videotext pages, which are labelled with a three-digit number. A videotext page consist of 24 lines of 40 characters. These are transmitted sequentially in the vertical blanking interval. The repetition rate of the individual pages is not distributed consistently. Overview pages containing information for navigating the pages are transmitted more frequently.

14.2 Videotext on DVB

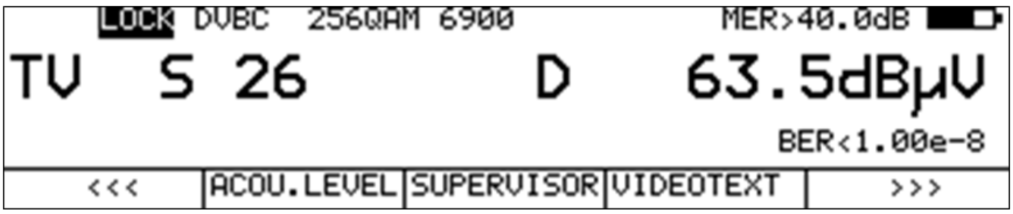
In contrast to analog television, where videotext is inserted as an additional signal in the vertical blanking interval, DVB uses a multiplexed videotext elementary stream that is inserted directly into the MPEG-2 transport stream. The videotext elementary stream is transmitted together with the video and audio elementary streams. The videotext stream is allocated an individual PID for each program. This PID can be found in the program details in the MPEG decoder.
Further information can be found in the "Chapter 11 - MPEG Decoder".

14.3 Operation

The videotext decoder can be called up in various operating modes of the measuring receiver. On analog SAT, analog TV and monitor (SCART input) sources, the videotext information is transmitted in the video signal as detailed above in the “Chapter 14.1 - Videotext on ATV". To call up the decoder, the instrument must be tuned or set to the monitor operating mode.

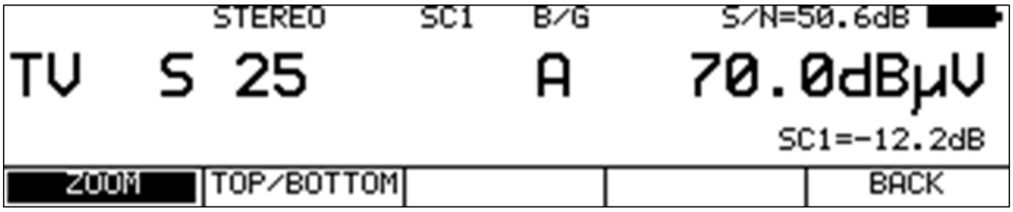


On DVB, the decoder extracts the videotext data from the MPEG transport stream. The videotext decoder can also be called up via the ASI interface.
The instrument must also be tuned in advance in the digital operating modes. Additionally, a video program must also be called up in the MPEG decoder. The videotext decoder can be activated only when the current program is transmitted with a videotext PID.



The videotext decoder can be called up using the **VIDEOTEXT** menu item.
The instrument then searches for page 100 (default) and shows the page on the TFT.

A three-digit page number can now be entered using the numeric keypad. The decoder starts to search for the new videotext page as soon as the third digit is entered.
A videotext page can be enlarged vertically by a factor of 2 using the **ZOOM** function. The **TOP/BOTTOM** menu item is used to switch between the display of the top and bottom half of the screen.



Select the **BACK** menu item to exit videotext.

14.4 Videotext test tables

Special test tables are used for checking the videotext function quickly. The characters used in the test tables set increased demands on the character generator in the videotext decoder.

On ATV:

As the videotext information is contained in the baseband (video signal), malfunctions in the transmission link have a particular impact on the characters in videotext (character errors).
These test tables are then particularly suitable for testing the transmission link for reflections. For this, call up videotext page 195 or 199. Unfortunately, these test tables are not offered by all program providers. If there are reflections in the transmission path, some of the “betas” on the page are fragmented. This is an indication of incorrect tuning, irregularities, damaged cables or defective plug connectors.

On DVB:

For DVB videotext, information is transmitted is made in the same way as video and audio transmission. The transmission link can be evaluated using the BER, MER and packet error measurements. Therefore, the test tables (if transmitted at all) are of less significance. However, errors can occur when multiplexing the MPEG-2 transport stream, meaning some or all pages are not transmitted at all.

14.5 VPS (Video Programming System) evaluation

This function is not available for DVB. VPS is used for recording control in video recorders. The data are transmitted in TV line 16.
The following information is contained in VPS:
Start date and time of a new program, country identification and network identification, program type, sound type.
Country identification and network identification are designated together as CNI (Country Network Identification).

The following example provides an illustration:

VPS
24.08 09:00 CNI:=D C8h PTY:=FFh STEREO

Day:	24
Month:	08
Hours:	09
Minutes:	00
Country identification:	D (Germany)
Network identification:	C8 (Phoenix ARD/ZDF)
Program type:	FFh (not used)
Sound type:	STEREO

The contents of the **VPS** line can be displayed on the videotext screen using the menu item VPS. If the menu item **VPS** is accessed again, the previous videotext page will reappear.

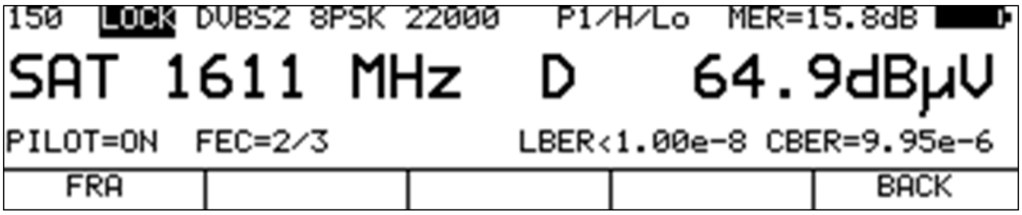
Chapter 15 Subtitle

15.1 Subtitle with DVB

In contrast to analog television, where subtitles for the current program are transmitted as special videotext tables, DVB uses its own subtitle elementary streams that are inserted directly into the MPEG-2 transport stream. The elementary stream for the subtitle is transmitted together with the video and audio elementary streams. The subtitle stream is allocated an individual PID for each program. This PID can be found in the program details in the MPEG decoder.
Further information can be found in "Chapter 11 - MPEG Decoder".

15.2 Operation

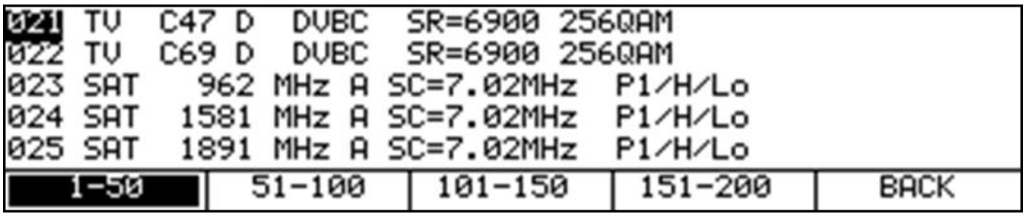
With DVB, the decoder extracts the subtitle data from the MPEG transport stream.
Subtitles can be viewed in all DVB operating modes and via ASI.
The instrument must first be tuned in one of the DVB operating modes. A video program must then be opened in the MPEG decoder. Subtitles can be viewed only if the current program has a subtitle PID.



The **SUBTITLE** menu item opens the decoder. If this menu item does not appear, the instrument hardware does not support this function.
Subtitles may be broadcast in a variety of languages. These are then listed in the menu bar, as can be seen in the figure. Subtitles are shown on the current program by selecting one of the menu items. The window with the video parameters is then hidden. Subtitles are often transmitted with films and newscasts. Selecting the **BACK** menu item hides the subtitles and the video parameters appear on the display once more.

Chapter 16 Memory Management

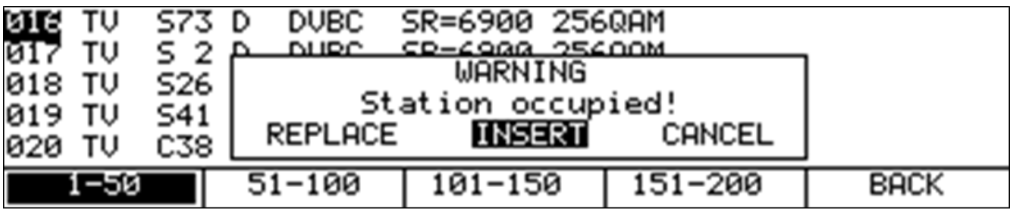
The instrument has a tuning memory with 200 program locations. The memory preview allows the user to get an overview over the tuning memory without having to access all memory locations or having to make corresponding notes when saving. The memory preview is activated when saving and accessing program locations and with many memory functions. On the display, you can show a page of the memory preview covering 5 memory locations.



As shown in the image above, the 200 memory locations are subdivided into 4 blocks with 50 locations each.
Using the function keys **F1**...**F4**, you can jump to the start of each block.
You can use the ← and → keys to scroll through the individual pages. You can use the ↑ and ↓ keys to move the cursor within the page.

16.1 Saving

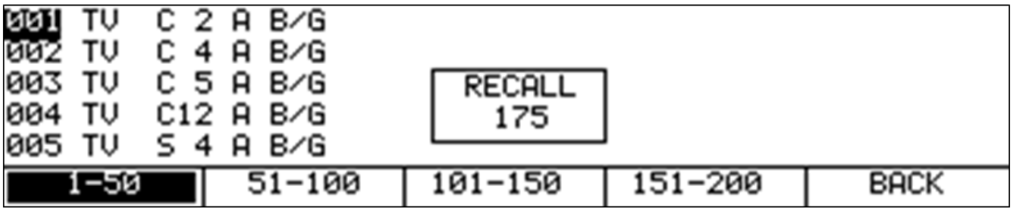
The measuring receiver must first be tuned. You access the memory preview described above using the **SAVE** key. Now the cursor can be moved to the desired memory location. You complete the save by pressing **SAVE** again. If the selected memory location is not empty, the following message appears on the display:



You can now use the ← or → keys to select between REPLACE, INSERT and CANCEL. Press **ENTER** to begin the process. With INSERT, the entire memory content that follows is moved forward one memory location. If the last memory location is occupied, then this location is deleted. With REPLACE, the memory location is simply deleted. When you next access the **SAVE** function, the cursor is automatically placed in the next memory location.

16.2 Recalling

The memory preview is called up using the **RECALL** key. The desired memory location can now be selected using the cursor.
Alternative the number block of the keypad can be used to enter a memory location from 1 to 200. That is also useful if you know the desired memory location number to save the browsing time of the memory preview.
The following figure shows a direct memory location recall of slot number 175.



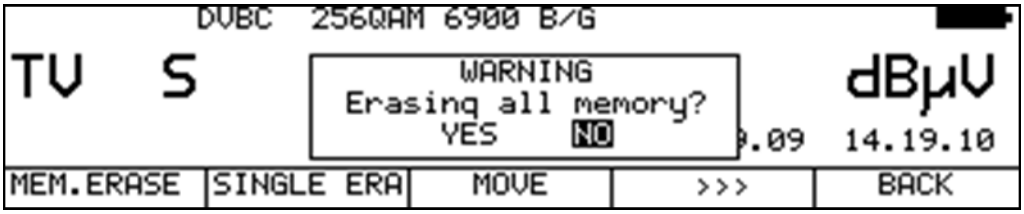
Press the **RECALL** key again or the **ENTER** key to open the memory. The measuring receiver then accepts the settings from the tuning memory. If the memory location is empty, the old settings are kept.

16.3 Memory functions

These make it possible for you to carry out various changes to the tuning memory.

16.3.1 Erasing the memory

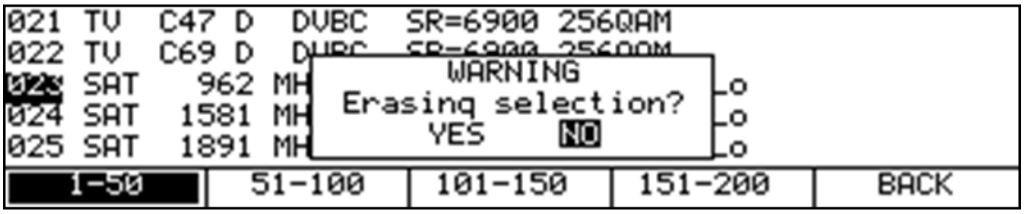
You can erase the entire tuning memory using this function.
After pressing the **MODE** key, select the menu item **MEMORY** -> **MEM. ERASE**. To prevent this from happening unintentionally, the following warning appears:



Move the cursor to the YES position using the ← key. The entire tuning memory is then irretrievably erased if you press the **ENTER** key.

16.3.2 Erasing a memory location

You can erase a single memory location with the tuning memory using this function. You access this function via **MODE** -> **MEMORY** -> **SINGLE ERA**.
First move the cursor to the memory location to be erased. After you confirm by pressing the **ENTER** key, the following message then appears.



You can use the ← and → keys to select either YES or NO. After you press the **ENTER** key again, the desired action is carried out.

16.3.3 Moving a memory location

You can use this function to move individual memory locations within the tuning memory. To do this, activate the menu item **MODE** -> **MEMORY** -> **MOVE**. The memory preview then appears. First move the cursor onto the memory location that is supposed to be moved. Then confirm this by pressing the **ENTER** key. You can then move the cursor to the target location. After you confirm by pressing the **ENTER** key, the following message appears.

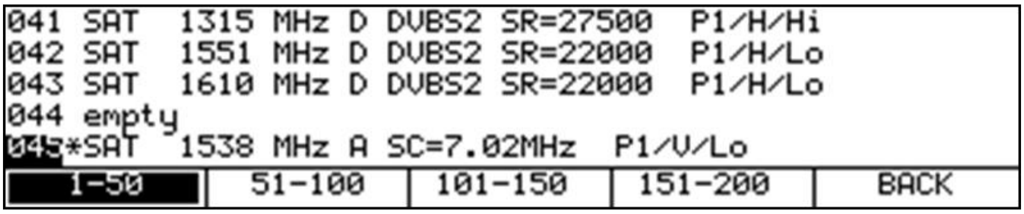
Using the ← or → keys, you can select the actions REPLACE, INSERT, EXCHANGE or CANCEL. The functions REPLACE and INSERT operate as described in chapter. With the selection EXCHANGE, the memory locations switch places with each other. In the above example, memory location 1 was exchanged with memory location 2.

16.3.4 Copying a memory location

With this feature, you can copy a memory location. To do this, select the menu item COPY via **MODE** -> MEMORY.
The memory preview appears and the operator can move the cursor to the memory location that is supposed to be copied. You confirm the selection by pressing **ENTER**. The memory location is displayed inverted. Now you can move the cursor to the next memory location, for example. Pressing the **ENTER** key causes the action to be carried out.

16.3.5 Activating memory protection

You can protect individual memory locations using this function. That means that a protected memory location can only be changed if the memory protection is cancelled. To do this, select the menu item **MODE** -> MEMORY -> PROTE. MEM.
The memory preview then appears. You can now move the cursor onto the memory location that is supposed to be protected. Pressing the **ENTER** key activates memory protection. To indicate protected memory locations, " * " appears after the memory location number.



16.3.6 Cancelling memory protection

You can cancel the memory protection of all 200 memory locations via the menu item **MODE** -> MEMORY -> CANCEL PRO.

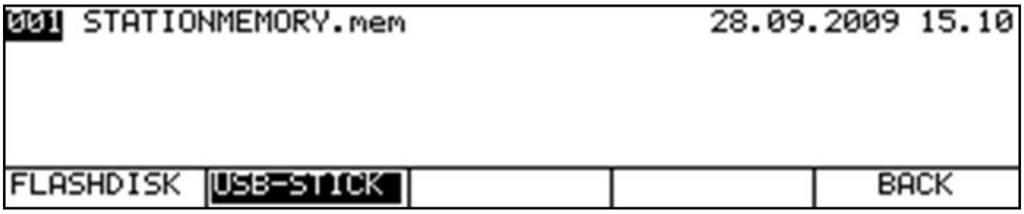
16.3.7 Memory export

Here you can write the complete tuning memory to a file.
To do this, access the menu item **MODE** -> MEMORY -> IMP/EXPORT -> EXPORT. An input menu for the file name will then appear.

You can use the ← and → keys to move the cursor. You can enter alphanumeric characters for the file name using the numeric keypad. The file name can be up to 20 characters. By pressing the **ENTER** key, the cursor jumps to START. When you press **ENTER** again, the process starts. In this example, a file named STATIONMEMORY.MEM is generated. You can write this either to an external USB stick or the internal flash disk. This can be useful if several people use the measuring instrument, for example. Then everyone can create his or her personal tuning memory and write it to a file. Before use, the contents of the file just need to be read back in (imported - see "Chapter 16.3.8 - Memory import").

16.3.8 Memory import

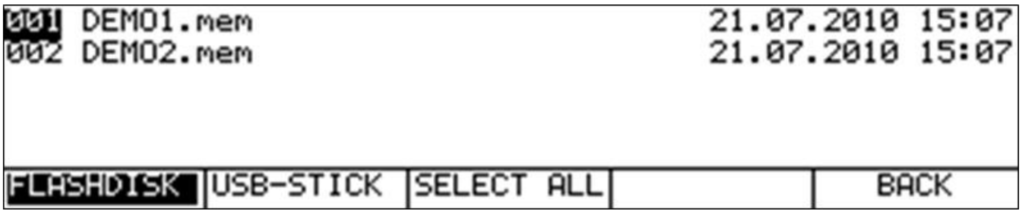
With the memory import function, you can restore to the instrument a copy of the tuning memory created by the memory export function. To do this, access the menu item **MODE** -> **MEMORY** -> **IMP/EXPORT** -> **IMPORT**. Then a selection appears of files that are available for import to the current memory medium.



You can use the ↑ and ↓ keys to move the cursor to the desired file name.
By pressing the **ENTER** key, the contents of the relevant file replace the tuning memory of the instrument.

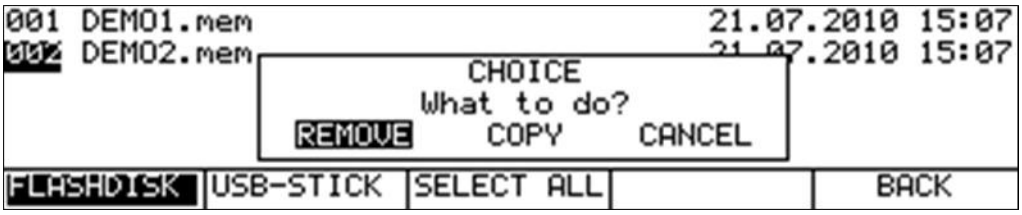
16.3.9 Opening the directory of the MEM files

You can display list of all MEM files using MODE -> **MEMORY** -> **IMP/EXPORT** -> **DIRECTORY**. Press **BACK** to exit the list. You can use the ← and → keys to scroll between the pages of the list. Use the **FLASH DISK** or **USB STICK** menu items to switch between the storage media.
All files can be selected my choosing the menu item **SELECT ALL**. This makes it possible to handle all of the files at the same time using the “delete MEM files” and “copy MEM files” functions.



16.3.9.1 Deleting MEM files

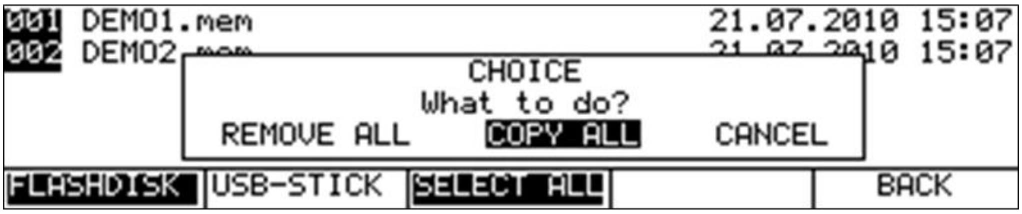
When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



To select **REMOVE** you can use the keys ← or →.The file DEMO2.MEM will be deleted from the flash disc by pressing the **ENTER** key.

16.3.9.2 Copying MEM files

When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



You can use the ← and → keys to select **COPY ALL**. In this example, all MEM files are copied from the internal flash disk to the USB stick when the **ENTER** key is pressed.

16.3.10 Automatic saving

This function allows you to automatically assign the tuning memory. To do this, you need to use the scan function in the particular measuring range that has been set. When the instrument detects a signal, it stores the receiver settings in the previously specified memory area. You can call the function in the following measuring ranges.

Range	**Operating mode**
SAT	
	DVB-S/DVB-S2
TV	
	ATV
	DVB-C
	DVB-T/DVB-T2
	EUDOCSIS
	USDOCSIS
	DTMB
FM	
DAB	

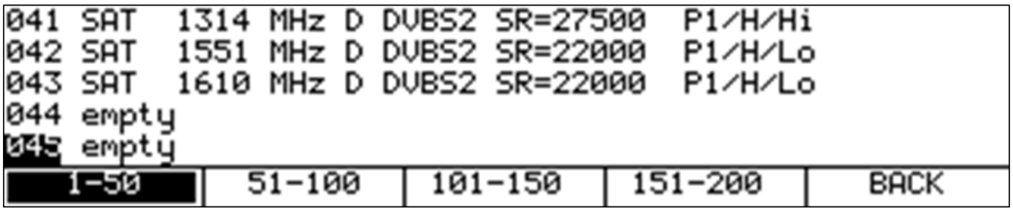
The measuring range that was previously set determines which signals are detected during automatic saving. If you have set TV + DVB-C, for example, the instrument only scans for digital cable channels. The modulation and symbol rate are detected automatically. This results in connected memory blocks that have the same receiver settings.

Important note on using the function in the SAT range

Before starting the function in the SAT range, ensure that the required LNB supply has been set. If the RF input mode is active and the LO assignment is set to “Ku-AUTO”, the instrument automatically switches to the high band when the switching threshold of 11.7 GHz is reached during automatic saving, and continues the process there. Also see the “Scan” section of the “SAT Measuring Range” chapter.

Before using this function, it is advisable to first export the current contents of the tuning memory to a file. See "Chapter 16.3.7 - Memory export” for more information. Afterwards, you can erase the entire memory. See "Chapter 16.3.1 - Erasing the memory” section for more information. If you proceed in this way, you will be unable to overwrite any existing memory locations.
In addition, you can generate separate memory assignments for various systems that simply need to be loaded using the memory import function.

You call the automatic saving function using the **MODE** -> **MEMORY** -> **AUTOM.SAVE** menu item. The memory preview then appears.



You can now use the **F1** to **F4** function keys plus the ←, →, ↑ and ↓ cursor keys to move the cursor to the memory location at which automatic saving should begin.

After you have confirmed by pressing **ENTER**, the instrument begins the process. The station search always starts at the beginning of the band. Here is an example of what the measuring instrument might display while the scan is running.

Once a station has been found, the receiver data is stored in the tuning memory.
If the designated memory location is already occupied, the following options appear.

You use REPLACE to overwrite the memory location and CANCEL to stop the automatic saving process.
Each time receiver data has been saved successfully, the cursor is moved to the next memory location. Once the last memory location has been assigned, automatic saving begins again at memory location number 1. Automatic saving ends as soon as the scan function reaches the end of the band.
You can also end the function manually at any time using the **ABORT** menu item.

16.3.11 Editing MEM files using AMA.remote

The **AMA.remote** PC software can be used to edit MEM files on the PC. The program makes it possible to make changes to files exported from the measuring receiver (see "chapter 16.3.7 - Memory export") or to create new files. Files created in this way can then be imported into the measuring instrument (see "Chapter 16.3.8 - Memory import"). The **AMA.remote** software is available for download from www.kws-electronic.de under “PRODUCTS” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.

16.3.12 Sorting the memory

Using the menu items **MODE** -> **MEMORY** -> **ORDER**, the entire tuning memory can be sorted according to the following criteria:

- Range (SAT, TV, ...)
- Frequency (ascending order within a range)
- Analog/digital (within a range)
- Modulation (DVB-C, DVB-T, DOCSIS, ...)

The sorting process can be started using the menu items **RANGE**, **FREQUENCY**, **ANA/DIG** or **MODULATION**. This may take a few seconds.

16.3.13 Defragmenting the memory

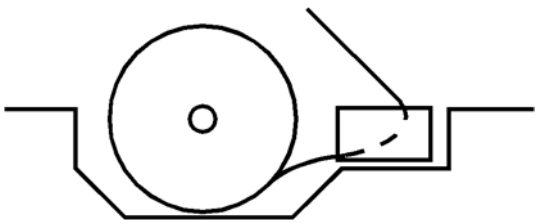
You can defragment the entire tuning memory using this function. This means that empty memory locations between individual blocks are removed.
This process is started using the menu items **MODE** -> **MEMORY** -> **DEFRAGMENT**.

Chapter 17 Printer

The measuring receiver has an integrated thermal printer with a horizontal resolution of 384 pixels.

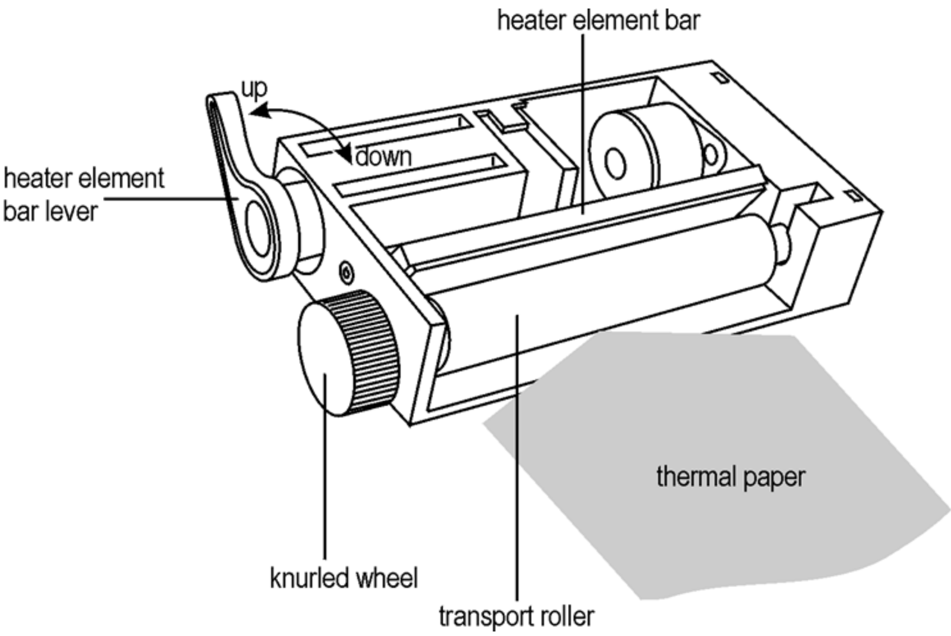
17.1 Paper refill

You must first open the printer cover by loosening the 4 cross-head screws and removing the metal cover. You can then insert the thermal paper roll according to the following illustration.



17.1.1 Manual paper feed

To feed in paper manually, first raise the heater bar off the transport roller by pulling the lever up. Then insert the beginning of the thermal paper roll under the transport roller. By turning the knurled wheel, you can push the paper through to the top. When the paper protrudes about 10 cm out of the heater bar, you can move the lever down so that the heater bar is pressed against the transport roller again. Lastly, you must thread the paper into the printer cover and reinstall the cover. You can now tear off the protruding paper on the tear-off edge as appropriate.



17.1.2 Automatic paper feed

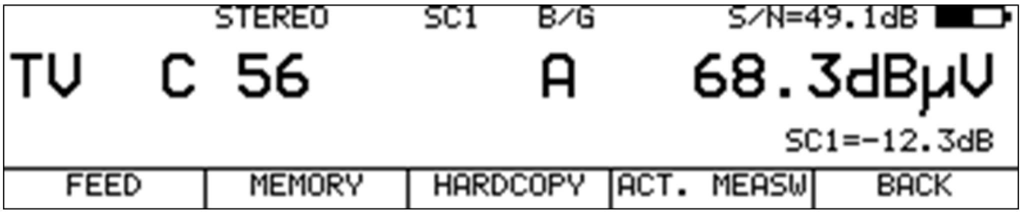
For this, the instrument must be switched on and the heater bar must be on the transport roller (lever down). Then you can insert the beginning of the paper roll under the transport roller.
When the paper sensor detects the thermal paper, the printer unit draws in the paper automatically. If the paper is pulled in at an angle, you can lift the lever to align the paper properly. You must then lock the lever again. After that, you feed the paper through the printer cover. Once that is done, you can reinstall the cover.

17.2 Cleaning the heater bar (only when necessary)

If the printout appears smeared, the cause can be a dirty heater bar. When cleaning the heater bar, the following steps are necessary. First, it is absolutely necessary that you switch off the instrument. Then raise the lever, whereby the heater bar is lifted off of the transport roller. Now you can clean the surface with a soft cloth soaked in alcohol. Lastly, push the lever down again. Never use sharp objects for cleaning.

17.3 Printer functions

For this, press the **PRINT** key, bringing up the following menu.

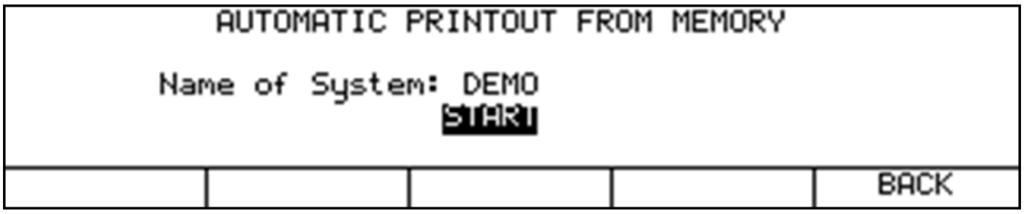


17.3.1 Manual feed

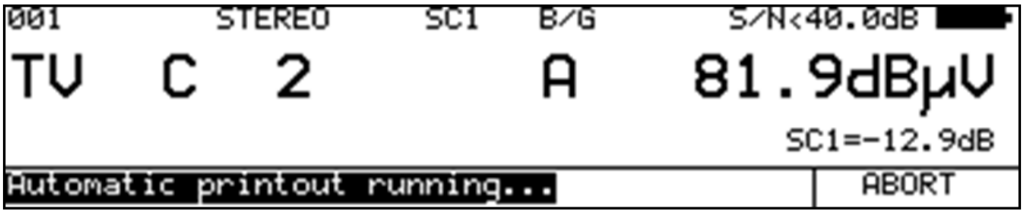
You can cause the printer to carry out a feed at any time by pressing the **F1** key. The printer unit feeds the paper forward continuously as long as the key is pressed. During this time, the menu item **FEED** is displayed inverted.

17.3.2 Automatic printout

You can carry out an automatic memory printout via the menu item **MEMORY**.
The memory preview then appears. You can now move the cursor onto the memory location from which the printout should begin. When you press the **ENTER** key, an input menu is shown in which you can edit the name of the system being measured.

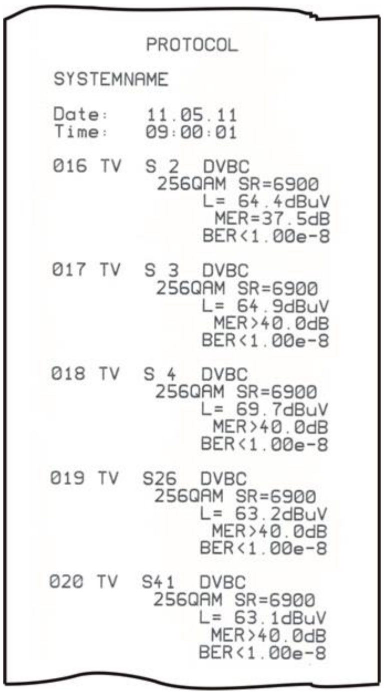


You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. If you press the **ENTER** key, the cursor jumps to **START**. When you press **ENTER** again, the process starts. In this example, SYSTEMNAME appears in the protocol header of the printout. The measuring instrument now recalls each memory location one by one and prints out the measured values. You can stop the printout manually via the menu item **ABORT**. The instrument otherwise prints until an empty memory location ends the block being measured.



The figure above shows the display during an automatic printout.

Automatic printout example:


PROTOCOL

SYSTEMNAME

Date: 11.05.11
Time: 09:00:01

016 TV S 2 DVBC
256QAM SR=6900
L= 64.4dBuV
MER=37.5dB
BER<1.00e-8

017 TV S 3 DVBC
256QAM SR=6900
L= 64.9dBuV
MER>40.0dB
BER<1.00e-8

018 TV S 4 DVBC
256QAM SR=6900
L= 69.7dBuV
MER>40.0dB
BER<1.00e-8

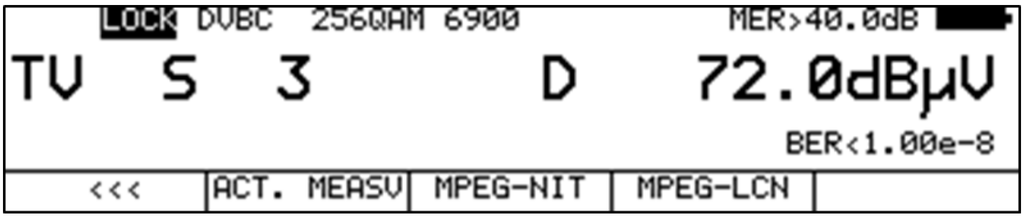
019 TV S26 DVBC
256QAM SR=6900
L= 63.2dBuV
MER>40.0dB
BER<1.00e-8

020 TV S41 DVBC
256QAM SR=6900
L= 63.1dBuV
MER>40.0dB
BER<1.00e-8

The protocol header can be designed according to each customer (See "Chapter 20.18 - User-defined headers for printing" and "Chapter 20.19 - User-defined logo for printing").

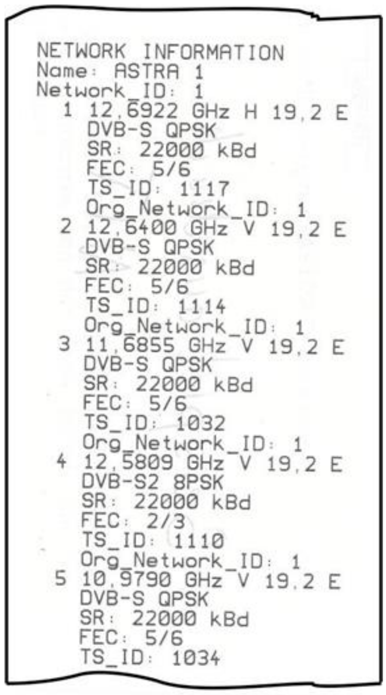
17.3.3 Printout of the NIT

First, the NIT must be read as shown in the "Chapter 11.6 - Network Information Table (NIT)". Now you can start the printout of the complete list on the thermal printer, including all details, via the menu item **PRINT** -> **MPEG-NIT** -> **PRINTER**.



You can cancel the current process at any time via the menu item **PRINT** -> **CANCEL**.

The following example printout shows the NIT from an ASTRA transponder.



NETWORK INFORMATION
Name: ASTRA 1
Network_ID: 1
1 12,6922 GHz H 19,2 E
DVB-S QPSK
SR: 22000 kBd
FEC: 5/6
TS_ID: 1117
Org_Network_ID: 1
2 12,6400 GHz V 19,2 E
DVB-S QPSK
SR: 22000 kBd
FEC: 5/6
TS_ID: 1114
Org_Network_ID: 1
3 11,6855 GHz V 19,2 E
DVB-S QPSK
SR: 22000 kBd
FEC: 5/6
TS_ID: 1032
Org_Network_ID: 1
4 12,5809 GHz V 19,2 E
DVB-S2 8PSK
SR: 22000 kBd
FEC: 2/3
TS_ID: 1110
Org_Network_ID: 1
5 10,9790 GHz V 19,2 E
DVB-S QPSK
SR: 22000 kBd
FEC: 5/6
TS_ID: 1034

17.3.4 Printout of the LCN list

First, the LCN list must be read as shown in the Network Information Table section. Now you can start the printout of the complete list on the thermal printer, via the menu item **PRINT** -> **MPEG-LCN** -> **PRINTER** .

17.3.5 Hard copy

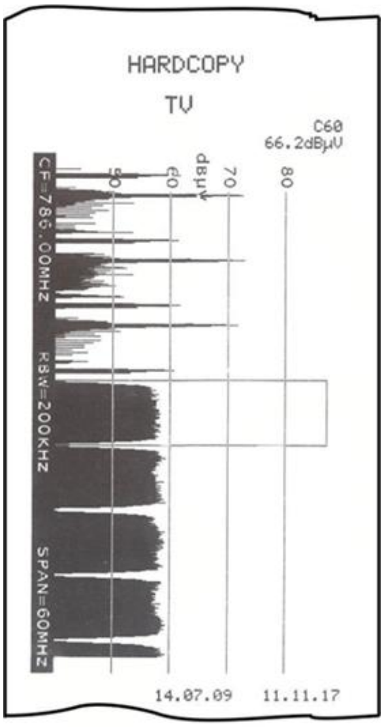
For purposes of documentation, you can output copies of the LCD and graphics screen to the thermal printer at any time. You can only make hard copies of the graphics if the graphics screen is switched on.

17.3.5.1 Hard copy of the LCD

You can print the current contents of the display onto paper via the menu item **PRINT** -> **HARDCOPY** -> **LCD** -> **PRINTER**. The figure below shows an example printout.

17.3.5.2 Hard copy of the graphics

You can print a copy of the current graphics screen (analyzer, constellation diagram, scope, impulse response...) via the menu item **PRINT** -> **HARDCOPY** -> **GRAPHIC** -> **PRINTER**. The next figure shows an example printout of an analyzer image.



17.3.6 Active measured values

You can use the **PRINT** -> **ACT. MEASV** menu item to output the active measured values to the printer in the style of an automatic printout. This requires that the measuring instrument is in the tuned mode (measuring mode).

Chapter 18 File Output

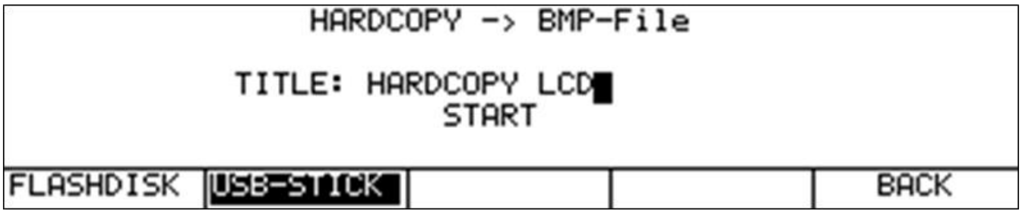
The operating system of the measuring receiver supports the FAT32 file system.
Various outputs can be written into a file using this system. A USB stick or the internal flash disk can be used as the storage medium.

18.1 Hard copy

Copies of the LCD and graphics screen can be saved as BMP files at any time for documentation purposes. The bitmap file format operates without losses or compression.

18.1.1 Hardcopy of the LCD

The current contents of the LCD can be saved as a BMP file in this manner.
You can open window for entering the file name by following **PRINT** -> **HARDCOPY** -> **LCD** -> **BMP- FILE**.



You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. After the **ENTER** key is pressed, the contents of the LCD (before the **PRINT** key was pressed) are written into a BMP file under the previously entered name. In this example, a file named HARDCOPY_LCD.BMP is created.

18.1.2 Hardcopy of the grafics

A copy of the current graphics screen (analyzer, constellation diagram, scope, impulse response) can be saved as a BMP file in this manner. By selecting
PRINT -> **HARDCOPY** -> **GRAPHIC** -> **BMP-FILE**, the window for entering the file name is opened (see above). If **+LCD** is selected additionally, the instrument adds the content of the LCD to the BMP file.
You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. After the **ENTER** key is pressed, the contents of the graphics screen are written into a BMP file under the corresponding name

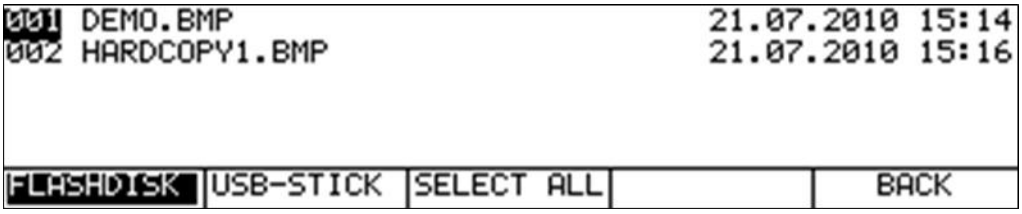
18.1.3 File names serially numbered

If the file name already exists in the directory the device automatically suggests a running number as suffix to the file name. This is helpful, when you make more hardcopies in the same context.

If you don`t want this suffix to be appended you can change the file name manually.

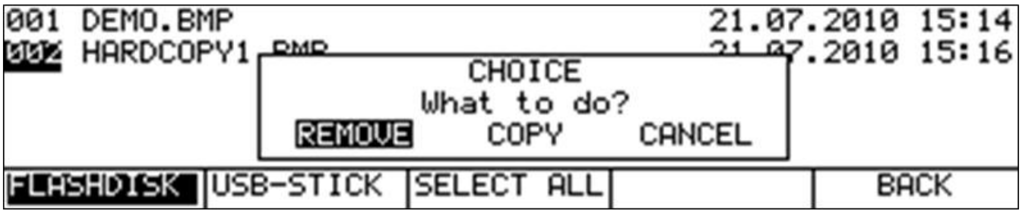
18.1.4 Calling up the directory of the BMP files

You can display list of all BMP files using **PRINT** -> **HARDCOPY** -> **DIRECTORY**. Press **BACK** to exit the list. You can use the ← or → keys to scroll between the pages of the list. Use the **FLASH DISK** or **USB-STICK** menu items to switch between the storage media.
All measurements can be selected my choosing the menu item **SELECT ALL**. This makes it possible to handle all of the files at the same time using the “delete BMP files” and “copy BMP files” functions.



18.1.4.1 Deleting BMP files

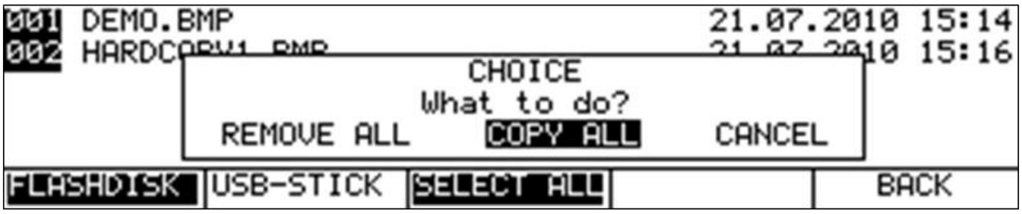
When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. After pressing the **ENTER** key, the following selection is displayed.



Use the ← and → keys to select **REMOVE**. In this example, the instrument deletes the HARDCOPY1.BMP file from the flash disk when the **ENTER** key is pressed.

18.1.4.2 Copying BMP files

When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. After pressing the **ENTER** key, the following selection is displayed.



You can use the ← and → keys to select **COPY ALL**. In this example, all BMP files are copied from the internal flash disk to the USB stick when the **ENTER** key is pressed.

18.2 NIT (network information table)

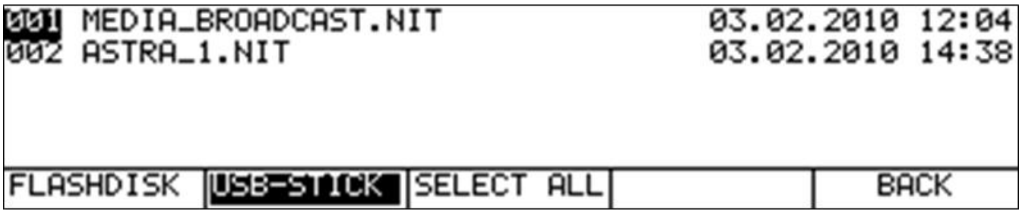
This section describes how DVB NITs can be saved as a text file and managed.

18.2.1 Saving the NIT as a text file

The NIT can be saved as a text file with the .NIT file extension in this manner. The file name is generated automatically from the NIT header.
The NIT must first be exported as described in the "Chapter 11.6 - Network Information Table (NIT)". The complete list (including all details) can then be output in a NIT file using the **PRINT** -> **MPEG-NIT** -> **NIT-FILE** menu item. If a file with the same name already exists, you will receive a warning. The process can then be cancelled or the existing file can be overwritten.

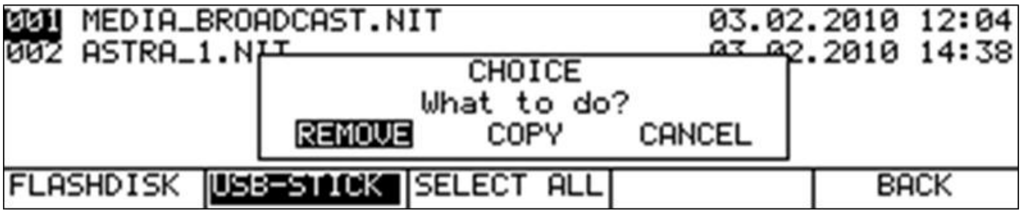
18.2.2 Calling up the directory of the NIT files

A list of all NIT files is displayed using **PRINT** -> **MPEG-NIT** -> **DIRECTORY**. Press **BACK** to exit the list. You can use the ← or → keys to scroll between the pages of the list. Use the **FLASH DISK** or **USB STICK** menu items to switch between the storage media.
All measurements can be selected my choosing the menu item **SELECT ALL**. This makes it possible to handle all of the files at the same time using the “delete NIT files” and “copy NIT files” functions.



18.2.2.1 Deleting NIT files

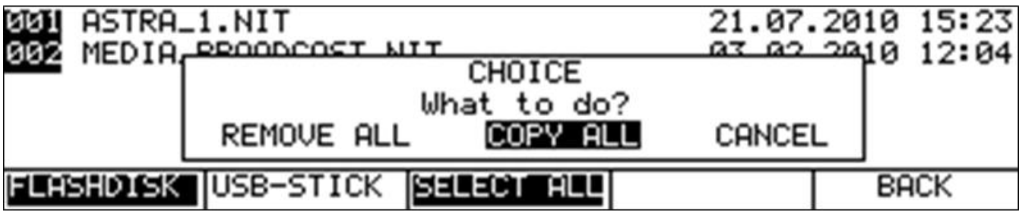
When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



Use the ← and → keys to select **DELETE**. In this example, the instrument deletes the MEDIA_BROADCAST.NIT from the USB stick when the **ENTER** key is pressed.

18.2.2.2 Copying NIT files

When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



You can use the ← and → keys to select **COPY ALL**. In this example, all NIT files are copied from the internal flash disk to a USB stick when the **ENTER** key is pressed.

18.3 Logical Channel Numbering (LCN)

This section describes how LCN lists can be saved as a text file and managed.

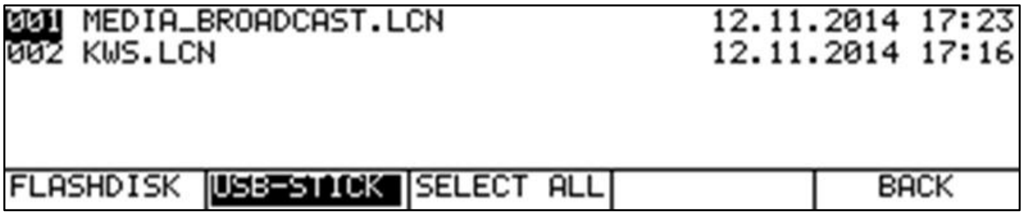
18.3.1 Saving the LCN list as a text file

The LCN list can be saved as a text file with the .LCN file extension in this manner. The file name is generated automatically from the list header.
The LCN must first be exported as described in the NIT section. The complete list can then be output in a NIT file using the **PRINT** -> **MPEG-LCN** -> **LCN-FILE** menu item. If a file with the same name already exists, you will receive a warning. The process can then be cancelled or the existing file can be overwritten.

18.3.2 Calling up the directory of the LCN files

A list of all NIT files is displayed using **PRINT** -> **MPEG-LCN** -> **DIRECTORY**. Press **BACK** to exit the list. You can use the ← or → keys to scroll between the pages of the list. Use the **FLASH DISK** or **USB STICK** menu items to switch between the storage media.

All measurements can be selected my choosing the menu item **SELECT ALL**. This makes it possible to handle all of the files at the same time using the "delete LCN files" and "copy LCN files" functions.



18.3.2.1 Deleting LCN files

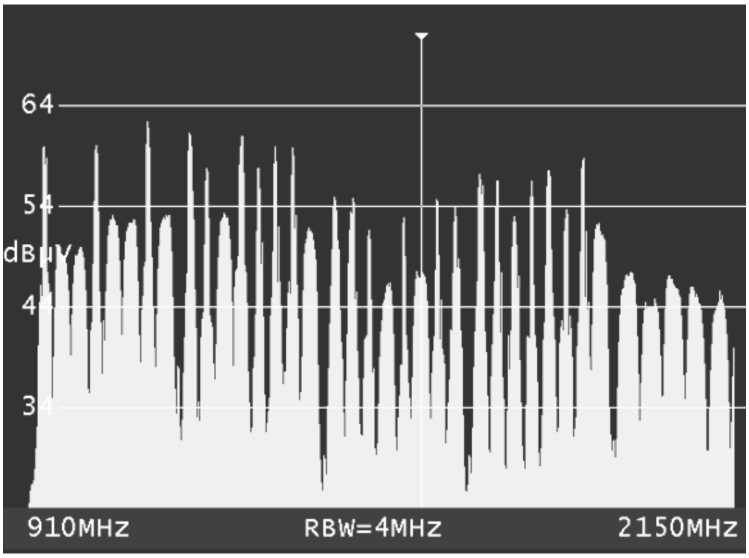
See "Chapter 18.2.2.1 - Deleting NIT files".

18.3.2.2 Copying LCN files

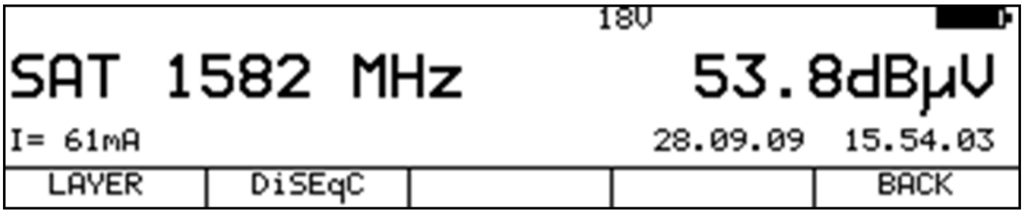
See "Chapter 18.2.2.2 - Copying NIT files".

Chapter 19 Spectrum Analyzer

You can access the spectrum analyzer in the satellite, TV, FM und RC ranges.
The figure below shows an ASTRA satellite spectrum.



The level grid is 10 dB/DIV. The dynamics can be a maximum of 40 dB.
The labelling of the level lines with the unit dBµV can be seen on the left. In the lower blue band, the center frequency (CF), the measuring bandwidth (RBW) and the frequency segment (SPAN) are shown. Parallel to this, additional information is shown in the LCD. These are the measuring range, the current cursor position and the level measured at the cursor position.



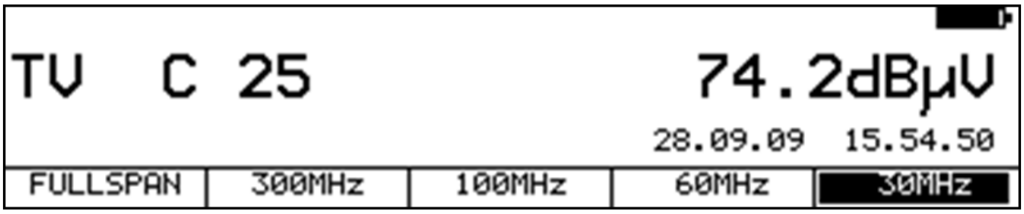
In addition, the set LNB supply, the measured LNB current and current time are shown.

19.1 Accessing the analyzer

You must first set the desired measuring range via the menu items **RANGE** -> SAT, TV, FM, RC or DAB. Press **ANALYZ** to initiate the analyzer. The status of the measuring receiver is now important. If the receiver is not tuned, the analyzer sweeps over the entire measuring range (FULLSPAN). But if the instrument is in the tuned mode (measuring mode), the analyzer displays the spectrum segment in the range of the measuring frequency.
When the UNICABLE control is active, the analyzer displays the frequency segment above and below the center frequency of the last UB slot that was activated.

19.2 Frequency segment (SPAN)

In all measuring ranges, you can change the frequency segment displayed.
You can do this via the menu item **SPAN** -> **FULLSPAN** or **xxMHz**.
In the "FULLSPAN" mode, the frequency segment spans the entire measuring range.



The figure shows the setting options in the TV range.

On devices working up to 1050MHz or 1214MHz in the range TV, there is a possibility to select a further frequency span called "SPAN867MHz" to display the span from start of band to 867MHz. This is useful for users working only in systems up to 867MHz, to get a better resolution.
The setting "FULLSPAN" or "SPAN867MHz" is stored in the device and the analyzer will come up with the last selection.

19.3 Measuring bandwidth (RBW)

The measuring instrument makes several measuring bandwidths available. These are coupled with the SPAN setting. The current setting is shown in the analyzer image.

19.4 Cursor

The cursor appears on the screen as a vertical white line with a tip. You can move the cursor within the frequency segment with the ← and → keys. After a change in the range or SPAN, the cursor is in the center of the frequency segment. Frequency and level displays in the LCD are always based on the cursor position.

TV range in the channel input mode:

Here you can move the cursor in the channel grid. The measuring receiver also detects whether the channels are analog or digital. With analog channels, the cursor jumps to the video carrier frequency; with digital channels, the cursor expands to a window that corresponds to the channel bandwidth. The channel bandwidth is assigned based on the channel table.

19.5 Switching between frequency and channel mode

You can only do this in the TV and DAB range. You can switch between modes via the menu items **CHANNEL** and **FREQUENCY**.

19.6 Level display

During each search, the level of the cursor frequency is measured and displayed in the LCD in dBµV. Level measurement in analyzer mode is comparable to a pure spectrum analyzer. The level is measured with the set measuring bandwidth (RBW).

TV range in the channel input mode:

The measuring instrument differentiates here automatically between analog and digital channels. With analog channels, the level specification is based on the peak value of the video carrier. With digital channels, the total power within the channel bandwidth is measured. It is not important here which SPAN is set.

19.7 Input of the center frequency

You can enter a new center frequency at any time using the numeric keypad. The frequency segment SPAN and the measuring bandwidth are not affected.

TV range in the channel input mode:

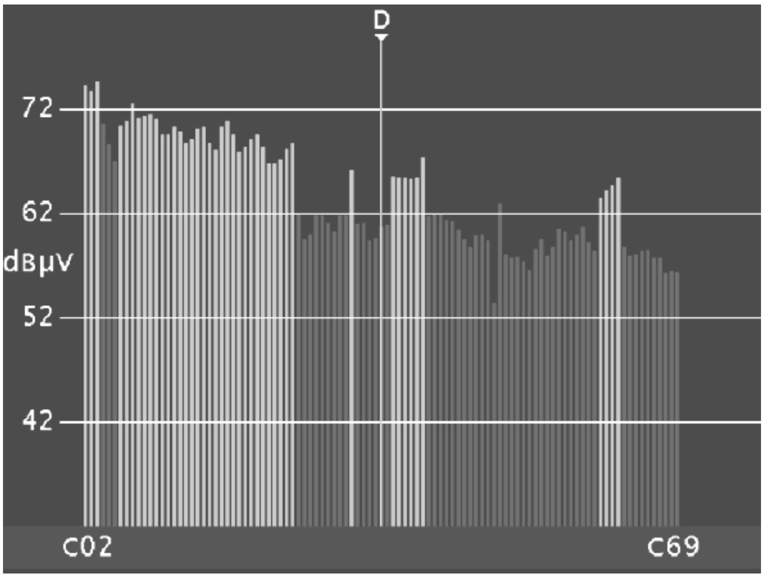
Using the menu item CHANNEL, you can switch between the input of C channels and S channels. Now you can type in a channel number using the numeric keypad. After you confirm with the **ENTER** key, the measuring instrument displays the spectrum around the set channel. Invalid entries are ignored.

19.8 Progress bar

A yellow bar on the lower edge of the screen grows from left to right during each new search by the analyzer. This allows you to follow the position of the "sweep".

19.9 Level diagram in the broadband cable range and DAB range

Assuming the measuring receiver is operating in the TV range, the mode is set to channel input and the frequency segment is FULLSPAN, the instrument provides a very useful feature.
As you can see in the figure, the diagram shows the relationship of the levels in a broadband cable system independent of the modulation (ATV or DVB-C) of the individual channels.



During the process, the instrument measures the levels of every individual channel and displays them in the diagram as a green or red bar. The green bars are analog and the red bars are digital channels. The cursor is marked with an "A" or "D".
In this diagram, tilted levels or abnormal drops in levels can be immediately detected with digital channels.

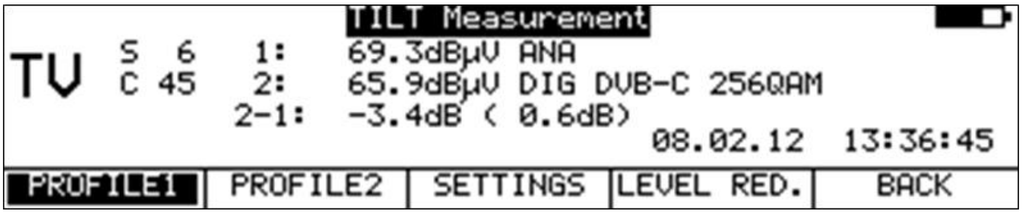
The function works in a similar manner in the DAB range, except that in this case there is nothing to indicate analog or digital. The levels are simply displayed as red bars.

19.10 TILT measurement in the TV range

This mode is an expansion on the level diagram in the TV range with the following additions:
You can select as many individual channels from the full channel table as you wish to include in the tilt measurement. The fewer "active" channels, the higher the repetition rate of the diagram. The specific combination of channels can be saved in a profile. The measuring instrument can manage 2 independent profile settings.
A second cursor appears for the tilt measurement. This can be moved with the ↑ und ↓ keys. The first cursor is moved with the ← and → keys.
If the channels upon which the two cursors are located are occupied, the device draws a reference line between the peaks of the level lines. To facilitate a tilt analysis in a system with both analog and digital channels, an "offset" line corresponding to the level reduction is added to the peaks of the level lines for digital channels. If the difference in level between an analog and a digital channel

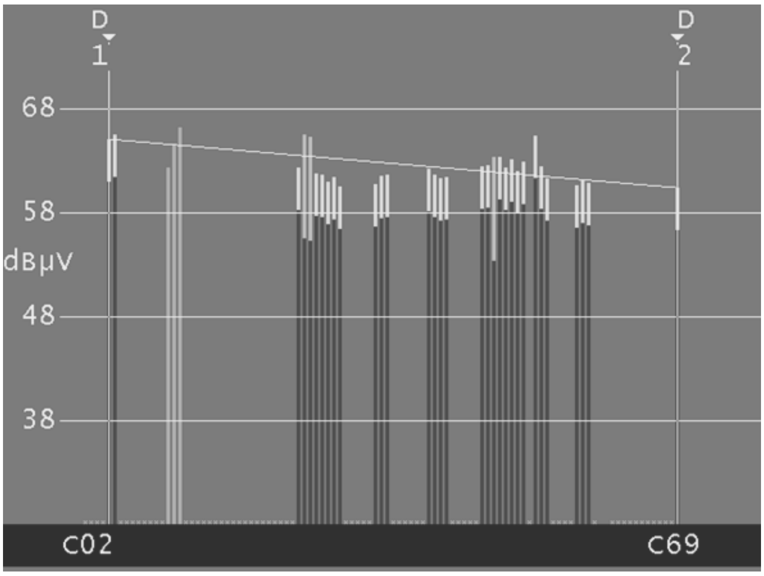
corresponds to the specified level reduction, the level lines are displayed with the same height in the diagram.
The instrument also determines the modulation for digital channels, and the “offset” line is displayed in a different color according to the modulation.
This allows you to quickly identify which DVB-C channels have 256 QAM and which have 64 QAM, for example.

Note! **While determining the modulation the instrument uses the following setting:**
DVB-C: Symbol rates 6,111, 6,875, 6,900 kSym/s
Modulation scheme: 64QAM, 256QAM
EURO-DOCSIS.



For every cursor position, the LCD shows the channel, the level measured during the last search, the channel type (analog/digital) and, for digital channels, the modulation.

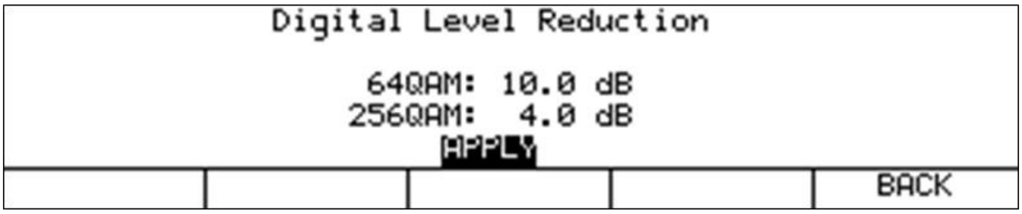
The level differential between the two cursor positions is also displayed. No level reduction is taken into account in the level displays. This means that these are the absolute levels. The level differential which appears in the brackets does, however, include the level reduction. This means that these displays can be used to set the reference line between the cursors exactly horizontal.



This function is activated via the **TILT** menu item. You can end the tilt measurement by selecting the **BACK** menu item.

19.10.1 Setting the level reduction

Using the menu item **LEVEL RED.**, the level reduction for digital channels can be set depending on the modulation scheme.



You can use the ← and → keys to move the cursor to the desired entry field.
You can now change the entry using the numeric keypad.
Confirm every entry using the **ENTER** key. The cursor then jumps to the next field.

The entries are saved when you move the cursor over the APPLY field and then press the **ENTER** key.

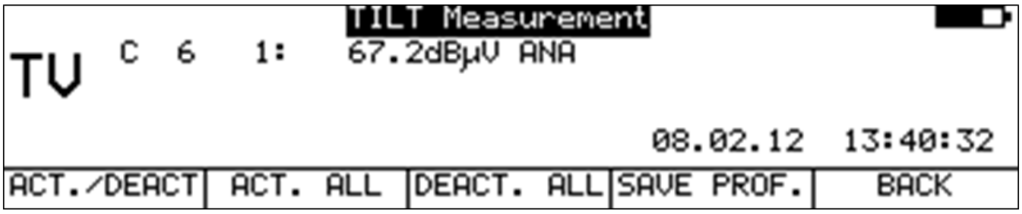
19.10.2 Selecting a profile

The measuring instrument can manage 2 different profiles for the tilt measurement. The profiles save the channels which are to be used for the measurement. The profiles can be selected using the menu items **PROFILE1** and **PROFILE2**.

On devices working up to 1050MHz or 1214MHz, there is a possibility to select quasi 2 further profiles "PROFILE3" and "PROFILE4" when calling the tilt measurement from "FULLSPAN" or "SPAN867MHz".

19.10.3 Creating or changing a profile

The currently active profile can be adjusted using the menu item **SETTINGS**. After the menu item is selected, the diagram is frozen and the 2nd cursor appears.



You can use the ← and → keys to move the cursor within the diagram. The current position is shown on the LCD.

Activate/deactivate individual channels.

The channel on which the cursor is located can either be included in the measurement or skipped using the menu item **ACT./DEACT**. If a channel is excluded from the measurement, a small, light-blue X appears in the diagram instead of the level line.

Activate all channels

The menu item **ACT. ALL** includes all channels in the measurement. All light-blue Xs in the diagram disappear.

Deactivate all channels

The menu item **DEACT. ALL** excludes all channels from the measurement, including the two on which the cursors are located.

Save profile

The menu item **SAVE PROF.** stores the channel profile. This confirms the adjustment of the profile and the diagram resumes updating with the modified settings.

Do not save profile

The menu item **BACK** discards all changes and the measurement resumes with the old settings.

Note! **The instrument automatically determines the symbol rate and the modulation for the digital channels as soon as a new profile has been added. After this the new information is memorized, therefore the intervals of TILT measurement will increase. Should there be a change of transmission of channels in a facility, then the profile must be stored new so that the instrument can define the sizes correctly.**

19.10.4 Application

There are two basic applications.

„Lining up" a system:

A profile is created with the channels that are occupied in the system. Move the 1st cursor onto the lowermost channel and the 2nd cursor onto the uppermost channel. First set the lowermost channel to the desired absolute level. You then have two options.

No predistortion:

Set the level of the uppermost channel so that the reference line between the two cursors is horizontal or raise the level display.
With predistortion:
Set the level of the uppermost channel appropriately higher.
The channels in between can then be "lined up" using the reference line.

Checking the tilt of the system:

A profile is created with the channels which are to be analyzed in the test. This may be fewer than the number which are occupied in the system. Including fewer channels increases the repetition rate.
Move the two cursors to the uppermost and the lowermost channels. Then check the level lines of the channels in between using the reference line.

19.11 Switching to measuring receiver mode

You can switch directly from the analyzer to measuring receiver mode while in all measuring ranges. The instrument uses the current cursor frequency to tune the measuring receiver. Direct switching with TV only is possible in the FULLSPAN setting. Press **ENTER** to trigger the process.

SAT range:

If the cursor is located on the center frequency of the transponder, the instrument detects whether it is an analog or digital transponder based on the spectrum. When you switch into measuring receiver mode, the instrument then sets the corresponding mode. But this feature only works when the digital transponder operates with symbol rates of 22,000 kBd or 27,500 kBd.
When the UNICABLE control is active, the frequency display always refers to the spectrum that was converted by the UNICABLE unit.

TV range in the channel input mode:

As already mentioned in the "Chapter 19.4 - Cursor", the instrument can distinguish between analog and digital channels based on the spectrum. This feature is used when switching into the measuring receiver mode. When the instrument detects an ATV channel, the corresponding measuring receiver mode is activated.

If it is a digital channel, the instrument switches to the last digital mode that was active (DVB-C, DVB-T or DOCSIS).

If the **ANALYZ** key is then pressed in the measuring receiver mode, the instrument switches back into analyzer mode and shows the most recently set spectrum segment.

19.12 Freezing the spectrum

You can freeze the current spectrum using **FREEZE**. While frozen, the menu item **FREEZE** is displayed inverted. If you select the menu item **FREEZE** a second time, the analyzer image will again be continuously updated.

19.13 Max hold function

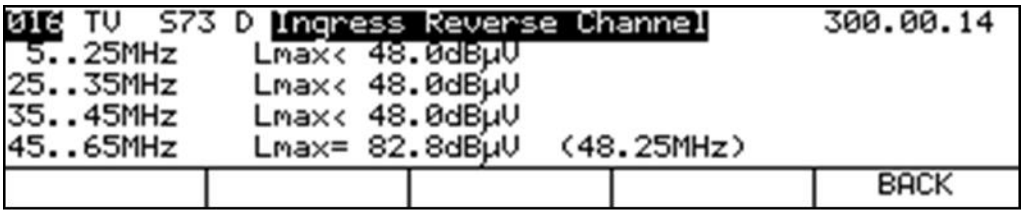
This function can be switched on and off via the menu item **MAX HOLD**. The menu item is then displayed inverted. The spectrum is only updated when the level increases. Since with an active return path, the spectrum changes depending on the activity of the connected cable modem a reasonable representation of the spectrum is only possible with this function.

This function can also be called upon in different analyzer ranges.

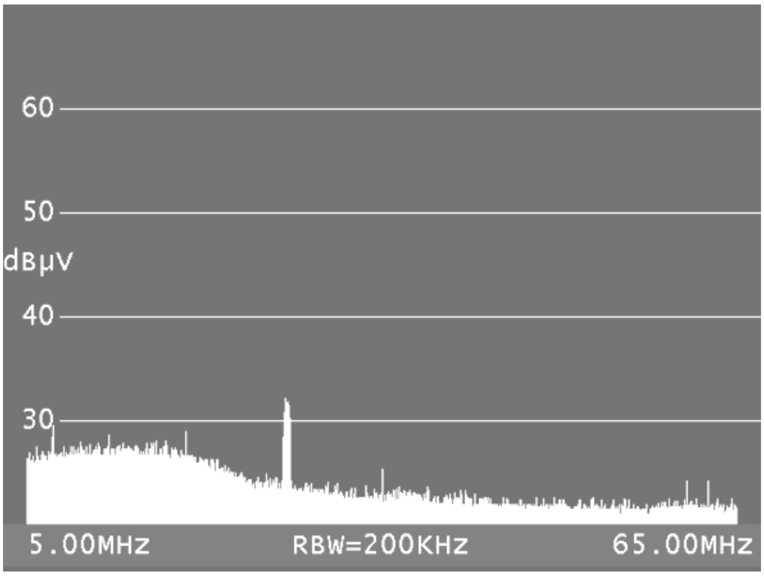
19.14 Ingress measurement in the return path

This function is activated via the menu item **INGRESS**. Ingress refers to all interference spectra that mix with the signal in the return path. This can be strong short wave stations, CB radio, baby monitors or interference emissions from electrical machines. Badly shielded return path components and incorrectly mounted plug connections can also increase the ingress. Ingress reduces the signal-to-noise ratio of return path signals and can therefore lead to errors in transmission.
The consequence is that the required data rates in interactive cable networks can no longer be maintained. It is therefore crucial to keep ingress as low as possible.

To support ingress measurement, the instrument provides a special function.

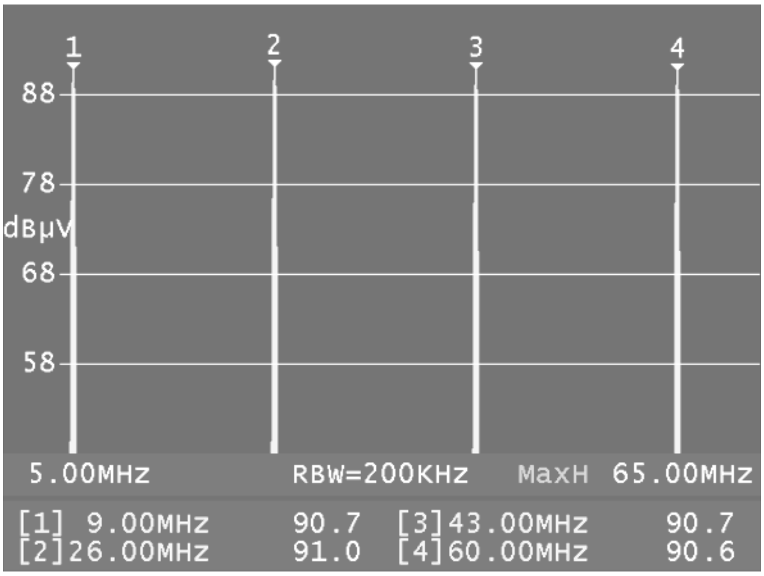


The frequency range from 5 to 65 MHz is divided into 4 ranges. Within these ranges, the maximum level and the frequency with which this level occurred is continuously measured and shown on the display. The instrument also shows the elapsed time since the start of the ingress measurement. The following spectrum shows a strong interference at 27 MHz (CB radio). You can end the ingress measurement by selecting the menu item **BACK**. The ingress measurement makes use of the max hold function.



19.15 Marker function

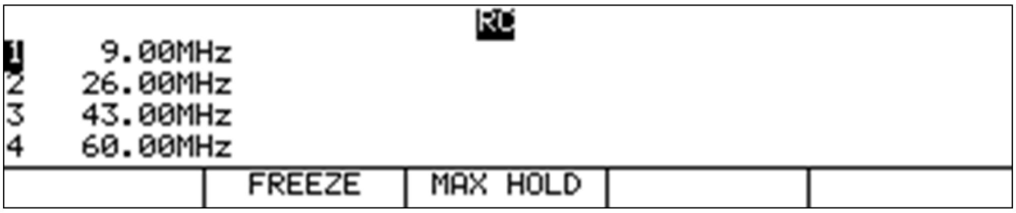
As described in the "Chapter 9 - RC (Return Channel) Measuring Range", when the device is in the RC measuring range, it can be switched to an operating mode for stationary operation at a head end. This is displayed slightly differently in the analyzer.



4 markers appear on the screen printout.

The level values at the marker positions are shown in the lower section. When “MaxH” appears, the Max-Hold function is switched on. The figure is recorded along with the upstream generator and the generator transmits 4 unmodulated carriers. This provides information about the frequency response of the return path.

The marker frequencies can be edited. See the display on the right for this purpose.



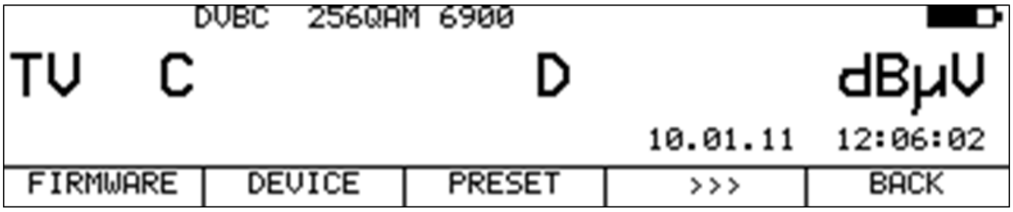
Four marker frequencies appear in the display. Marker 1 is selected. Use the ↑ and ↓ -keys to select one of the four markers You can change the marker frequency using the numeric keypad. You can also gradually adjust the markers using the ← or → keys. The settings are non-volatile.

19.16 Activating the remote supply

You may activate the remote power supply options available in each respective measuring range (e.g. LNB supply) while in analyzer mode in the same way as was discussed in previous sections. Therefore, first use the **LNB** key to access the corresponding menu.

Chapter 20 Management of the Instrument

Via **MODE** -> **SETTINGS**, you can access the following menu.



This menu includes several pages that can be reached with **>>>**.

20.1 Language of user interface

The instrument supports a user interface in German, English and French. You can select the desired language using **MODE** -> **SETTINGS** -> **DEVICE** -> **LANGUAGE** -> **GERMAN**, **ENGLISH**, **FRENCH**. The setting is non-volatile. The default setting is German.

20.2 Query software version

This function allows you to query the software version (firmware). To do this, choose the menu items **MODE** -> **SETTINGS** -> **FIRMWARE** -> **INFO**. The instrument then shows the current firmware version and the software version of the MPEG decoder. If the DOCSIS analyzer option is installed, its software version is also displayed. In the firmware information, the digits after the point (1565 in this example) represent the instrument's hardware version. The entry after the point indicates the current firmware release (11b).

As of version Vxx.11a, two firmware variants are available. One variant applies to existing instruments without integrated memory expansion. The second variant applies only to instruments with memory expansion. An “(E)” after the firmware version indicates an integrated memory expansion. Some future features will require a memory expansion.

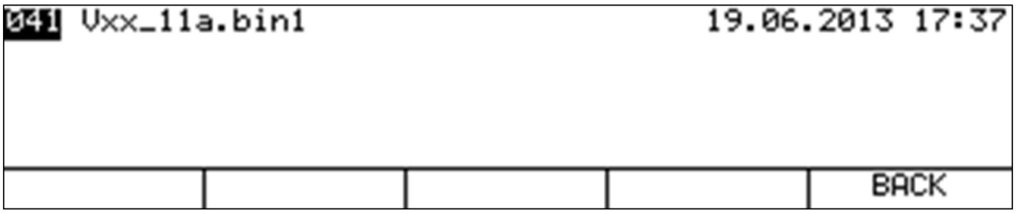
You can close the INFO window again by pressing **ENTER**.

20.3 Software update

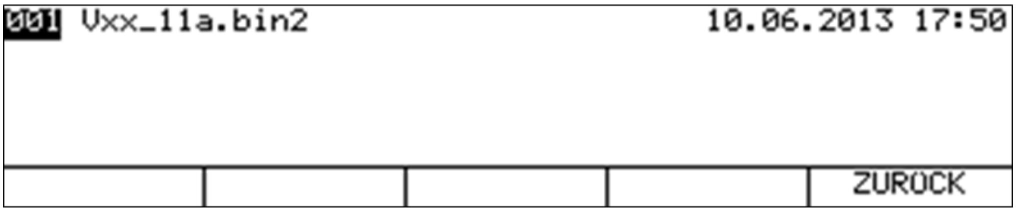
You can load a new firmware release onto the instrument at any time.
The software is saved in a file with the extension *.bin or *.bin1 (for instruments without memory expansion) or *.bin2 (for instruments with memory expansion). These files may be requested from the manufacturer or downloaded directly from the website www.kws-electronic.de and then copied to the supplied USB stick from a PC.
It is advisable to save both files (*.bin1 and *.bin2) to the stick. The instrument will then select the appropriate file automatically.

Before performing the update, connect the instrument to the mains for safety.
The instrument must not be switched off while the update is running as the update process deletes the old firmware and the new version may not have been fully installed.

To perform the update, insert the USB stick in the instrument and choose the menu items **MODE** -> **SETTINGS** -> **FIRMWARE** -> **UPDATE**. All saved BINx files are then displayed for selection. Use the ↑ and ↓ keys to move the cursor to the relevant file. The following screenshot is taken from an instrument without memory expansion.



If the instrument has a memory expansion, only *.bin2 files are available for selection.



Press the **ENTER** key to start the software update. The instrument deletes the old version from memory and writes the new software onto the internal flash memory.
This process can take about 70 seconds. As soon as the update is finished, the instrument emits a short beep and boots using the new firmware.

Important: **As of version Vxx_11a, a memory expansion is required for fully equipped instruments. This results in a need for two different files. The *.bin1 extension is retained for instruments without memory expansion. The software for instruments with memory expansion is contained in a separate file with the extension *.bin2. The instrument detects the appropriate file automatically. It is therefore advisable simply to copy both the *.bin1 and *.bin2 files to the supplied USB stick and select the required version. The file extension must not be changed on the PC.**

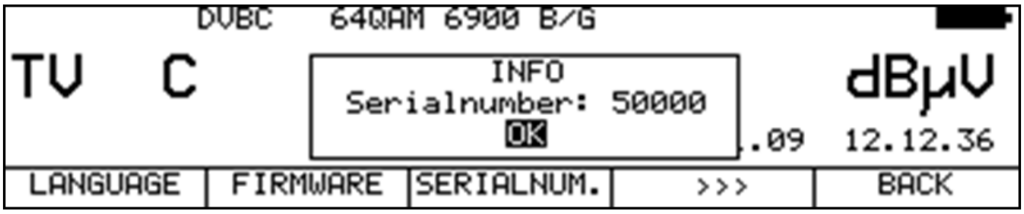
Important: **The following paragraph applies only to instruments without memory expansion. Starting with version Vxx_06a, the extension of the image file has been changed from .bin to .bin1. That is necessary because an enhanced bootloader is required. However, this bootloader is used only for versions Vxx_5b and higher. So, in order to update to version Vxx_06a and higher, a version that is Vxx_5b or higher must already be loaded on the instrument. If that is not the case, first update to Vxx_5b.**
Vxx_5b or higher is required so that an image file with the extension .bin1 can be selected for the update.

20.4 Updating hardware modules

The instrument contains some components with dedicated software or programmable logic. So that updates can also be performed at the customer, the instrument offers the ability to program the most important components using the instrument software. The instrument must fulfil certain prerequisites for this. Use the **MODE** -> SETTINGS -> FIRMWARE -> ADVANCED menu items to access a sub-menu showing the components that can be programmed using the current instrument version. More information is available from the Service team or via the website www.kws-electronic.de.

20.5 Serial number

In addition to finding the serial number next to the text on the name plate on the back of the instrument, you can also access the serial number of the measuring receiver here. This is done via **MODE** > SETTINGS -> DEVICE -> SERIALNUM.



You can close the INFO window again by pressing **ENTER**.

20.6 MAC address

A MAC address (Media Access Control Address) is the physical address that each individual network adapter has for unique identification of the device in a computer network. Every instrument is given a MAC address that is unique worldwide.
This can be viewed using **MODE** -> SETTINGS -> DEVICE -> MACADR.

The INFO page can be closed again using the **ENTER** key.

20.7 SCART

The graphics screen output (e.g. analyzer, scope, constellation diagram) via the SCART connector can be controlled under **MODE** -> SETTINGS -> DEVICE -> SCART.
Output can be either an RGB or CVBS signal.

Note! **This menu item only appears if the device hardware is suitably equipped. Otherwise the graphics output via SCART is generally an RGB signal.**

20.8 Query hardware configuration

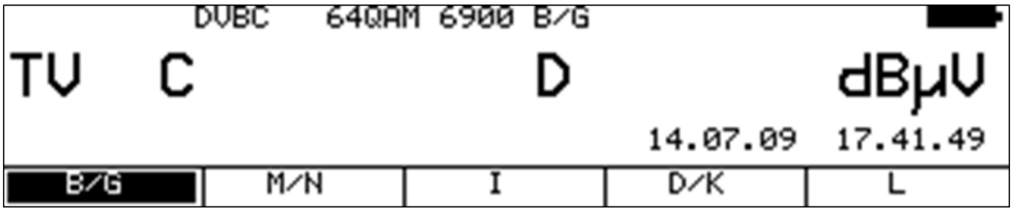
The instrument reads out all included modules under **MODE** -> SETTINGS -> DEVICE -> SERVICE -> HARDWARE and shows its number and version.

20.9 Default setting

Via **MODE** -> **SETTINGS** -> **PRESET**, all non-volatile instrument settings are set back to the delivery condition. The contents of the tuning memory are not affected.

20.10 TV standard

You can select 5 different TV standards via **MODE** -> **SETTINGS** -> **DEVICE** -> **TV-STAND** -> **B/G**, **M/N**, **I**, **D/K** or **L**. The TV standard is linked to the channel table used with TV. The TV standard also defines the video/sound carrier used with ATV (Analog TV). The channel table defines the channel spacing used and the channel bandwidth. This also applies to digital transmissions (DVB-C, DVB-T, DOCSIS). This setting is non-volatile and is incorporated in the tuning memory. For this reason, you can create memory locations with different TV standards. The default setting is B/G.



20.11 Setting date and time

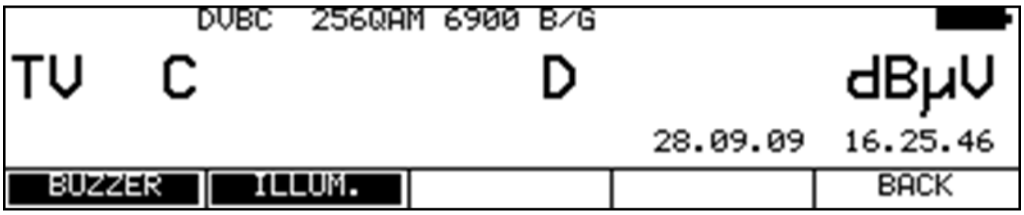
The measuring receiver is equipped with a clock component. The date and time are displayed in many operating modes on the display line above the menu bar.
Via the menu item **MODE** -> **SETTINGS** -> **DEVICE** -> **TIME/DATE**, you can access the following input menu. You can change the date and time, e. g. for switching to summer/winter time.

You can use the ← and → keys to move the cursor to the desired entry field.
You can now change the entry using the numeric keypad. Confirm every entry using the **ENTER** key. The cursor then jumps to the next field.

The entries are saved when you move the cursor over the APPLY field and then press the **ENTER** key.

20.12 Keypad settings

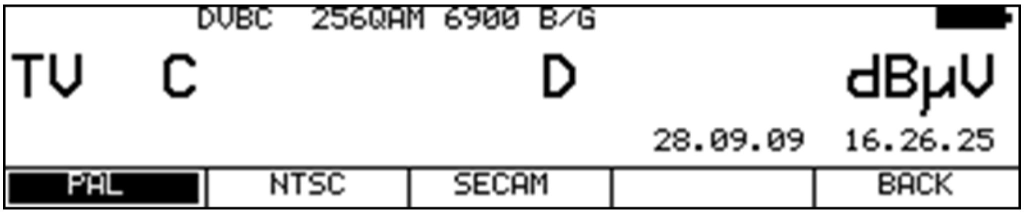
Using the menu item **MODE** -> **SETTINGS** -> **DEVICE** -> **KEYBOARD**, you can switch the key illumination and buzzer off and on.



The figure shows the default setting. The buzzer and illumination are switched on. These settings are non-volatile.

20.13 Color standard

You can select the desired standard for color decoding with ATV (Analog TV) using **MODE** -> **SETTINGS** -> **DEVICE** -> **COLORSTAND** -> **PAL, NTSC** or **SECAM**.



This setting also applies to an external FBAS video signal that is fed in through the SCART socket. This setting is non-volatile but is not incorporated in the tuning memory. The default setting is PAL.

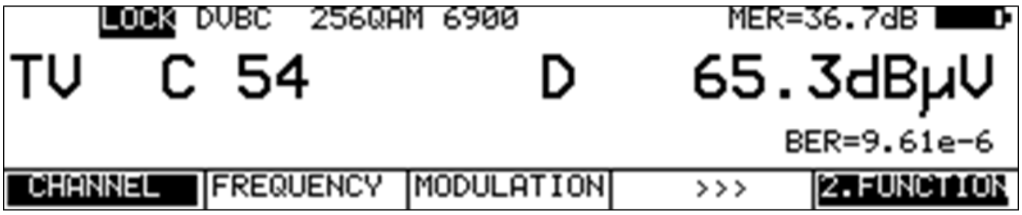
20.14 User-defined channel table for TV

In addition to the preset channel tables that the instrument uses in combination with the set TV standard, a user-defined channel table can be loaded onto the instrument. Users can use the AMA.remote PC software to create their own tables and then export them as files. The channel table currently used in the instrument can be exported so as not to have to create a channel table from scratch.
To do this, use the menu items **MODE** -> **SETTINGS** -> **DEVICE** -> **CHAN.TABLE** -> **EXPORT**. The instrument creates a CHA file with a file name that is derived from the name of the currently set channel table, for example STANDARD_BG.CHA. This file can be used as a template in AMA.remote.
If you wish to import a channel table using a CHA file, the following steps are necessary.
MODE -> **SETTINGS** -> **DEVICE** -> **CHAN.TABLE** -> **LOAD** allows the user to select the CHA files stored on the USB stick. Use the cursor to select the desired file, and press the **ENTER** button. The measuring instrument will then load the channel table stored in the file into a non-volatile memory.
If the file is defective, the process is cancelled and a corresponding message will appear on the display.

With **MODE** -> **SETTINGS** -> **DEVICE** -> **CHAN.TABLE** -> **DIRECTORY**, the channel tables can be transfered from the USB stick to the internal flash disk and then the files may be loaded into the instrument from there.

With **MODE** -> **SETTINGS** -> **DEVICE** -> **CHAN.TABLE** -> **INFO**, the instrument displays the file name from which the most recently loaded channel table comes.

With **MODE** -> **SETTINGS** -> **DEVICE** -> **CHAN.TABLE** -> **USER**, the instrument switches to using the channel table that has been loaded. An error message appears if no channel table has been loaded. The following figure shows that menu item **CHANNEL** receives the extension (BEN).



The instrument now uses the user-defined table for all functions that are based on a channel table.

This setting is non-volatile. In other words, the instrument works with the table that has been loaded even after being switched on and off. In addition, the channel table is also incorporated in the tuning memory. In this way, entries from both the standard channel table and the user-defined table can be saved.

Caution! **If the user-defined channel table is changed, the instrument can no longer use the memory entries that were stored using the previous version of the user-defined channel table.**

With **MODE** -> **SETTINGS** -> **DEVICE** -> **CHAN.TABLE** -> **STANDARD**, the instrument uses the channel table that is stored permanently in the instrument according to the TV standard. This is the default setting.

The AMA.remote software is available for download from www.kws-electronic.de under “PRODUCTS” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.

D Channels:
Since nowadays analog channels are often turned off in the cable networks, digital channels are named after their center frequencies (e.g. D346). The software AMA.remote can be used to create user defined channel tables containing these D channels. Furthermore it is possible to mix the standard C and S channels with the D channels. Hence you can create a channel table where the analog channels are still defined as C and S channels, but the digital channels are called D channels for example.

With introduction of DOCSIS 3.1 in the CATV networks, there are OFDM-downstream channels with bandwidths from 24 - 192MHz. These widthband channels can be assigned in a user defined channel table within the software AMA.remote.

20.15 Formatting the internal flash disk

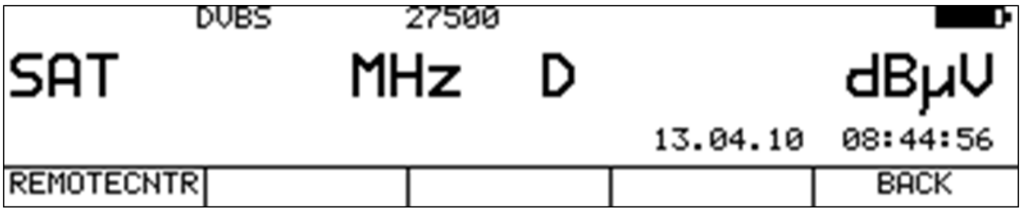
The instrument is equipped with a 64 MByte flash disk. The data medium is formatted in the factory. You can reformat the flash disk via **MODE** -> **SETTINGS** -> **FLASH-DISK** -> **FORM.FLDSK**. This causes all files stored by the user to be deleted.

20.16 Exporting the internal flash disk

All files on the flash disk can be copied to a connected USB stick using **MODE** -> **SETTINGS** -> **FLASH-DISK** -> **EXPO.FLDSK**. If formatting is then carried out, the internal data carrier will revert to the state it was in when the instrument was delivered.

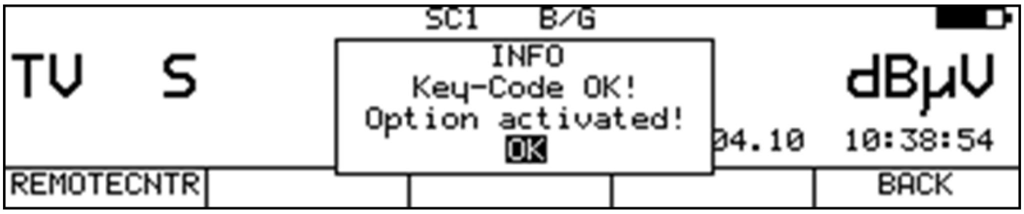
20.17 Activating software options

Software options can be activated by entering an 8-digit key code.
You can request the individual key code for each option from the manufacturer.
When you select **MODE** -> **SETTINGS** -> **KEY-CODE**, the following submenu appears.



The options available to date are listed here. Options that are already activated are displayed inverted. The "Remote Control via SNMP" and "FTP" option are currently available.
To activate the “Remote Control via SNMP” option, select the **REMOTECNTR** menu item. For turning on the “FTP” option, the **FTP** menu item has to be chosen. An entry field for the 8-digit key code is then displayed.

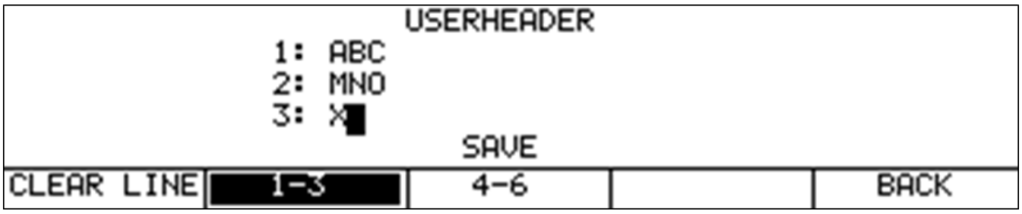
If the code is entered successfully, the following message appears.



The corresponding option is now activated. To use the option, you need to switch the instrument off and on again.

20.18 User-defined headers for printing

Up to six user-defined rows can be added to the standard protocol header of the printout (see "Chapter 17.3.2 - Automatic printout").
With **MODE** -> **SETTINGS** -> **PRINTOUT** -> **EDIT HEAD**, takes the user to the following window for entering the information.



Menu items **1 - 3** and **4 - 6** can be used to switch between the entry of lines 1-3 and 4-6.

The ← and → keys are used to move the cursor to the desired line or position. Each line can include up to 20 characters, which can be entered using the numeric keypad.
Press **ENTER** to accept the entries. The cursor moves to the beginning of the next line. Menu item **CLEAR LINE** is used to delete the entire line. After an entry has been made in the third line, the cursor moves to the **SAVE** selection. Press **ENTER** again to save the headers in the instrument.

With **MODE** -> **SETTINGS** -> **PRINTOUT** -> **HEADER**, the user-defined lines are added to the standard protocol header. In the default setting, the additional headers function is deactivated.

MODE -> **SETTINGS** -> **PRINTOUT** -> **TEST** can be used to generate a sample printout of the new protocol header.

20.19 User-defined logo for printing

A logo can be added to the printout instead of or in addition to the user-defined headers. This logo can be loaded into the instrument as a Bitmap file.

An example of this type of logo can be downloaded from the www.kws-electronic.de webpage under „PRODUCTS“ –> „AMA 310“ -> „Downloads“ -> „Demologo.bmp“. This “Demologo.bmp” file can be changed according to the user’s preference using Microsoft® Paint software. However, the format of the sample file must be retained.
This Bitmap file can now be uploaded to the instrument via the USB stick.
This is done is follows: **MODE** -> **SETTINGS** -> **PRINTOUT** -> **LOAD LOGO**.

A list appears containing all BMP files. The desired file can be selected using the cursor keys. Press **ENTER** to copy the file into the internal FLASH DISK. If the format of the file is not compatible, the process is cancelled and an error message appears.

Caution! If the internal FLASK DISK is formatted at a later time, the logo will become lost. For this reason, a backup copy of the file should always be kept.

MODE -> **SETTINGS** -> **PRINTOUT** -> **LOGO** is used to print the logo loaded from the BMP file before the standard protocol header. No logo is printed in the default setting.

MODE -> **SETTINGS** -> **PRINTOUT** -> **TEST** can be used to generate a sample printout of the new protocol header.

20.20 Deactivating the DOCSIS analyzer

If the measuring receiver is equipped with a DOCSIS analyzer, the analyzer can be deactivated manually. This can be useful in many cases.

If no return-path-capable components are integrated in a system, but the DOCSIS downstream channel is still to be measured, this will prevent the measuring instrument on the upstream from trying to send. As this occurs in such a case with a high transmitting power, the downstream measurements can be interrupted in some circumstances.

With automatic measurements (DataLogger and automatic printout), the upstream transmitting power is also taken into consideration with the active DOCSIS analyzer. However, to do this, the ranging process must be completed. This usually takes a few seconds. If only the downstream parameters are to be recorded with DOCSIS, it is better to deactivate the DOCSIS analyzer.

MODE -> **SETTINGS** -> **DOCSISANAL** -> **UPSTREAM** can be used to activate and deactivate the DOCSIS analyzer. When the DOCSIS analyzer is active, the menu item is displayed inverted.

This setting is non-volatile. It is also incorporated in the tuning memory. For this reason, memory locations can be created with an active or inactive DOCSIS analyzer. Memory entries, for which the DOCSIS analyzer is active are marked with +US.
In the default setting, the DOCSIS analyzer is active.

20.21 Configuration of the PING test in the DOCSIS analyzer

If the measuring receiver is equipped with a DOCSIS analyzer, the analyzer can be used to perform a PING test.

MODE -> **SETTINGS** -> **DOCSISANAL** -> **PING-TEST** is used to configure this test. By default, PING packets with a 64-byte length are sent during this test. The number of the packets to be sent and the time interval between two PINGs can be configured in the submenu.

MODE -> **SETTINGS** -> **DOCSISANAL** -> **PING-TEST**-> **PACKETS** is used to set the number of packets to be sent. After calling the submenu, the user can select the number of packets. This number can be changed using the numeric keypad. The allowed value range is from 5 to 100 packets. If a value smaller than 5 or larger than 100 is entered, the display resets to the last value that was entered correctly.

After a valid value has been entered, pressing the **ENTER** key twice applies the setting for all future PING tests until a new value is entered. The entry is non-volatile and is kept even when the instrument is shut off.

MODE -> **SETTINGS** -> **DOCSISANAL** -> **PING-TEST** -> **INTERVAL** is used to set the time interval between two PINGs.
Keys **F1** to **F4** are used to select between 0.5 seconds, 1 second, 2 seconds and 5 seconds. Press **BACK** to exit the submenu. The entry is non-volatile and is kept even when the instrument is shut off.

20.22 Configuring of the Speed test in the DOCSIS analyzer

If the measuring receiver is equipped with a DOCSIS analyzer, it can be used to perform a speed test (data throughput measurement) in the uplink and downlink directions. The test is based on transmission of data from or to an FTP server that is connected to the headend. Several parameters must be stored in the measuring instrument for this test.

You can use **MODE** -> **SETTINGS** -> **DOCSISANAL** -> **SPEED TEST** to configure the test. This section offers four profiles which also allow you to store the data for multiple HFC clusters or headends.

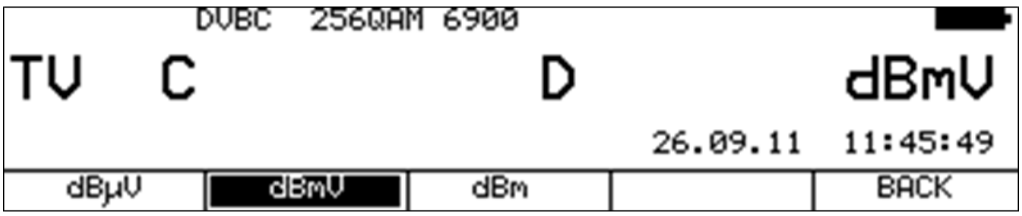
You can use keys **F1** to **F4** to select a profile. You can edit the selected profile using the steps described below. At the same time, the parameters of the most recently selected profile are automatically selected for future speed tests of the DOCSIS 3.0 analyzer.

You can use the ← or → keys to move the cursor within the profiles to change individual parameters. You can use the measuring instrument's numerical keypad to enter not only numbers, but also letters and special characters. The individual keys include both their numerical value, and a label of the letters they can be used to enter. By pressing a key multiple times, you can switch between the individual letters, uppercase and lowercase, and the numerical value. You can enter a space with the 0 key, and the 1 control button can be used for various special characters.

Enter the IP address in the usual format. The username and password of the FTP server and the name (or path, where applicable) of the download file are alphanumeric character strings. 16 characters are available for the password, 18 for the username and 30 for the file name or file path. The value range for the downlink file size is 0.1 to 2,048 MByte. The uplink file size is 0.1 to 500 MByte. Even though, for example, a profile is only configured for a downstream test, a valid figure must be entered for the upstream file size. When you are done entering a value, use the **ENTER** key to skip straight to the next value. The last parameter is the name of the profile. The user can also edit the parameter name. Using the APPLY button, you can permanently store all the parameters in the measuring instrument's memory. The name entered for the profile – which can be no more than 10 characters long – is displayed above the corresponding F key after you reopen the speed test configurator.

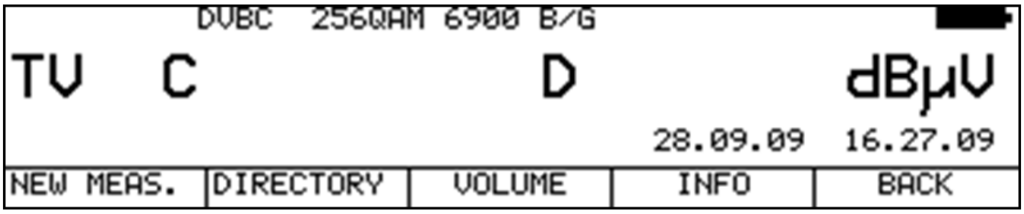
20.23 Level measurement unit

MODE -> **SETTINGS** -> **UNITS** -> **LEVEL** is used to switch the measuring receiver between the units dBµV (default), dBmV and dBm (W).



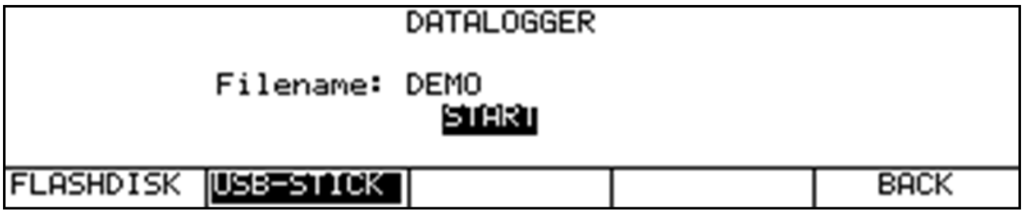
Chapter 21 Measurement Data Memory (DataLogger)

The instrument is equipped with a datalogger function. This makes it possible for sets of measurements to be automatically saved in the form of an XML file onto a USB stick or onto the internal flash disk of the measuring receiver. The data can then be evaluated using MSExcel or OpenOfficeCalc. For this, you must store the measuring receiver settings for recording the set of measurements in the tuning memory of the measuring receiver.
You can access the following menu via **MODE** -> **DATALOGGER**.

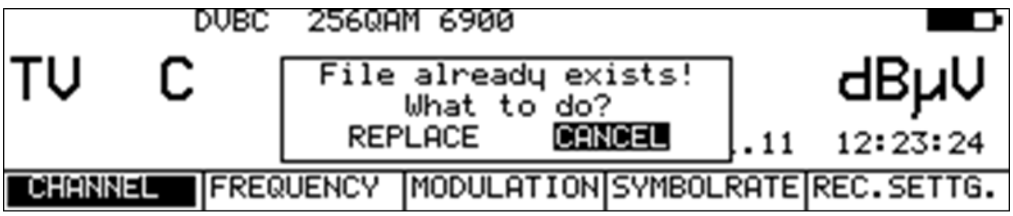


21.1 Creating a set of measurements

You can record a new set of measurement by selecting the menu item **NEW MEAS.**. The memory preview then appears. You can now move the cursor to the first memory location of the set of measurements. When you press the **ENTER** key, an input menu is shown in which you can edit the name of the system being measured.
This name is also the name of the XML file.



Selecting the menu item **LEVEL ONLY** reduces the measurements to level values. This speeds up the data recording. You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. By pressing the **ENTER** key, the cursor jumps to **START**. When you press **ENTER** again, the instrument begins recording the set of measurements. If the file name you have entered already exists, the following warning appears.



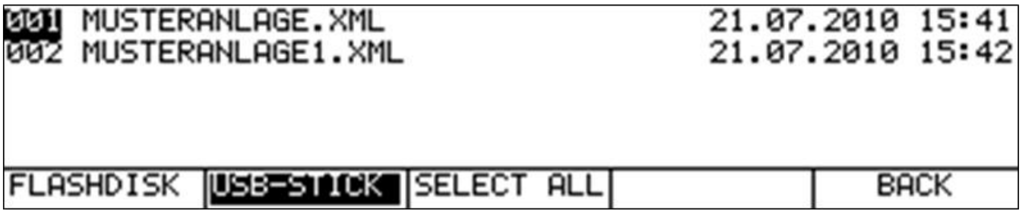
You can use the ← and → keys to select between **REPLACE** and **CANCEL**.
If you press the **ENTER** key, the process is continued or cancelled.
In this example, the new set of measurements is created in a file named DEMO.XML.

The measuring instrument now recalls each memory location one by one and writes the measured values to the XML file. You can stop the process manually via the menu item **ABORT**. The process otherwise continues until an empty memory location in the tuning memory ends the block being measured.

The figure above shows the display during a running set of measurements.

21.2 Accessing the directory

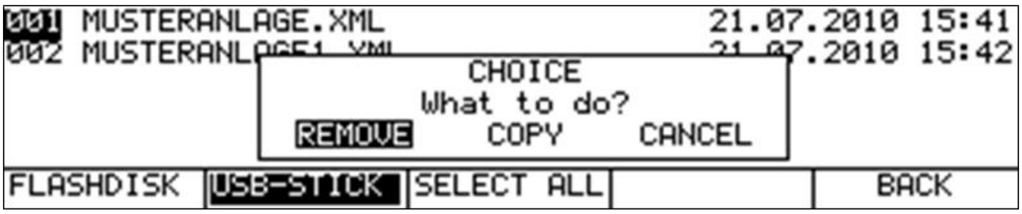
The menu item **DIRECTORY** opens a list of all saved measurements. Press **ABORT** to exit the list. You can use the ← and → keys to scroll between the pages of the list. Use the **FLASH DISK** or **USB STICK** menu items to switch between the storage media. All measurements can be selected my choosing the menu item **SELECT ALL**. This makes it possible to handle all of the files at the same time using the "delete measurements" and "copy measurements" functions.



Note: **The device can list a maximum of 200 files. A message appears if there are more files of the same type (e.g. XML) on the data carrier. If this happens, the first 200 files should be backed up and then deleted from the data carrier. See "Chapter 21.2.1 - Erasing a set of measurements" and "Chapter 21.2.2 - Copying a set of measurements". This situation can arise when files are continuously saved on the internal flash disk and are then copied individually onto a USB stick without being deleted from the flash disk.**

21.2.1 Erasing a set of measurements

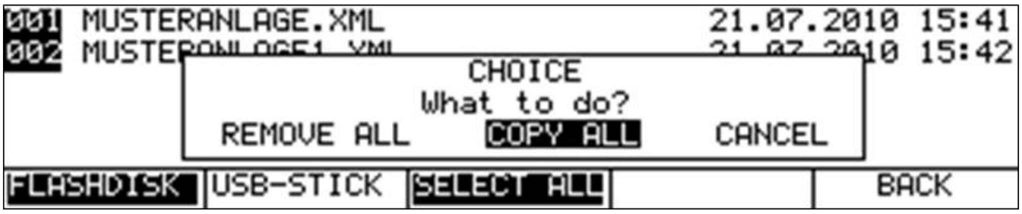
With the directory open, you can move the cursor to the desired set of measurements using the ↑ and ↓ keys. After you confirm by pressing the **ENTER** key, the following choice appears.



Use the ← and → keys to select **REMOVE**. The device deletes the file MUSTERANLAGE.XML from the USB stick when **ENTER** is pressed.

21.2.2 Copying a set of measurements

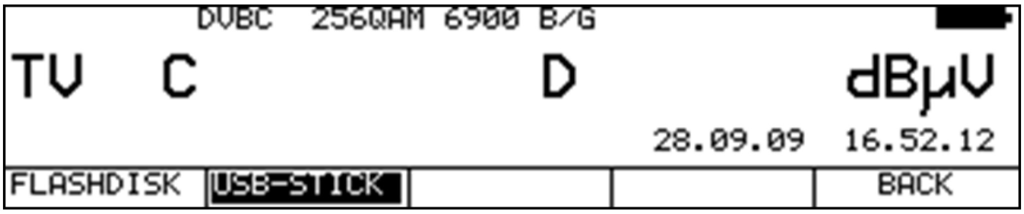
With the directory open, you can move the cursor to the desired set of measurements using the ↑ and ↓ keys. After you confirm by pressing the **ENTER** key, the following choice appears.



You can use the ← and → keys to select **COPY ALL**. All measurements (XML files) are copied from the internal flash disk of the measuring instrument to a USB stick when **ENTER** is pressed.

21.3 Select the drive

You can select the memory medium used (USB stick or flash disk) via **MODE** -> **DATALOGGER**-> **DIRECTORY**. The menu item of the currently set drive is shown inverted in the menu bar.



21.4 Query memory capacity

The number of saved files on the storage medium and the free memory capacity can be queried using **MODE** -> **DATALOGGER** -> **INFO**. The number of objects refers to all files.

21.5 Evaluating the measurement sets on a PC

To evaluate, document or process the set of measurements, you must first transfer the data to a PC or laptop. For this, you must first use the copy function to copy the sets of measurements onto the USB stick if they were stored on the flash disk. The XML files created by the measuring receiver can be read and processed using MSExcel or OpenOfficeCalc. The following figure shows a set of measurements in MSExcel:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		Range	Channel	Frequency/MHz	LNB	Mode	Modulation	Symbol rate	Rec.Modif.	Level/dBµV	SC1/dB	SC2/dB	SN/dB	NICBER
2	156	TV	S21	303.25		ATV	B/G			68.8	-13.2	-21.1	49.5	
3	157	TV	S22	311.25		ATV	B/G			68.5	-15.0	-20.1	47.9	
4	158	TV	S23	319.25		ATV	B/G			67.9	-12.9	-20.0	49.7	
5	159	TV	S24	327.25		ATV	B/G			68.1	-13.0	-20.6	49.6	
6	160	TV	S25	335.25		ATV	B/G			67.5	-13.2	-20.4	50.7	
7		Range	Channel	Frequency/MHz	LNB	Mode	Modulation	Symbol rate	Rec.Modif.	Level/dBµV	MER/dB	BER	PJ/°	
8	161	TV	S26	346.00		DVB-C	256QAM	6900		61.5	38.0	<1.00E-8		
9	162	TV	S27	354.00		DVB-C	64QAM	6900		58.7	36.1	<1.00E-8		
10	163	TV	S28	362.00		DVB-C	64QAM	6900		58.8	36.6	<1.00E-8		
11	164	TV	S29	370.00		DVB-C	256QAM	6900		61.3	38.0	<1.00E-8		
12	165	TV	S30	378.00		DVB-C	256QAM	6900		61.2	37.9	<1.00E-8		
13	166	TV	S31	386.00		DVB-C	256QAM	6900		60.6	37.5	<1.00E-8		
14	167	TV	S32	394.00		DVB-C	256QAM	6900		60.3	37.0	<1.00E-8		
15	168	TV	S33	402.00		DVB-C	256QAM	6900		59.8	38.2	<1.00E-8		
16	169	TV	S34	410.00		DVB-C	256QAM	6900		59.7	38.0	<1.00E-8		
17	170	TV	S38	442.00		DVB-C	256QAM	6900		58.5	37.2	<1.00E-8		
18	171	TV	S39	450.00		DVB-C	256QAM	6900	CRL!	55.8	34.9	1.13E-6	0.68	
19	172	TV	S40	458.00		DVB-C	256QAM	6900	CRL!	56.1	36.1	1.70E-6	0.69	
20	173	TV	S41	466.00		DVB-C	256QAM	6900	CRL!	56.6	35.8	1.16E-6	0.70	
21	174	TV	S02	113.00		DVB-C	256QAM	6900		62.5	37.9	<1.00E-8		
22	175	TV	S03	121.00		DVB-C	256QAM	6900		62.2	>40.0	<1.00E-8		
23														
24														
25														
26														
27														

It is also possible to import the XML files into the AMA.remote PC software. When multiple DataLogger files are selected at the same time, different measurements can be combined automatically into a single table and stored in a file. In this way, several measurements from one project can be grouped together.

The AMA.remote software is available for download from www.kws-electronic.de under “PRODUCTS” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.

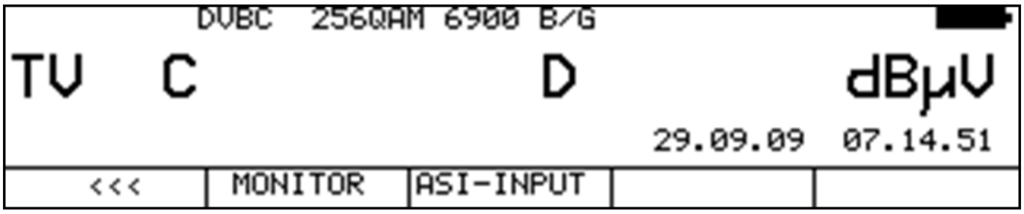
Chapter 22 AV Input and Output

22.1 AV output

The video signal on the SCART output is always identical to the contents of the TFT display. Video signals from the videotext decoder and graphics source can be output as RGB signals only. Parallel to this, the signals of both sound paths (L/R) exist only on the audio outputs.

22.2 Monitor function

In addition to the AV output, the instrument also has an AV input.



You can access the following menu via **RANGE** -> **>>>**. The measuring instrument operates as a monitor if the menu item **MONITOR** is selected. That means that external video signals (FBAS or RGB) are shown on the TFT screen. At the same time, the sound paths (L / R) are switched from the SCART socket to the integrated loudspeaker and headphone jack.
The operating elements volume, brightness and color are fully functional here.
The following menu bar appears in the monitor operating mode:

22.2.1 Switching between FBAS and RGB input

You can select the video source via the menu items **FBAS** and **RGB**. This setting is non-volatile. The default setting is FBAS.

22.2.2 Videotext with external video signals

By selecting the menu item **VIDEOTEXT**, the videotext of the external video signal is accessed. For more, see "Chapter 14 - Videotext".

22.2.3 S/N measurement with external video signals

The S/N measurement is used with analog television for quality assessment of the video signal received. The measuring receiver measures the assessed signal to noise ratio of the video signal fed in externally. For this, the noise signal of an empty video line is fed through an evaluation filter written in CCIR569. The displayed S/N value is calculated from the ratio of the nominal video signal limit (700 mVpp) to the assessed noise level.

The measuring range spans 40 to 60 dB with a resolution of 0.1 dB. A video signal with an assessed S/N of more than 46.5 dB can be considered noise-free.

The default setting is to use video line 6 for the measurement of the noise signal. With **MODE** -> **SETTINGS** -> **S/N-LINE**, lines 5 and 7 are available as alternative settings. With the **SCOPE** function, you can check whether the relevant video line has no content (is empty).
The S/N measurement can only be carried out with an FBAS signal.

22.2.4 Scope display with external video signals

The line oscilloscope function is under the menu item **SCOPE**. Here you can oscillographically display individual lines of the external video signal. Additional notes can be found in the "Chapter 13 - SCOPE".

Chapter 23 MPEG Transport Stream Interface (ASI)

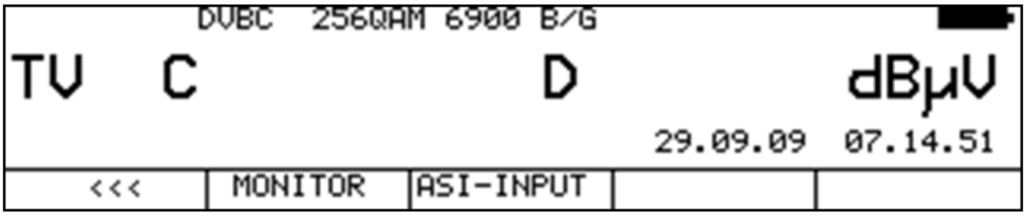
The measuring instrument is equipped with an ASI (Asynchronous Serial Interface) serial transport stream interface. The instrument has an input and an output as a separate BNC socket on the right side of the case.

23.1 ASI output

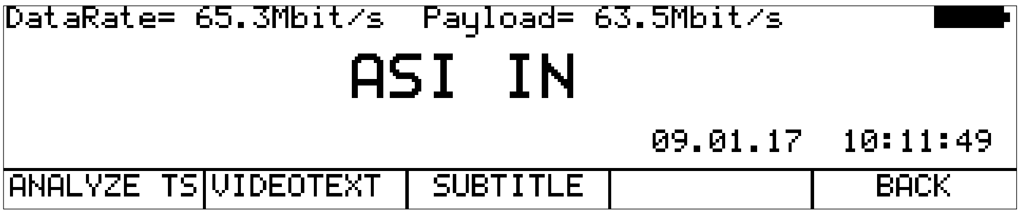
As soon as the measuring receiver receives a valid data stream in the operating modes DVB-S/S2, DVB-C or DVB-T/T2, it is output 1:1 to the ASI output. There is therefore a signal present on the interface as soon as the MPEG decoder is activated.

23.2 ASI input

An external transport stream can be fed through this input into the measuring instrument for analysis by the MPEG decoder. A green LED flashes between the BNC sockets if the instrument detects a valid transport stream on the ASI input.



You can access the following menu via **RANGE** -> **>>>**. If you select the menu item **ASI-INPUT**, the MPEG decoder is switched on and the program lists are built. It is operated according to the description in "Chapter 11 - MPEG Decoder".



If you select the menu item **ANALYZE TS**, the MPEG decoder rebuilds the program list. This is necessary with a change of transport stream, for example.
The ASI interface supports both burst and packet mode.
Encrypted programs from the external transport stream can be decrypted via the integrated Common Interface.

23.2.1 Data rate measurement

Herein the device measures the data rate of the transport stream. On the one hand it measures the gross data rate (all transmitted packets including the null packets are measured) and on the other hand is measures the payload data rate (all transmitted packets with PID other than null PID are measured). This informations are displayed in the first line. Take a look at the screenshot above. In the example the gross data rate is 65.3 Mbit/s and the payload data rate is 63.5 Mbit/s. If there is no valid transport stream on the ASI input, both data rates are zero.

Chapter 24 DVI Interface

The measuring instrument is equipped with a DVI/HDMI port for the connection of an “HD ready” TV set. This allows you to check the function of the DVD/HDMI port of an LCD screen, for example. The DVI port is on the right side of the instrument.
DVI stands for “Digital Visual Interface” (HDMI means “High Definition Multimedia Interface”). The port is designed physically as a DVI-I socket. The protocol HDMI-compliant however. This means that, in addition to video data, audio data are also output. Video and audio data are transmitted via three different data channels and a differential clock line in TMDS (Transition Minimized Differential Signaling). The measuring instrument can be connected with the HDMI input of a TV set using a DVI/HDMI adapter. The measuring receiver does not support HDCP (High-bandwidth Digital Content Protection), however. HDCP restricts the tapping of digital and audio material within the HDMI connection. HDCP is demanded by the program being played. If an HDTV program demands HDCP, the measuring instrument cannot output the data via the DVI/HDMI port. The connected TV set remains dark in this case.

HEVC and AVS+ contents are internally downscaled to adapt it to the small display. On DVI/HDMI output it is upscaled again to the standard output format 1920x1080i. So the quality of video could be reduced. But it is possible to output the video directly from the decoder via the DVI/HDMI port. By pressing the key ↓ one, two or three times the output format can be changed in 1280x720p, 1920x1080p or 3480x2160p. In this case the video on the internal display must be switched off and the DVI/HDMI output format is displayed instead of. By pressing the key ↑ the video is displayed on the internal display again. It is thus possible to connect an UHD-Monitor and test it with full resolution.

Chapter 25 USB Interface

The measuring instrument is equipped with a USB-A and a USB-B port. Both ports are located on the right side of the instrument. USB stands for Universal Serial Bus and has become the standard port in the PC world.

25.1 USB-A

This port operates according to the 1.1 specification at a maximum of 12 MBit/s at full speed. The measuring instrument functions here as the master, meaning that it takes over full control of the port. Before an application can communicate with a USB device, the host must first determine what kind of device it is and what driver must be loaded. This happens after a device is plugged into the USB port. This process is called enumeration. The standard defines several USB device classes. The measuring instrument only supports the class MASS STORAGE DEVICE (USB stick).
The software of the measuring receiver can read and write files to the USB stick via the integrated FAT32 file system.

The USB driver is optimized for the stick that is included. This means that this stick should be used.

If the software tries to access the USB interface when no stick has been inserted, the following error message appears on the display.

25.2 USB-B

Here the instrument operates as a USB slave. This port is currently used for manufacturer testing purposes only.

Chapter 26 ETHERNET Interface

The measuring instrument is equipped with an Ethernet port in the 10Base-T standard with a maximum transfer speed of 10 MBit/s. The RJ-45 socket used for this is located on the right side of the instrument.

At present, the measuring instrument can be monitored and remotely controlled via the Ethernet interface. Additionally file transmission is offered. Further information can be found in "0 - ".

Chapter 27 Monitoring Program

The measuring receiver is equipped with a monitoring program ("Supervisor"). This special function can be called up in all measuring ranges. Using this function, measured values can be monitored over a set time period by specifying tolerances.
Various measurement parameters can be monitored depending on the measuring range. The following table provides an overview. This applies to a fully equipped instrument.

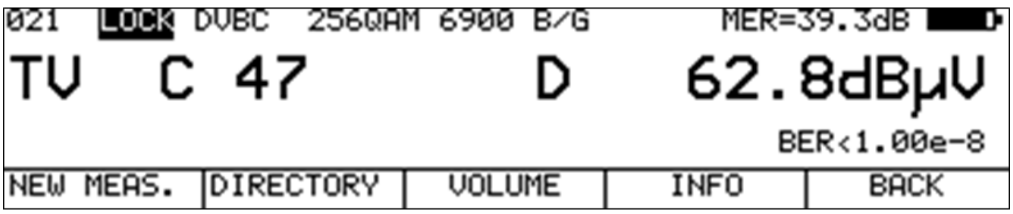
Range	Operating mode	Monitored parameters
SAT		
	DVB-S	Level, MER, CBER, VBER, PE (packet errors)
	DVB-S2	Level, MER, CBER, LBER, PE (packet errors)
TV		
	ATV	Level, S/N
	DVB-C	Level, MER, BER, PE (packet errors)
	DVB-T	Level, MER, CBER, VBER, PE (packet errors)
	DVB-T2	Level, MER, CBER, LBER, PE (packet errors)
	EUDOCSIS	Level, MER, BER, PE (packet errors)
	USDOCSIS	Level, MER, VBER, PE (packet errors)
	DOCSIS (OFDM)	Level, MER
	DTMB	Level, MER, CBER, LBER, PE (packet errors)
FM		Level
RC		Level
DAB		Level, MER, CBER

If the optical input is activated, the optical power can be monitored in each range.

You can also specify which measurement parameters should not be monitored. This is done as the tolerances are entered.
Errors are output using a log, which can either be output on the instrument's printer and/or in a file. When output in a file, a text file with the LOG file extension is created. These files can be deleted and copied. This means that you can save a monitoring log on the internal flash disk, copy it to a USB stick and finally process it on a PC.

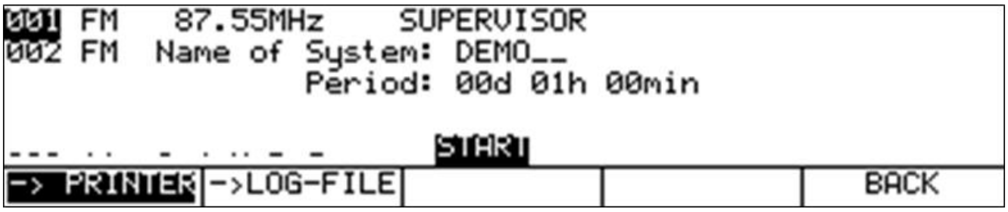
27.1 Starting the monitoring

The measuring instrument must be in the tuned mode (measuring mode) to start the monitoring function. The following submenu opens when the **SUPERVISOR** menu item is called up.



27.1.1 Entry of the name and monitoring period

The following window is opened for entry by selecting the **NEW MEAS.** menu item.



The monitoring name and monitoring period can be entered here.

You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. Press **ENTER** to accept the entries. The cursor moves to the next entry field.
The monitoring period can be set between 00 hours 00 minutes and 23 hours 59 minutes. This means that an entire day can be monitored. 01 hour 00 minutes is the factory default. Press **ENTER** after entering the monitoring period. The cursor now moves to the **START** field.

27.1.2 Specifying the destination of the alarm output

The measuring instrument continuously monitors the measurement parameters in the corresponding measuring range while taking the tolerances into account. The instrument triggers an alarm in the event of impermissible deviations. This monitoring log can be output via the installed printer and/or saved in a LOG file.
You can specify the alarm output destination by selecting **->PRINTER** or **->LOG-FILE**. If file output is specified, the instrument creates a file with the LOG file extension and the name specified under “Name of system”.
By pressing **ENTER** again, the following window opens for specifying the tolerances.

27.1.3 Setting the tolerances

Tolerances can be specified for the monitored measurement parameters depending on the measuring range.

These limits can be set in the following entry menu.

You can move the cursor to the desired entry field using the ← and → keys. Tolerances can be entered for the specified measurement parameters using the numeric keypad. Confirm each entry using **ENTER**. The cursor then moves to the next entry field. The tolerance entries are non-volatile. The following tolerance ranges can be set in the following ranges.

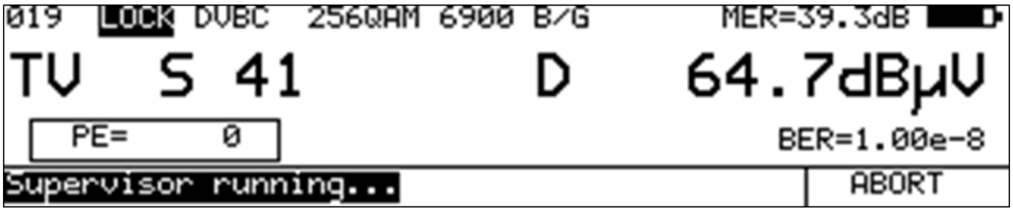
Parameter	**Tolerance**
Level	± 0.1 dB - ± 9.9 dB
MER	± 0.1 dB - ± 9.9 dB
S/N	± 0.1 dB - ± 9.9 dB
BER	e±1 – e±3

The tolerance for BER also applies to CBER, VBER, LBER and NICAM BER.
“e±1” means that the bit error rate can be increased or decreased by a factor of 10 without triggering the alarm.
Entering ± 0.0 dB or e±0 means that the measurement parameter is not monitored.
By activating **PACKET ERR**, the packet error counter is included in the monitoring. An entry is made in the monitoring log as soon as at least one packet error occurs. If the menu item is deactivated, packet errors in the MPEG-2 transport stream are not included in the monitoring.
The monitoring program is started when the cursor is positioned on **APPLY** and the **ENTER** key is pressed.

27.1.4 During monitoring

After monitoring is started, the reference values of the measurement parameters are defined first. These are applied in the log header of the alarm output. The PE counter is always set to 0 when monitoring is started.
During monitoring, the display shows the following contents (example). The remaining monitoring time is shown in the menu bar.

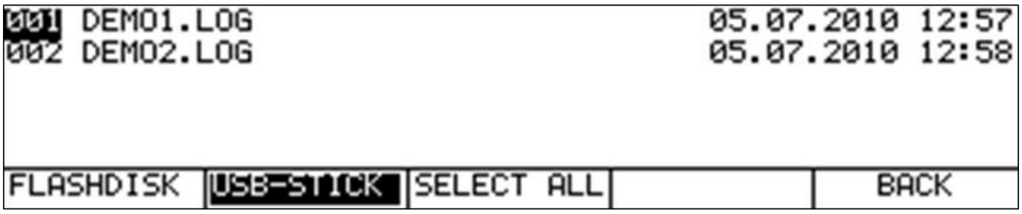
In digital measuring ranges, the PE counter is also displayed in monitoring mode.



The monitoring program can be stopped at any time using **ABORT.**

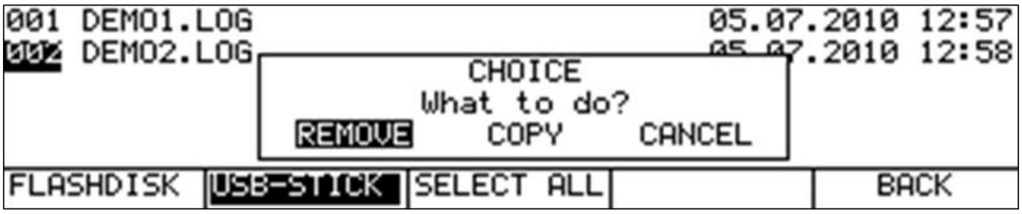
27.2 Managing LOG files

If file output is activated for the alarm, the monitoring log is written as a text file with the .LOG file extension. The file name is derived from the name entered for monitoring. The destination drive (flash disk or USB stick) can be set under **VOLUME**. A list of previously saved LOG files can be accessed for each drive under **DIRECTORY**.
All files can be selected my choosing the menu item **SELECT ALL**. This makes it possible to handle all of the files at the same time using the “delete monitoring logs” and “copy monitoring logs” functions.



27.2.1 Deleting monitoring logs

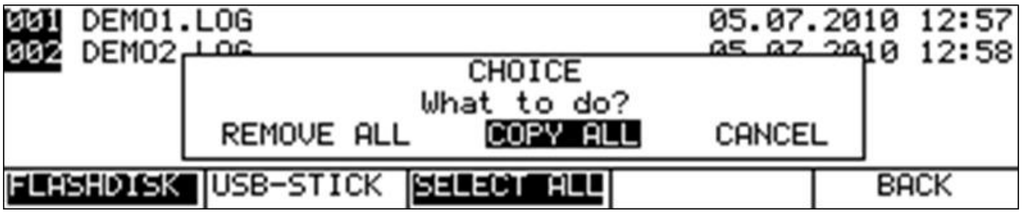
When the directory is open, you can move the cursor to the desired file using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.


001 DEMO1.LOG 05.07.2010 12:57
002 DEMO2.LOG 05.07.2010 12:58
CHOICE
What to do?
REMOVE COPY CANCEL
FLASHDISK
USB-STICK
SELECT ALL
BACK

Use the ← and → keys to select **REMOVE**. In this example, the DEMO2.LOG file is deleted from the USB stick when **ENTER** is pressed.

27.2.2 Copying monitoring logs

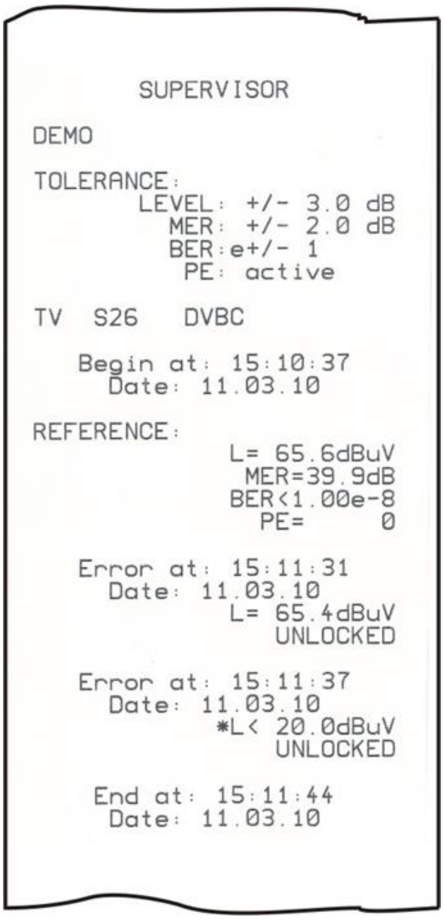
When the directory is open, you can move the cursor to the desired file using the □ and □ keys. When you press **ENTER**, the following selection is displayed.



You can use the ← and → keys to select **COPY ALL**. All LOG files are copied from the internal flash disk of the measuring instrument to a USB stick when **ENTER** is pressed.

27.3 Monitoring log

The monitoring log can be output via the printer and/or in a file.
The structure of the log is identical in both cases. An example of a monitoring log is shown below.
The log header consists of the name, the tolerances that are set for the measurement parameters and the settings on the measuring receiver. This is followed by the time and date for the start of monitoring. The log header is completed by the reference values that are determined at the start of each new monitoring process. Only tolerance specifications that are not zero are recorded on the log (i.e. when the corresponding measurement parameter is included in the monitoring).



```
SUPERVISOR

DEMO

TOLERANCE:
      LEVEL: +/- 3.0 dB
        MER: +/- 2.0 dB
        BER:e+/- 1
         PE: active

TV  S26   DVBC

   Begin at: 15:10:37
       Date: 11.03.10

REFERENCE:
           L= 65.6dBuV
            MER=39.9dB
           BER<1.00e-8
             PE=     0

   Error at: 15:11:31
       Date: 11.03.10
           L= 65.4dBuV
              UNLOCKED

   Error at: 15:11:37
       Date: 11.03.10
          *L< 20.0dBuV
              UNLOCKED

     End at: 15:11:44
       Date: 11.03.10
```

If the monitoring program detects an error, the measured values of all measurement parameters in the corresponding measurement range are printed in the log with the current date and time.
Measurement parameters that are outside the tolerance are indicated with a "*".
An error is present when at least one measurement parameter is outside the specified tolerance, the PE counter has increased or the receiver is locked out.
If an error is permanent, another error message is printed in the log after 60 seconds.
Once the measured values are OK again, an OK message is displayed with the date, time and all measured values.
The monitoring log is completed with the time and date of the end of the monitoring process.

Chapter 28 Measurement Data Recording (DataGrabber)

The DataGrabber allows the measuring instrument to record measurement data over a specified period of time and display it graphically. The shortest period of time that you can enter is one minute. The longest period is 23 hours and 59 minutes.
The memory depth is 500. This means that 500 values are recorded in equivalent time periods for each measurement parameter. The time interval between two samples thus depends on the recording period that has been specified.

The table below provides an overview of the recording options that are available. This applies to a fully equipped instrument.

Range	Operating mode	Recorded parameters
SAT		
	DVB-S	Level, MER, CBER, PE (Packet Errors)
	DVB-S2	Level, MER, CBER, PE (Packet Errors)
TV		
	ATV	Level, S/N (only with option S/N)
	DVB-C	Level, MER, BER, PE (Packet Errors)
	DVB-T	Level, MER, CBER, PE (Packet Errors)
	DVB-T2	Level, MER, CBER, PE (Packet Errors)
	EUDOCSIS (ScQAM)	Level, MER, BER, PE (Packet Errors) DF (Duty Factor, Downstream capacity utilization)
	USDOCSIS (ScQAM)	Level, MER, VBER, PE (Packet Errors) DF (Duty Factor, Downstream capacity utilization)
	DOCSIS (OFDM)	Level (PLC, Channel), MER (PLC)
	DTMB	Level, MER, CBER, PE (Packet Errors)
FM		Level
RC		Level
DAB		Level, MER, CBER

If the optical input is activated, the optical power trend is recorded instead of the level.

Note on recording the duty factor:

This function is only available for DOCSIS2.0 analyzers and higher. Before recording starts, the menu item **DUTYFACTOR** can be used to select recording with or without duty factor. If this item is active, the diagram with the bit error rate is omitted.

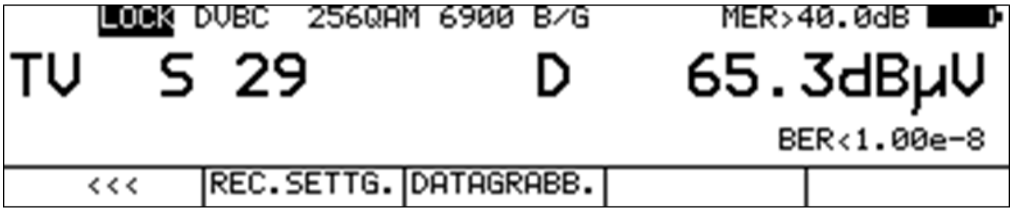
For all measurement parameters apart from PE, the value saved is the one that is active during recording at the time of sampling.
The situation is slightly different when packet errors are captured. During normal measuring operations, packet errors are continuously added up (accumulated). When the DataGrabber function is used, packet error counter changes from one sampling time point to the next are recorded. This makes it possible to subsequently determine how many packet errors occurred and at what times. The absolute number of packet errors is shown in the LCD while the measurement data is recorded and is incorporated in the graphics screen once the measurements are finished.

Note! **Packet errors can also occur when the measuring receiver's automatic attenuation control changes the input attenuation. In order to achieve optimal performance at all times, attenuation control must also operate during measurement data recording.**
Packet errors that occurred due to a change in the input attenuation are displayed in magenta by the measuring receiver while "normal" errors are shown in yellow.

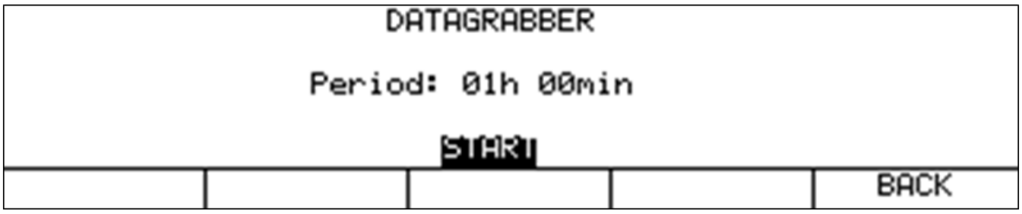
If no measured values are available for particular measurement parameters at the time of sampling, a vertical red bar appears in the respective diagram. This can happen if the receiver goes to "unlocked", for example.
If the status of the receiver subsequently changes back to "locked", the measurement parameters are recorded again and the packet error counter is set to zero. However, this does not affect the previously recorded packet errors in the diagram. They remain unchanged.

28.1 Starting the recording

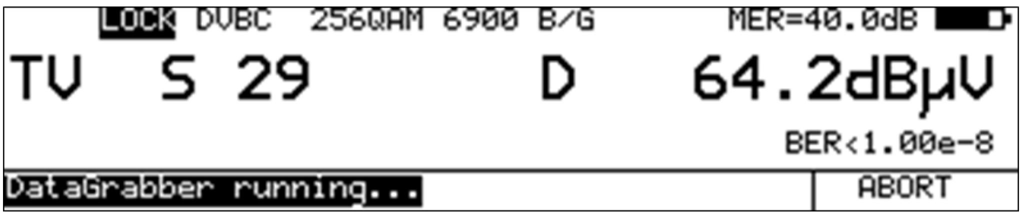
The measuring instrument must be in the tuned mode (measuring mode) when the DataGrabber function is started.



When you call the **DATAGRABB.** menu item, the following submenu appears.



This is where you specify the recording time period.
You can use the ← and → keys to move the cursor. You can set the recording period to a value between 00h 01min and 23h 59min using the numeric keypad. This means that recording can take place over a whole day. The factory setting is 01h 00min. Once you have finished entering the hours and/or minutes by pressing **ENTER**, the cursor moves to the **START** field. When you press **ENTER** again, the measuring instrument begins recording the measurement data. The instrument first captures the active measured values and uses these to calculate the scaling for the individual diagrams. Individual diagrams then appear on the graphics screen for each measurement parameter. Data is now continuously added to these diagrams. Here is an example of what the LCD might display while the DataGrabber is running.

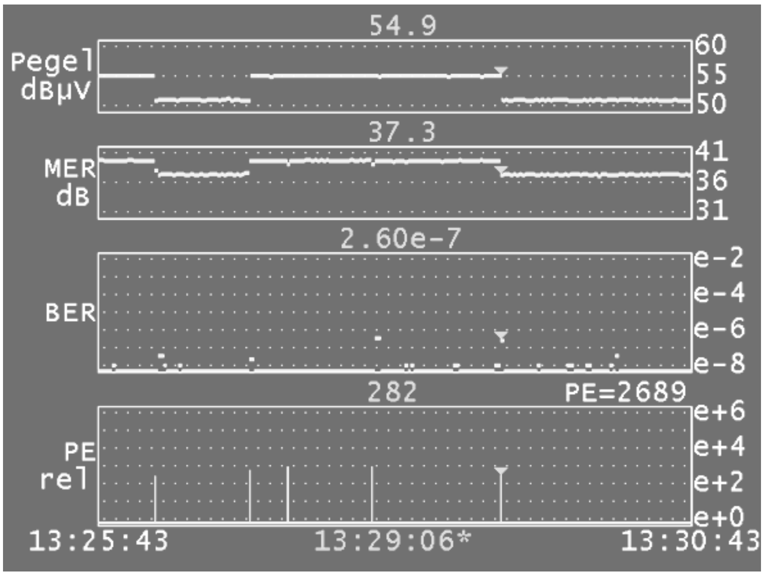


The absolute number of packet errors is also displayed in this operating mode.
You can use the **ABORT** menu item to stop the recording before the specified time period has elapsed. This only stops the recording. Data that was recorded up until this point remains saved on the graphics screen.
If the instrument reaches the end of the recording process normally, i.e., without being interrupted, a beep sounds and the following message appears.

The **RESTART** menu item allows you to initiate a new recording process using the same settings.

28.2 Evaluating a recording

Once the DataGrabber has finished (automatically or stopped manually), you can use the cursor function to determine the time at which a possible error occurred in the system. To do this, you use the ← and → keys to move the cursor (represented by a triangle) to the required position.
The following figure shows sample measurement data that was recorded for a DVB-C channel.



The level, MER, BER and packet errors (relative) are recorded for the DVB-C mode.
The start time and time at which recording ended (normally) appear in the lower left and lower right of the display respectively. The cursor time is marked with a '*'. The measured value at the cursor position is displayed above each diagram. In the above example, 282 packet errors occurred at 13:29:06. These errors were caused by an adjustable attenuator element. PE=2689 means that an absolute number of 2,689 packet errors occurred in the period from 13:25:43 to 13:30:43.

28.3 Documenting a recording

For purposes of documentation, you can either output the graphics screen to the printer, or save it as a bitmap file. More detailed information is provided in "Chapter 17 - Printer" and "Chapter 18.1.2 - Hardcopy of the grafics".

Chapter 29 Common Interface (CI)

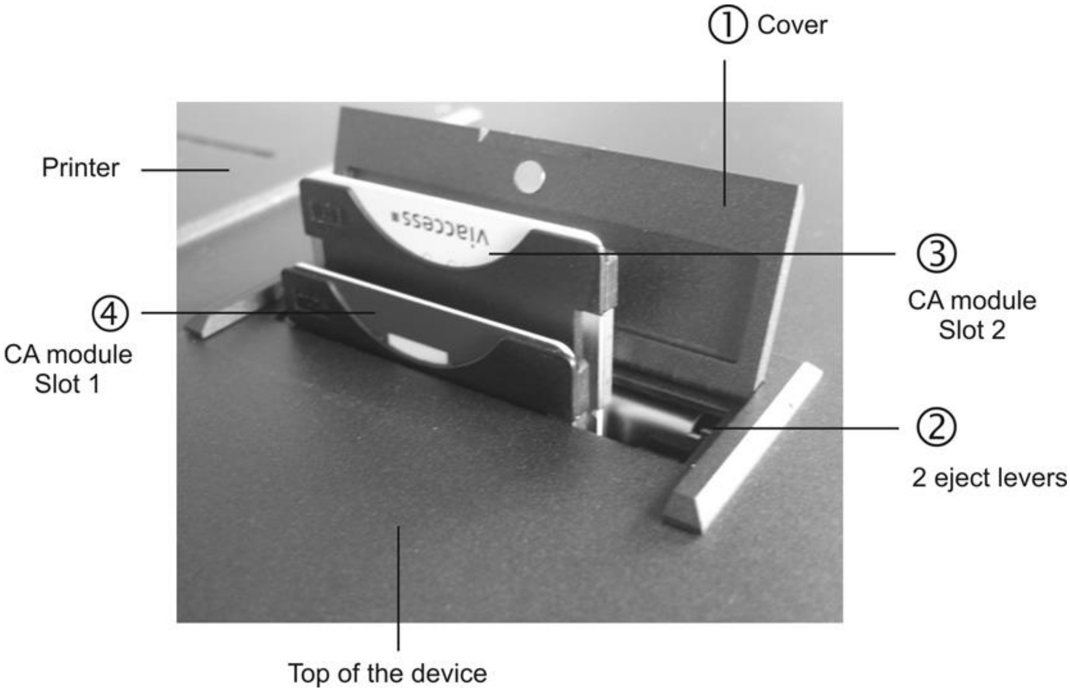
Pay TV providers usually transmit their programs encrypted. For decryption, a CA (Conditional Access) unit must be present in the receiver. This can be permanently integrated into the receiver or inserted into a CI that conforms to the EN50221 standard.
The latter has been implemented in this measuring instrument.

The measuring receiver is equipped with 2 PCMCIA interfaces for accepting up to 2 CA (Conditional Access) modules. The PCMCIA slots are accessible via a hinged lid on the top panel of the instrument.

This makes it possible for all DVB programs to be decrypted if you have an appropriate CA module with an activated SmartCard. The data stream is **not** decrypted in the MPEG decoder, but instead exclusively in the inserted CA modules.

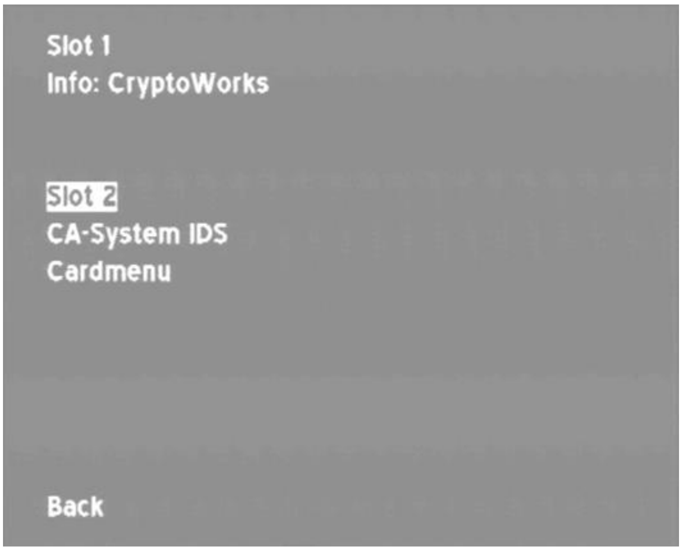
29.1 Changing the CA modules

Before changing a CA module, always switch off the instrument.
First open the hinged lid that is located on top of the instrument and secured by a magnet. Then you can raise an inserted module with the ejection lever until you can reach it with your fingers. Now you can pull the module out of the instrument. When inserting a module, ensure that the polarity of module is correct. The colored sticker of a CA module usually must point toward the back. You should also check whether the module is lining up with the guide rails provided for this purpose. Under no circumstances should there be a great amount of resistance during insertion. If there is, check the seating and the polarity of the CA module again. The following figure clarifies the process.



29.2 Initializing and querying the CA modules

The inserted CA modules are re-initialized every time the MPEG decoder is cold started. This process runs in the background while the decoder builds the program list. After initialization, you can query the inserted CA modules under the Common Interface (CI) menu item.



You can choose between the 1st and 2nd PCMCIA slot by selecting the menu item **Slot2** or **Slot1** with the **ENTER** key. Slot1 is the slot that is nearer to the front panel of the instrument.
If you place the cursor on the CA-System IDs menu item and press the **ENTER** key, the instrument lists all CA system IDs that the inserted CA module supports. If the list is longer than one page, you can use the ← and → keys to navigate through them. Every encryption system such as VIACCESS, CRYPTOWORKS, NAGRAVISITON, etc. has its own number IDs. These numbers are carried in the data streams of the encrypted programs. This makes it possible for the MPEG decoder to determine the appropriate CA module for decrypting the desired program.

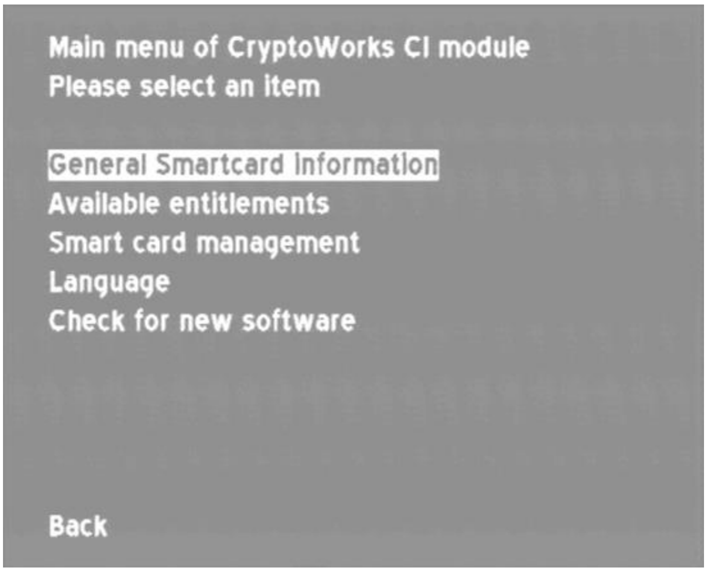
29.3 Card menu

You can open the main menu of the CA module via the menu item **Card Menu**. You can access different information and services here such as information about the SmartCard, software version, software updates, etc. according to the module.

The following applies for the menu interface: You can use the ↑ and ↓ keys to move the cursor through the menu. You can use the ← and → keys to scroll back and forth. You can select a menu item by pressing **ENTER**.

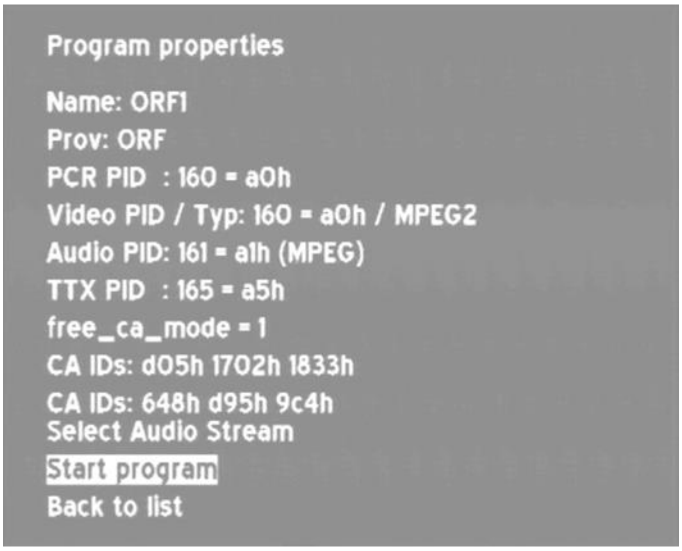
If the module requires entry of a PIN, select the number field using the ← or → keys and choose a number (0-9) using the ↑ or ↓ keys. Press **ENTER** to confirm the entry. The PIN cannot be entered using the numeric keypad.

The following figure shows the main menu of an Alphacrypt module:



29.4 Playing an encrypted program

To play an encrypted program, follow the same procedure as for a non-encrypted program: Select the program name from the station list and press **ENTER** to confirm. The list of program details then appears.

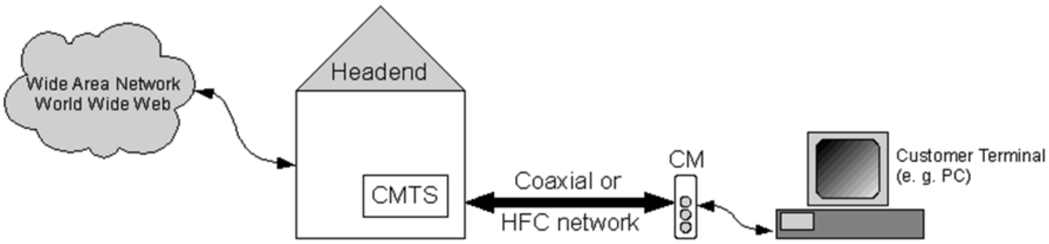


If programs are encrypted, a list of all CA system IDs used appears in the program details. If several CA IDs are listed, this indicates SimulCrypt encoding.

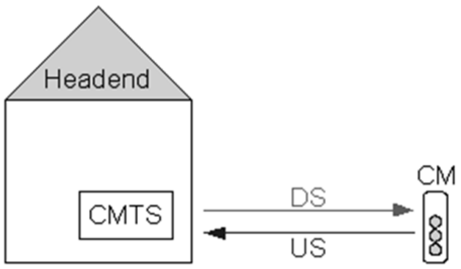
Chapter 30 DOCSIS Analyzer

30.1 Introduction

The analyzer of the measuring receiver operates in accordance with specification DOCSIS 1.1, DOCSIS2.0 or DOCSIS 3.0 (depending on the connected hardware). DOCSIS stands for “Data-Over-Cable Service Interface Specification”. The standard sets the rules for fast, bi directional communication and IP data exchange between the headend and the user either via a pure coaxial network or an HFC network (Hybrid Fiber/Coaxial). The counterpart station for the cable modem (CM) on the user side is the CMTS (Cable Modem Termination System) in the headend.



The data from the headend to the customer is transmitted in the so-called downstream (DS); information returning from the customer is transmitted in the upstream (US). The US and DS are transmitted in the same cable but in different frequency ranges.



There are two different specifications for DOCSIS3.0 and lower: Euro and US-DOCSIS. Both standards can be measured with the measuring device. The differences lie in the DS error protection and in the DS channel bandwidths or in the channel spacing and in the DS and US frequency range. The content of the messages exchanged between the head end and the user is identical in both specifications. Here we only work with QAM.
An essential extension is the DOCSIS3.1 standard. Here, the modulation method OFDM is additionally used for transmission, as it is already known from DVBT / DVBT2. In addition, there is an extension of the frequency range both in the downstream and in the upstream.

30.2 DOCSIS3.0-Analyzer

With DOCSIS3.0 cable modem

The DOCSIS3.0 analyzer can measure DOCSIS3.0 systems that bundle a maximum of 8 QAM downstream channels (Euro or US DOCSIS) and up to 4 upstream channels.The 8 bundled downstream channels must be in a 64 MHz frequency window.

A detailed description of the DOCSIS3.0 analyzer is omitted here, since the DOCSIS3.1 analyzer behaves almost identically in a 3.0 system. Please refer to earlier versions of the manual.

30.3 DOCSIS3.1-Analyzer

With DOCSIS3.1 cable modem

Differences to DOCSIS3.0:
At DOCSIS3.1 OFDM is used in addition to QAM (Euro / US-DOCSIS) as a modulation scheme both in downstream and in upstream. In addition, the much more efficient error protection LDPC / BCH is used in connection with OFDM. This is also used at DVB-S2 and DVB-T2. At EURO-DOCSIS, Reed-Solomon is used as error protection, while US-DOCSIS uses Viterbi and Reed-Solomon. For OFDM downstreams channel bandwidths up to 192 MHz and upstreams up to 96 MHz can be used, while EURO- and US-DOCSIS downstreams uses channel bandwidths of 8 or 6 MHz and upstreams channel bandwidths up to 6.4 MHz.

QAM and OFDM can be combined in both downstream and upstream. In addition, there is a frequency range extension in the downstream up to 1218MHz and in the upstream up to 204MHz.
The meter includes a DOCSIS3.1 cable modem, capable of bonding up to 32 QAM channels plus 2 OFDM channels in the downstream and up to 8 QAM channels plus 2 OFDM channels in the upstream..

DOCSIS3.1 provides an upstream frequency range up to 204MHz. Since the cable networks usually will not be upgraded automatically to the full upstream and downstream bandwidth when DOCSIS3.1 is injected, the meter can be set to two different down / upstream modes. One setting for upstream frequency range up to 85MHz and the other up to 204MHz.

OFDM-downstream:
An OFDM downstream in DOCSIS3.1 may have bandwidths of 24 to 192 MHz. There are 2 FFT modes (4k or 8k) with a maximum of 7600 or 3800 possible active single carriers. The spacing is either 50kHz (4k) or 25kHz (8k). Furthermore, 5 different roll-offs and 5 different guard intervals (cyclic prefix) are provided. All these parameters must be known to the OFDM downstream receiver.

For the transmission of these parameters, DOCSIS3.1 provides an area in the OFDM spectrum.
This area is called PLC (Physical Layer Link Channel). In this 6MHz-wide excerpt, pilots and data carriers are transmitted in a fixed format. This allows the receiver to determine all the necessary additional parameters.

OFDM-upstream:
An OFDM upstream in DOCSIS3.1 may have bandwidths of 6.4 to 96 MHz. Here are the 2 FFT modes (4k or 2k) with a maximum of 3800 or 1900 possible single carriers. The spacing of the individual carriers is either 50kHz (2k) or 25kHz (4k). Again, several different roll-off and cyclic prefix settings are provided. A PLC does not exist in the upstream because the other OFDM parameters with which the modem must send are contained in the UCD (Upstream Channel Descriptor) message that the CMTS informs the modem in primary downstream. OFDM upstreams can share the frequency range with QAM upstreams. So, it is possible that in one time slot, one modem sends bonded QAM upstreams and another modem in the same frequency range uses OFDM upstreams in a next timeslot.

Downstream-Belegung:
With DOCSIS3.1 downstreams (QAM or OFDM) can be distributed and bonded over the entire frequency range. With appropriate occupancy, older cable modems can still be used. For this, it is necessary that the CMTS sends several downstreams with primary information. A DOCSIS 3.1 modem can therefore receive the primary information from a QAM or an OFDM channel.

30.3.1 Setting the MAC address of the cable modem in the CMTS

Typically, all cable modems operating in a DOCSIS network must be advertised on the CMTS (Cable Modem Terminal System) first. This is done via the MAC address. This also applies to the built-in cable modem of the meter. The MAC address of the device can be read out via the device management (see chapter 20.6). Normally, the cable modem doesn't go "online" or "operational" if the cable modem of the device is not registered in the CMTS. This should be checked by the user of the DOCSIS analyzer before starting the measurements.

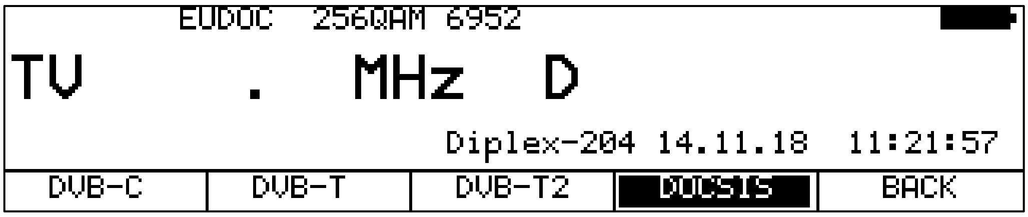
30.3.2 Setting the RF-diplexer

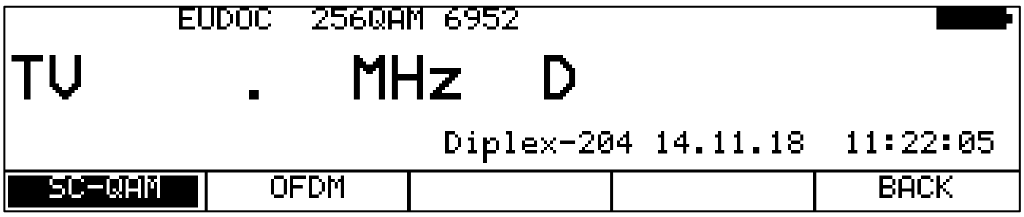
As mentioned earlier, the meter can be set to two different upstream frequency ranges. The device includes a switchable RF diplexer, which separates downstream and upstream at the RF input and thus decouples downstream receiver and upstream transmitter.
To set the diplexer, the modulation in the device must first be set to DOCSIS. This can be done in the TV measuring range via the menu item **MODULATION** -> **DOCSIS** -> **SC-QAM** or -> **OFDM**.
Via the menu item **DOCSISANAL** -> **US-DIPLEX**-> **DIPLEX-85** or -> **DIPLEX-204** the diplexer can either be set to a maximum upstream frequency of 85 MHz or 204 MHz. The current diplexer setting is shown in the display next to Date / Time. If the diplexer is set to 204 MHz, the lower downstream frequency is limited to 258 MHz, while in the other setting a lower downstream frequency up to 108 MHz is possible.

30.3.3 Tuning to a QAM Downstream

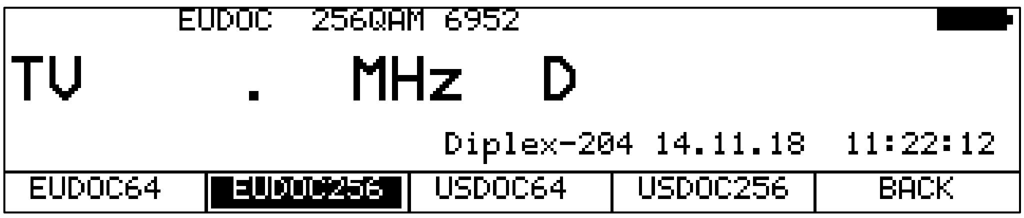
For the DOCSIS analysis, the meter has a standard QAM receiver, which, regardless of whether the downstream is "primary" or "secondary", or bonded to a group of downstreams, measures the values displayed on the right display. For the further DOCSIS analysis, the device additionally contains a cable modem, which tries to log in at the same time after entering a downstream.

To enter a QAM downstream frequency, the device must first be switched to DOCSIS ScQAM mode. This happens in the TV measuring range via the menu **MODULATION** -> **DOCSIS** -> **SC-QAM**.





In another menu, the modulation scheme and the DOCSIS variant can be selected.

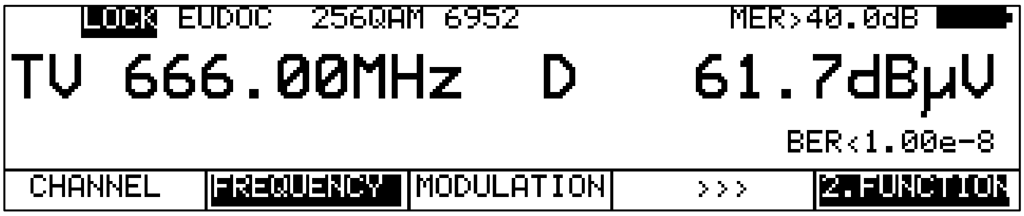


The corresponding symbol rate is set automatically.

Automatic search of the DOCSIS variant:

If a new frequency or channel is entered, the receiver attempts to synchronize with the current settings (DOCSIS variant, modulation scheme). If this fails, the device alternatively uses the other possible settings **EUDOC64**, **EUDOC256**, **USDOC64** or **USDOC256**, to receive the incoming signal.

A search for an OFDM downstream is not provided here.

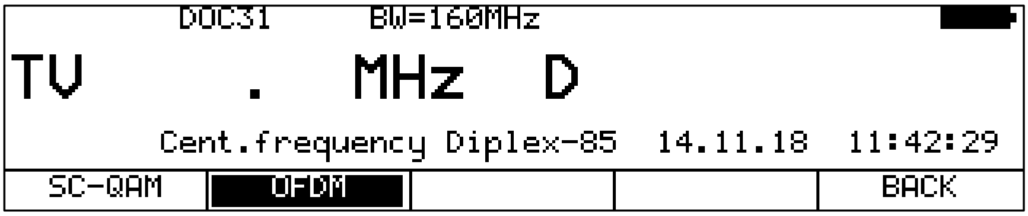


In addition to the direct channel input of a known DOCSIS downstream channel, there is also the option of an automatic search in the entire TV frequency band (see "Chapter 7.2.2.5.3 - Search").

30.3.4 Tuning to an OFDM -Downstream

For the DOCSIS analysis, the meter has a standard OFDM receiver, which, regardless of whether the downstream is "primary" or "secondary", or bonded to a group of downstreams, measures the values displayed on the right display. For the further DOCSIS analysis, the device additionally contains a cable modem, which tries to log in at the same time after entering a downstream.

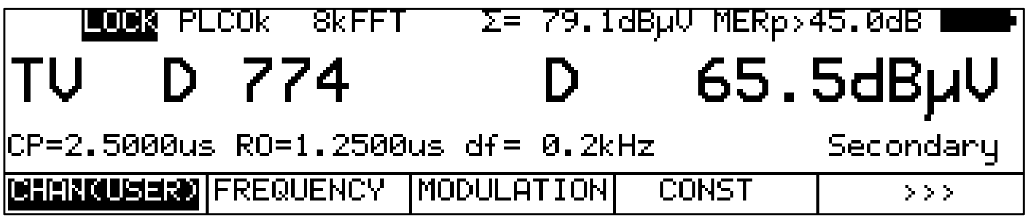
To enter a OFDM downstream frequency, the device must first be switched to DOCSIS OFDM mode. This happens in the TV measuring range via the menu **MODULATION** -> **DOCSIS** -> **OFDM**.



It is important that the center frequency of the OFDM downstream channel to be measured is entered.

Entering a downstream frequency is done with the number keys and is completed with the ENTER key.

Alternatively, the tuning can also be done via a channel input. This requires loading a custom channel table with predefined DOCSIS3.1 OFDM channels.



An alternative search for a QAM downstream is not provided here.
Further information on the measured values can be found in the chapter "OFDM-DOCSIS".

30.3.5 Down- und Upstream-Analyse mit dem DOCSIS-3.1-Analyzer

After the meter has been tuned to a new downstream frequency or channel, the built-in cable modem will start. The modem needs about 38 seconds after a restart until it is completely booted. A progress bar is displayed to track the process on the device. In this phase you can switch to other graphics functions, such as constellation diagram or impulse response.

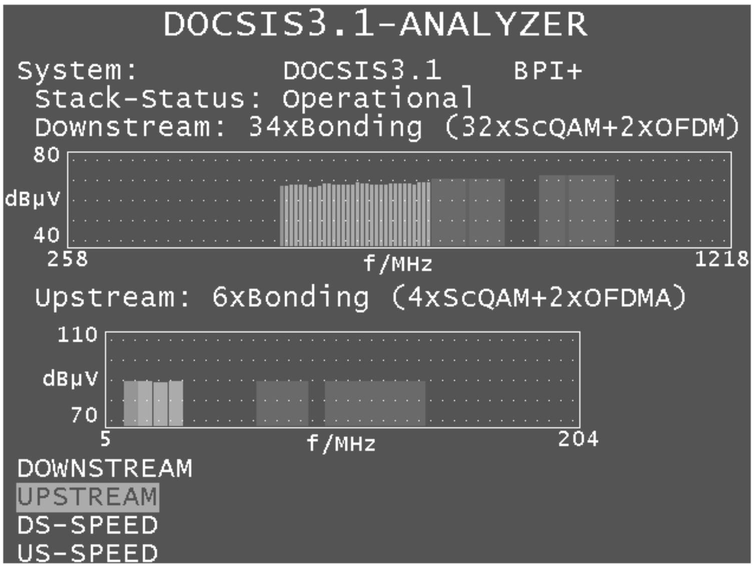
After completing the boot process, the modem will be forced to log in to the entered downstream. That the modem does not look for alternative downstream frequencies, should not be possible to log in on this downstream. Now the device switches over to the DOCSIS Analyzer screen and logging in can be tracked via the displayed stack state.

For the DOCSIS analysis with the cable modem, it does not matter if the launch is via a QAM downstream or an OFDM downstream. However, the prerequisite is that each is a primary downstream.

With the DOCSIS analyzer, it is possible to check first of all, whether a communication between a modem and the CMTS basically works at the place of measurement. That whether the modem goes "online" or into the status "Operational". Return routes can be leveled on the basis of the upstream transmission levels that the modem receives from the CMTS via the ranging process.

If the device has been tuned to an OFDM or QAM downstream as described above, the DOCSIS 3.1 analyzer will provide a graphical overview of all bonded down- and upstream channels with their level ratios and channel bandwidths after successful entry into the CMTS.

The following figure shows an example with 34 (32 QAM and 2 OFDM) bonded downstreams and 6 (4 QAM and 2 OFDM) bonded upstreams.



After the modem enters the "operational" state, the following parameters are displayed:

- DOCSIS standard (for example DOCSIS2.0, DOCSIS3.0 or DOCSIS3.1)
- Display of the encryption system used (e.g., BPI +)
- Stack state of the modem
- Number of bonded downstream channels (separated by QAM and OFDM)

• Number of bonded upstream channels (separated by QAM and OFDM)

The top line provides information about the DOCSIS system, which is currently being measured. Here you can read whether it is a 2.0, 3.0 or 3.1 system. Once channel bonding on downstream and / or upstream, it is a 3.x system. If at least one channel is OFDM then there is a DOCSIS3.1 system.

While the modem is logging on to the CMTS, the progress of the log-in can be monitored on the basis of the stack status. The DOCSIS standard defines several states while logging on a cable modem. The next section briefly describes what happens during modem login. Based on the display of the stack state they can be tracked on the meter. The entire process can take several minutes, depending on the load on the network.

First, the modem tries to receive the tuned downstream channel. If this succeeds (PhySynchronized), it tries to extract the UCD (Upstream Channel Descriptor) messages from the downstream data. In a "primary" downstream, this data is available (UsParameterAcquired), but not in a "secondary" downstream. The modem then attempts to reach the CMTS via the upstream and sets the required transmission level. If this ranging process (RanginginProgess) is completed, the modem is in the status "RangingComplete". In the next step, the modem requests an IP address from the CMTS via DHCP. If the modem receives an IP address, the stack status changes to "DhcpVxComplete". Then the modem can load the so-called config file from the CMTS. It contains all other information about authorizations and channel bundling. If the modem has loaded the config file, then the stack state goes to "ConfigFileDownloadComplete". If all authorizations are valid, in particular the MAC address of the modem must be entered in the so-called "Profsystem" of the CMTS, then the modem goes "online" and the stack state changes to "Operational". In this context, there are a few more stack states, which are usually so short that they can not be followed in.

If the modem is in the state "Operational", all parameters and measured values of all bundled down- and upstream channels are available. The meter creates a bar graph for the current down- and upstream configuration in the main screen. In these charts, the bar height indicates the level ratios and the bar width indicates the bandwidth. A green bar in the downstream diagram indicates that the modem has begun logging in to this downstream channel. This is the frequency to which the user has tuned the meter. Yellow bars indicate QAM channels, while OFDM channels are shown in magenta. In the case of OFDM downstreams, the position of the PLC (Physical Layer Channel) within the OFDM bandwidth is marked by a narrow red bar. In the upstream diagram, the upstream on which the initial ranging took place is highlighted in green.

The figure above shows a DOCSIS 3.1 analysis after successful log-in (stack state is "Operational") in a DOCSIS3.1 system.

At the bottom of the graphics screen you can see the DOCSIS Analyzer main menu. The currently selected menu item is highlighted by the yellow cursor. Use the arrow keys and the **ENTER** key to navigate in the menu of the graphics screen.

30.3.5.1 Downstream diagram

After selecting the menu item **DOWNSTREAM**, the upstream diagram disappears and below the downstream diagram the current measured values of the downstream marked with the cursor (red bar) are displayed. Use the ← or → keys to move the cursor within the bundled downstream channels.

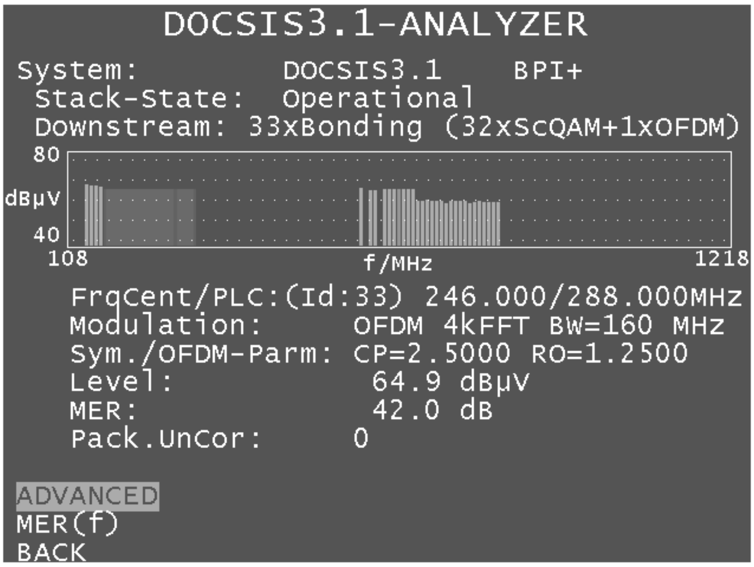
In the following diagram, an OFDM downstream is marked and its parameters and measured values are displayed below the diagram. Each downstream gets a unique identification number (Id) from the CMTS, which is displayed in the upper line (Id = 33).

Since this is an OFDM channel, the frequency of the PLC (Physical Layer Channel) is displayed in addition to the center frequency. The following lines show the OFDM parameters FFT order (4k), bandwidth (160MHz), cyclic prefix (2.5µs) and roll off (1.25µs).
The measured values are level, MER and the number of uncorrectable data packets.

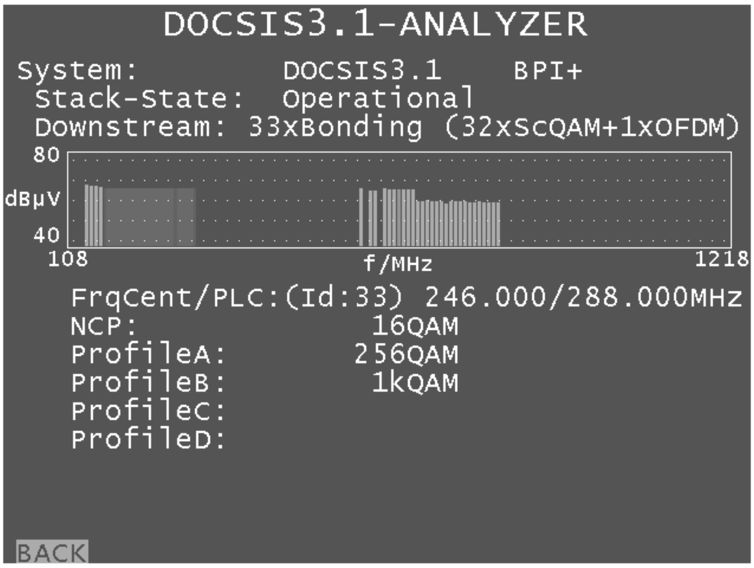
In contrast to a QAM downstream, the displayed level of an OFDM channel is not the level of the entire channel, but is the level of a 6 MHz wide window around the PLC. The displayed MER, on the other hand, is the mean MER of the total channel.

The uncorrectable data packets or packet errors are reseted when the DOCSIS Analyzer enters into "Operational" state. If packet errors occur, the counter is incremented as long as the modem remains online.

If the measuring receiver is tuned to a QAM downstream, then the channel utilization can be measured for this channel (marked in green in the downstream diagram). When measuring the load, the number of transmitted DOCSIS packets in the MPEG data stream is related to the total number of transmitted MPEG packets. The utilization is displayed in % below the MER value.
This measurement is not possible with an OFDM downstream.



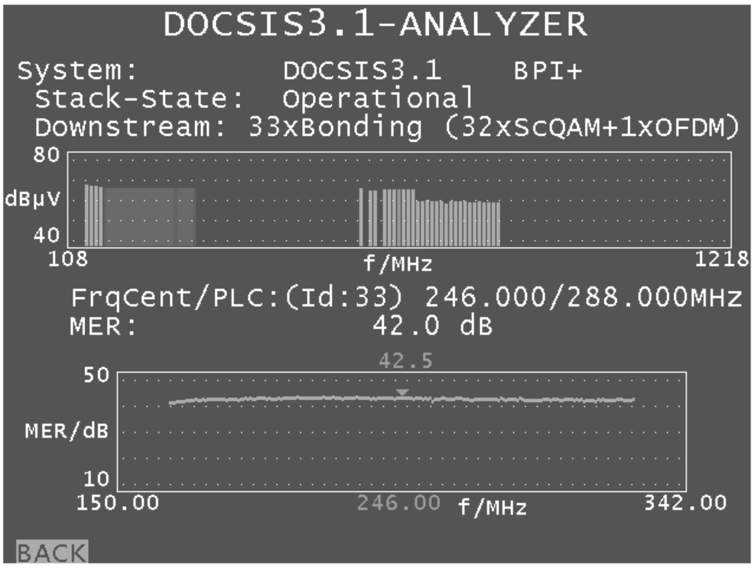
If the currently selected downstream is an OFDM channel, the modulation schemes of the individual data profiles and the NCP (Next Channel Pointer) can be displayed by selecting the nenu item **ADVANCED**.



In the upper figure, it can be seen that the OFDM downstream contains two profiles (A and B) in which the individual OFDM carriers are modulated either 256QAM (profile A) or 1kQAM (profile B). This makes it possible to transmit more or less data rate via a downstream depending on the quality of reception or authorization.

With an OFDM downstream, the MER (Modulation Error Rate) can be measured for each individual carrier. This allows the measurement to be plotted against the frequency MER (f). Via the menu item **MER(f)**, the MER (f) measurement can be called up. The following figure shows the MER (f) diagram of an OFDM channel.

This measurement is not possible with a QAM channel.



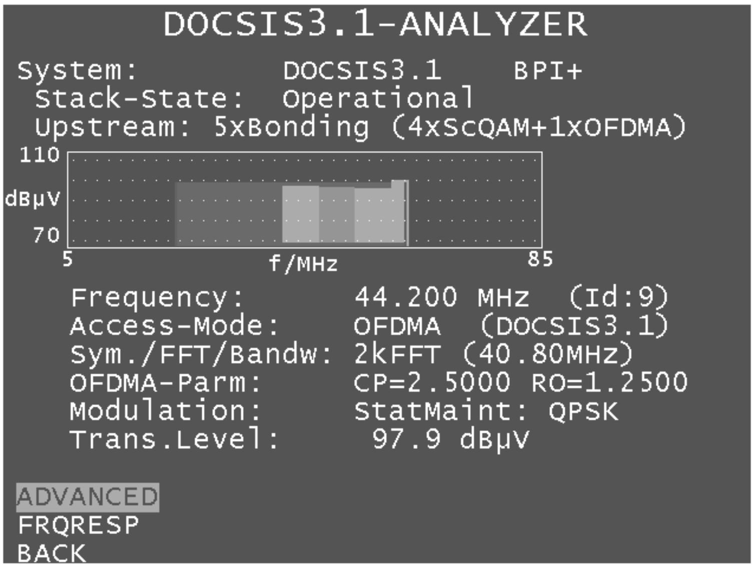
The displayed cursor (small triangle) displays the MER in dB at a specific frequency. Use the ← or → keys to move the cursor within the frequency limits of the OFDM downstream channel.

The menu item **BACK** returns to the previous menu.

30.3.5.2 Upstream diagramm

After selecting the menu item **UPSTREAM**, the downstream diagram disappears and below the upstream diagram the current parameters and measured values of the upstream marked with the cursor (red bar) are displayed. Use the ← or → keys to move the cursor within the bundled upstream channels.

In the following diagram, an OFDM upstream is marked and its parameters and measured values can be seen in the following lines.

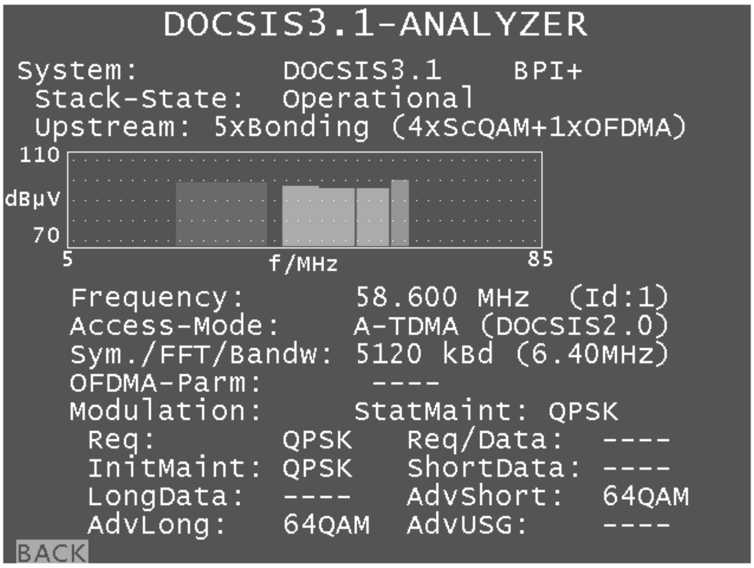


Each upstream is gets a unique identification number (Id) from the CMTS, which is displayed in the upper line (Id = 9).

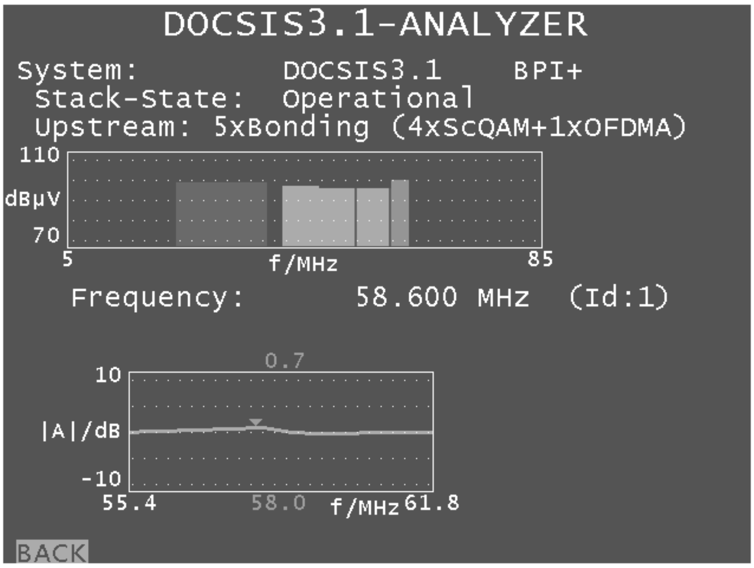
In this upstream configuration, 4 QAM upstreams and one OFDM upstream are bonded. It can be seen that the QAM upstream and OFDM upstream frequencies overlap here. This means that some modems use an OFDM upstream and other modems use 4 bundled QAM upstreams. The overlap is characterized by the QAM upstreams starting slightly higher up, thus OFDM upstreams can be seen underneath.

The following parameters and measured values are displayed for this OFDM upstream:
The center frequency of the active OFDM spectrum, the access method (OFDMA), the FFT order (2k), the bandwidth of the active OFDM carriers (31.8 MHz), the cyclic prefix (2.5000µs), the roll off (1 , 2500µs) and the transmission level (97.9 dBµV).

Via the menu item **ADVANCED**, further information regarding the time slots used and their modulation schemes can be displayed.



Via the menu item **FRQRESP**, the frequency response of an upstream channel can be displayed on the basis of the parameters transmitted by the CMTS for setting the pre-equalizer.



The displayed cursor (small triangle) shows the relative frequency response correction of the pre-equalizer at the current cursor frequency. Use the ← or → keys to move the cursor within the frequency limits of an upstream channel.

The menu item **BACK** returns to the previous menu.

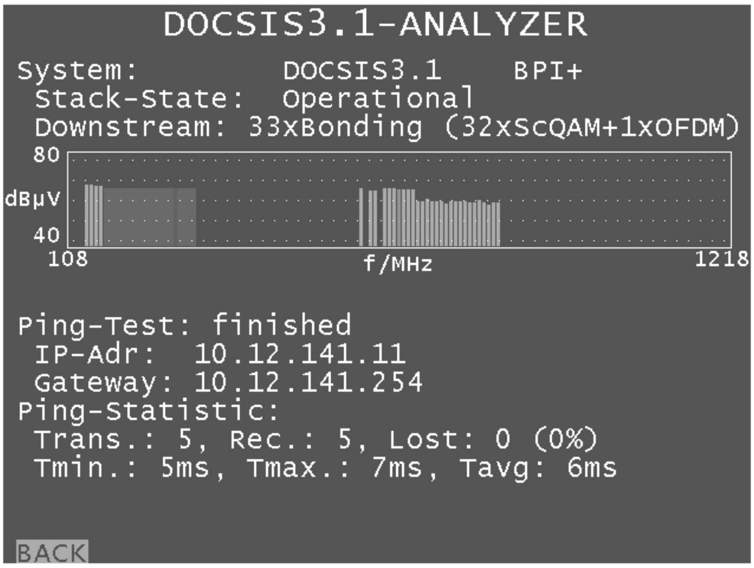
30.4 PING test

The PING test is a diagnostic tool that is well-known from the PC world. It can be used to assess the quality of an IP connection. In this test, certain IP packets are sent to a host, and the host must respond to them (insofar as it supports the protocol). The quantity of responses received to the PING packets that are sent and how long this time delay is (round trip delay) are used to provide qualitative information.

A PING test is triggered by selecting the menu item **PING** in the main menu of the DOCSIS analyzer. This is located on the second page of the menu, which means that you must first scroll to the second page by pressing the → key.

Since an IP connection is required for a PING test, the submenu can only be called up if the stack status is "Operational". The PING test is configured (the number and the time interval of the PING packets to be sent) in the device management (see "Chapter 20.21 - Configuration of the PING test in the DOCSIS Analyzer").

The top line of the ping test shows the status of the test ("initialized", "running ..." or "finished").



Below this, the IP address assigned to the modem by DHCP and the IP address of the default gateway to which the PING is executed are displayed.

If the ping status switches to “finished”, the results are summarized below in statistical form (packets sent; packets received; packets lost, calculated from packets sent and received; and the minimum, maximum and average time to receive a response from the individual PINGs). Since many PINGs can be sent (at most 100 packets), a detailed listing for each individual PING would not be helpful here.

Since many PINGs can be sent (up to 100 packets), a detailed listing for each individual PING would not be helpful here.

During the PING test, detailed progress information appears in the line after “Ping statistics”.

Press **ENTER** to exit the PING test. This not possible until the test has completely finished and the statistical evaluation has been displayed.

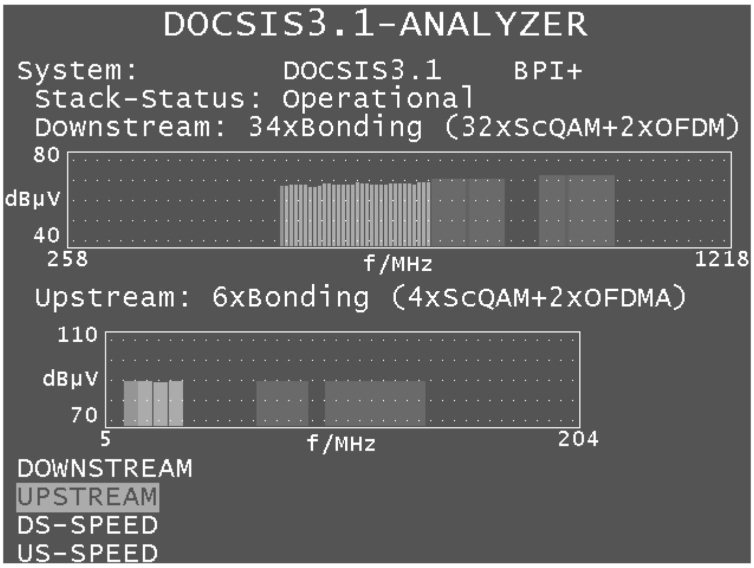
30.5 Speed test

This test can determine the data rate that can be achieved both in the uplink and the downlink directions at the point that the measurement is taken. You can combine it with the PING test and the downstream duty factor to get a very detailed picture of the HFC network's performance.

The data throughput test is based on the FTP (file transfer protocol). For an uplink test, data is loaded onto an FTP server connected to the headend. For a downlink test, a file with a known file path and size is downloaded from this server. The time required for uploading or downloading is measured. In combination with the known file volumes, this time is used to determine the data rate achieved.

For detailed information on the speed test, please refer to application note "AN004 – DOCSIS 3.0 Analyzer". You can find this on our homepage, www.kws-electronic.de, under "SUPPORT" –> "Application Notes".

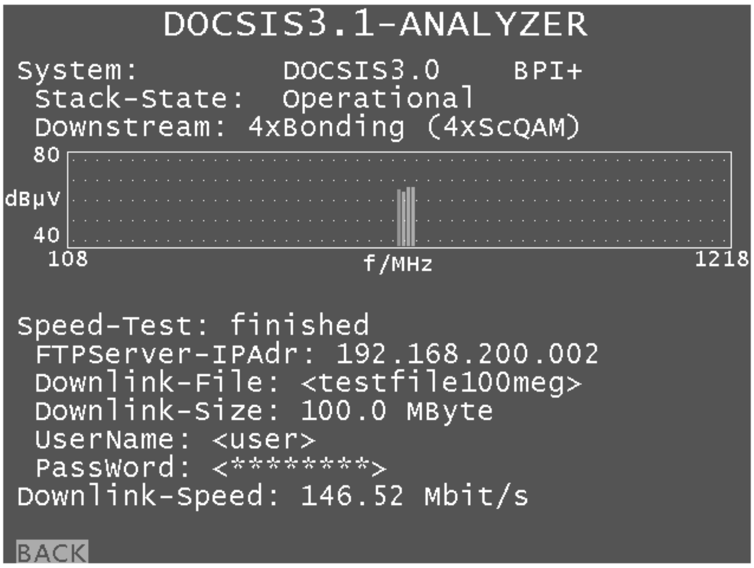
For the speed test, the registration between the DOCSIS modem and the headend must be complete, so the meter must have reached the stack state "Operational". Previously, the menu items **DS-SPEED** or **US-SPEED** can not be called to execute a speed test. These are located in the main menu of the DOCSIS Analyzer on the first page.



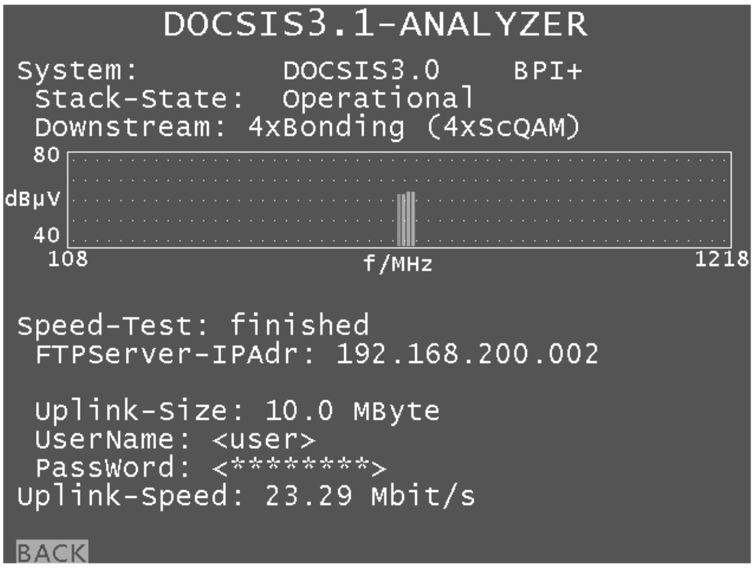
Several parameters in the measuring instrument are necessary for performing the speed test. They are: the IP address of the FTP server, the username and password of the FTP server, the name and size of the download file (only for downlink tests), and the size of the upload file (only for uplink tests). You can enter this data using Instrument Management (see "Chapter 20.22 – Configuaton of the PING-test in the DOCSIS analyzer"). This section offers four profiles which also allow you to store the data for multiple HFC clusters or headends.

If the submenu is activated for one direction of the throughput test, the corresponding test will start as soon as possible. During this process, the top line of the display will indicate the current status of the test. The status will go through the phases "started", "initialized", "running..." and "finished". If the test cannot be completed properly, the status will be "aborted".

Under this status bar, the measuring instrument will show the parameters set in Instrument Management for the current test. If the speed test was completed successfully, the bottom line of the display will show the data rate achieved as the measurement result. The following image shows the conditions for a successfully performed downlink speed test.



For uplink tests, the display is the same except for the minor difference that the line for the file name remains empty because random data is sent from the measuring instrument to the FTP server in this case. After the end of the test, the measuring receiver deletes the data from the server.



You can exit the submenu using **BACK**. For downlink tests, you can also use this button to cancel the test before it is finished. It is not possible to cancel uplink tests before they are finished. The reason is that the data that was already transferred to a server is not deleted after a cancellation. If you were to keep performing and cancelling the tests, the amount of unusable data on the server would continue to grow and take up storage space. As a result, you should always wait until the end of the speed test in the uplink direction.

After the speed test is completed (or cancelled), the DOCSIS analyzer returns to the continuous update of all upstream and downstream measurement parameters.

30.6 Further information

For more information about measuring with the DOCSIS 3.0 / 3.1 Analyzer, see the application notes "AN004 - DOCSIS 3.0 Analyzer" and "AN007 - DOCSIS 3.1 Analyzer". These can be found on the homepage www.kws-electronic.de under "SUPPORT" -> "Application Notes".

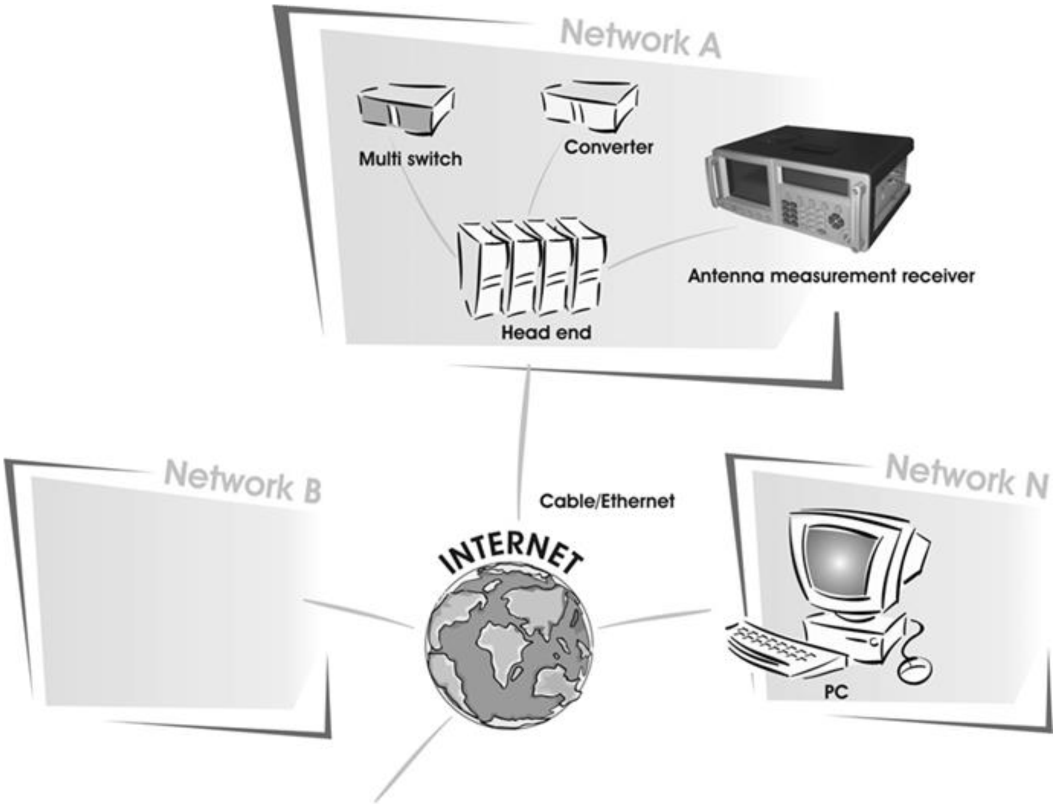
Chapter 31 Remote Access

These options must be activated by entering an 8-digit key code in the measuring instrument. You can request the key codes from the manufacturer. Further information on entering the key code is provided in the "Chapter 20.17 - Activating software options".

31.1 SNMP-Remote-Control (Option)

This option allows the measuring receiver to be monitored and remotely controlled. SNMP stands for Simple Network Management Protocol. This protocol permits the management of networks and their connected components.

The protocol was originally intended to allow network administrators to monitor and remotely control devices in a network with the help of network management software, for example. The software uses SNMP to communicate with the network devices (such as routers and switches). The devices and a PC with the management software, which are connected to one another via Ethernet and/or WLAN, for example, make up the network. Provided a system component has an Internet connection, the network can, under certain conditions, also be accessed via the Internet. Devices in the network can then be addressed from a PC with network management software via the Internet. Suitable software packages can be purchased from various providers or are offered free of charge.
In addition, the AMA.remote PC software is used to control the measuring receiver remotely. This SNMP management software is available for download from www.kws-electronic.de under “PRODUCTS” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.
Because many headends are connected to the Internet, SNMP is increasingly being used to monitor and remotely control headends. At the same time, headends have an increasing number of network-capable components such as multiplexers, which cable network operators can manage via the Internet. The measuring receiver can also be monitored and remotely controlled using the SNMP option. This requires that the instrument is connected to the headend via the Ethernet interface.



31.1.1 Features and function of SNMP

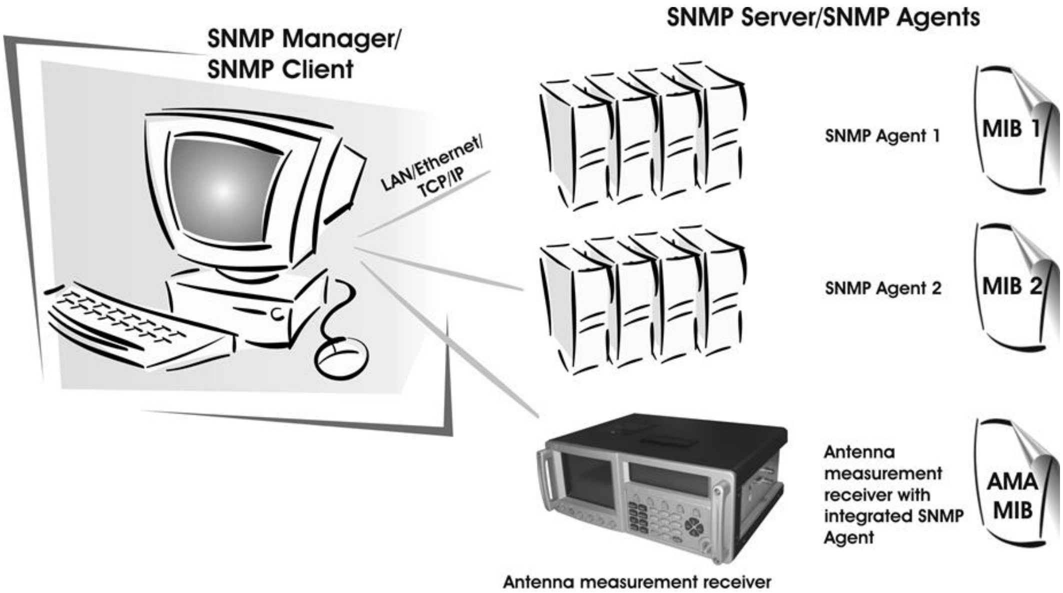
SNMP is based on the Internet Protocol (IP) and is available in three versions. The Internet standards are specified in Request for Comments documents (RFCs). Version 1 of the SNMP standard (SNMPv1), for example, is described in the documents RFC1155, RFC1156 and RFC1157. The measuring receiver's SNMP option uses SNMPv3.

A PC or network device on which SNMP-compatible network management software is installed is referred to as an SNMP Manager or SNMP Client. The network device to be monitored, such as a measuring receiver, is referred to as an SNMP Agent or SNMP Server. This client/server designation refers to the fact that the network device to be monitored, acting as a server, provides data and the monitoring program, acting as a client, retrieves this data. In the following, the network management system is referred to as the SNMP Manager and the device to be monitored is referred to as the SNMP Agent.

A network device is controlled by specifying and reading settings. A network device can also initiate "events" in order to provide information on particular incidents. SNMP primarily uses Set instructions (to specify settings) and Get instructions (to read settings, measured values and parameters) to control devices. The events that are initiated (that may be used for monitoring, for example) are referred to as "traps". The objects (mostly variables), which are required for control and monitoring, are represented by unique object identifiers (OIDs).

All OIDs are listed in a Management Information Base (MIB). The MIB is hierarchical (tree structure). Each node in the MIB tree has a name as well as a number and an OID holds all names and numbers up to the actual object. Certain MIB elements are standardized; however, a company may, for example, request a Private Enterprise Number (PEN) from the Internet Assigned Numbers Authority (IANA). According to the standard, the nodes up to the PENs are .iso(1).org(3).dod(6).internet(1).private(4).enterprise(1).

The manufacturer has the PEN 35128, for example, and the OID for the MER object of measuring receivers is .1 .3 .6 .1 .4 .1 .35128 .ama(1) .measuredValues(2) .amaMER(4).
It is left up to the PEN holder to assign the OIDs after the PEN. This is carried out in a device-specific MIB. Strictly speaking, this MIB is a sub-MIB, which can normally be requested from the device manufacturer. A (sub-) MIB is specified in a text file with the file extension .mib and the content of the file follows a predefined syntax. This ensures that an SNMP agent type can be made known to an SNMP Manager by reading in a MIB. The SNMP Manager can then manage all SNMP agents for which the read-in MIB applies. A particular network device is addressed via its IP address.



31.1.2 MIB structure

The AMA MIB is divided into eight sections.

control:
This category includes all objects that are necessary for tuning the measuring receiver. Various objects need to be used, depending on the measuring range etc. The order in which the settings are specified corresponds to how the measuring receiver is operated.
Furthermore, some of the objects in particular configurations do not need to be set, as these parameters are determined automatically by the measuring receiver.

measuredValues:
Objects from this section return the measured values. The number of objects with valid measured values varies depending on the measuring range. For a tuned measuring instrument, the amaLevel object always returns a measured value for the level.

receivedParameters:
These are parameters that are determined automatically by the measuring receiver. Here too, the number of objects with valid values varies depending on the measuring range.

trapControl:
This is where the settings for sending trap messages are specified. The following three tables are provided for this: amaEventTable, amaAlarmTable and amaTrapTable. All settings relating to the event recipient are specified in the amaEventTable. The amaAlarmTable contains all information on the measurement parameters to be monitored and the amaTrapTable is used to monitor states, such as amaState.

traps:
This section lists the traps that are sent by the measuring receiver when certain events occur.

transportStreamData:
Some SI-table information from the MPEG data streams can be queried via this section. The data query initiates a Transport Stream analysis of the relevant table, the results of which are then transmitted.

deviceManagement:
Instrument-specific data is transmitted via the deviceManagement objects. This includes the querying of serial numbers or setting up a key lock.

analyzerControl:
Some of the settings in the spectrum analyze mode of the measuring receiver can be made via this section.

fileTransferConfig:
The objects in this section are used for the file transmission via FTP. Among other things you can set an user name and a password.

To be able to receive measured values and parameters, the measuring receiver must have been tuned and therefore at least one control object set as an SNMP command. When a control object is set, SNMP functionality is activated in the measuring receiver and measured values and parameters can be read.

31.2 FTP (Option)

This option allows file exchanges with the measuring receiver. FTP stands for File Transfer Protocol and is used to transmit files over networks.

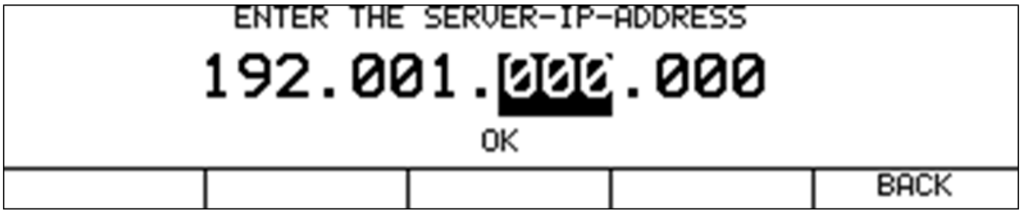
A device connected to the network, which provides files, is called FTP server. A PC software, which offers up- and downloading of files, serves as FTP client. For example the Windows Explorer can be used as a FTP client by entering "ftp://" and the required IP address of the FTP server into the address line.

There is the possibility to make a FTP connection secure by using a user name and a password. If this is not needed, public access to a FTP server is granted by assigning the user name "anonymous". You can set the required login details for the measuring instrument via SNMP.

In the measuring receiver the flash disk is the disk space used for file exchange. You can download files stored at the flash disk, like screen shots, tuning memory tables, channel tables and DataLogger files via FTP. For generating files to download from remote, settings with SNMP are needed. Additionally you can load files transmitted via FTP into the device with SNMP commands. These files could be firmware files, tuning memory tables and channel tables.

31.3 Setting of the IP address

The IP settings must be done before the measuring instrument is used in a network. For this you need IP-address, subnet-mask and standard-gateway.
These entries can be set through **MODE -> EINSTELLU. -> IPCONFIG -> IP-ADR, SUBNETMASK or STDGATEWAY**.



Use the numeric keypad to enter the address. After entering a position, confirm the entry by pressing **ENTER**. The cursor then jumps to the next position. Once the last position has been entered, the cursor jumps to OK. Now press the **ENTER** key a final time, causing the IP address to be stored. After changing the IP address, you must switch the measuring instrument off and on again, so that the TCP/IP stack is initialised with the new setting.

31.4 Further information

You can find further information in application note AN001 “Remote Control”. This document is available from our homepage www.kws-electronic.de under “SUPPORT” – “Application Notes”.

Chapter 32 Electro Magnetic Interference Measurement

32.1 Introduction

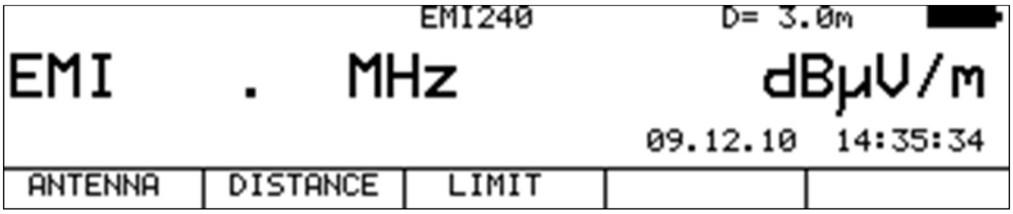
The German regulation on the protection of public telecommunication networks and transmission and receiving radio plants that are operated in the defined frequency ranges for security purposes (SchuTSEV) ["Verordnung zum Schutz von oeffentlichen Telekommunikationsnetzen und Sende- und Emfpangsfunkanlagen, die in definierten Frequenzbereichen zu Sicherheitszwecken betrieben werden"] has been in effect since May 2009. This regulation controls, for example, the switching off of analog TV content in the special channels S2 to S5 for the protection of aircraft radio frequencies (108 - 137 MHz). In addition, the regulation sets high requirements on the cable networks regarding their maximum permitted transmitted interference field strengths.

The principle of the procedure implemented in this measuring instrument for measuring electromagnetic interference is implemented by many major cable network operators and is fully compatible with their measuring procedures.

Basic information on measuring radiation and on the required measuring equipment can be found in application note "AN002 – Electro Magnetic Interference Measurement (EMI)". This document is available from our webpage www.kws-electronic.de under "SUPPORT" – "Application notes".

32.2 Calling

Call measuring of electromagnetic interference (EMI) under **RANGE** -> **EMI**.



32.3 Frequency input

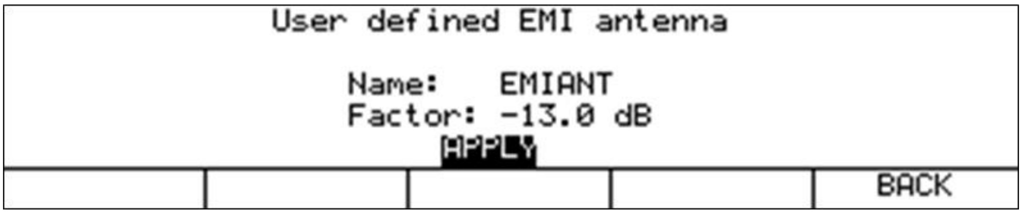
The numeric keypad can be used to set a frequency between 44.75 and 867.25 MHz. Increments are made in steps of 50 kHz. Use the **ENTER** key to confirm the entry. It is important to make sure that identification frequency generator and measuring receiver are tuned to the same frequency.

32.4 Antenna selection

The field strength that is displayed is acquired by measuring the antenna voltage and converting it, taking into consideration the physical properties of the antenna used. The antenna being used can be set under **ANTENNA**. Types EMI 240 and EMI 241 are currently supported. A pre-amplifier is already integrated in the EMI 241 antenna. With the EMI 240/Y antenna, note that the correct measuring results will be obtained only in connection with the EMI 240/V pre-amplifier.

32.4.1 User-defined EMI antenna

In addition a user-defined antenna may also be defined. Enter the name and correction factor for the EMI antenna using the menu item **EMIANT**.



If a new name is entered for the user-defined antenna, the name of the menu item will also change under the **ANTENNA** menu. The correction factor that is entered governs the conversion of the level measured by the receiver (in dBµV) to the displayed field strength (in dBµV/m). The following relationship applies: E[dBµV/m] = L[dBµV] + Factor[dB].

32.5 Entering the distance

The limits for observing the EMV are based on the norm-distance of 3 m to the outer wall of the building. As it is not always possible to take a measurement from 3 m away, the interference field strength at a greater distance can be measured and converted to the reference spacing of 3 m based on the current spacing to the building. The measuring instrument requires the distance to be entered for the conversion.

The measured distance can be entered under **DISTANCE**. This can be determined easily with the help of the additionally available DLE 70 laser distance measuring device, which can be mounted to the EMI 240/Y antenna.

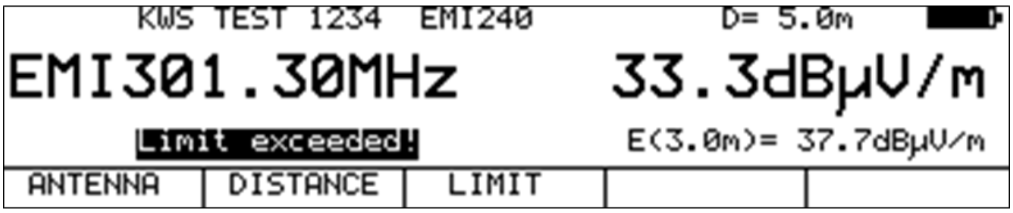
32.6 Entering the limit

There are official regulations for observing the interference radiation of cable systems. They set limits for the emission field strength at a distance of 3 m. The maximum field strength can be entered into the instrument. The instrument uses it for certain warnings when the limit has been exceeded. The maximum field strength in dBµV/m can be entered under **LIMIT**.

32.7 Analysis of identifier

The electromagnetic interference measurement is based on using the KFG 242 frequency identification generator. This generator is used as a defined source of interference in a cable system and should be integrated into the head end. The signal of the interference transmitter is modulated with an identifier for the unique assignment of the interference emission. This can be programmed in the frequency identification generator as a text having 13 characters. The measuring instrument demodulates the identifier and shows it in the top row on the display. To demonstrate that the identifier is being received continuously, the instrument clears the text and shows it again.

32.8 Measuring the interference field strength

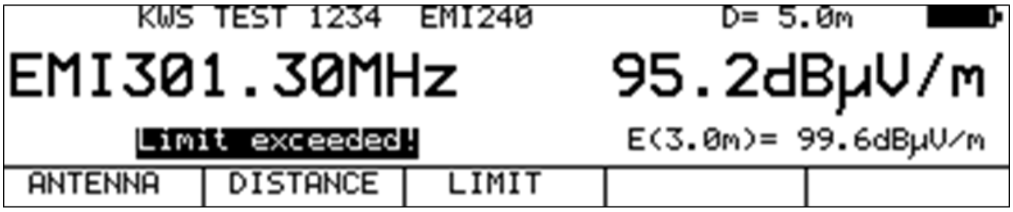


When tuned to a frequency, the instrument measures the antenna voltage of the receiving antenna and converts it into the equivalent field strength. The absolute field strength is displayed in dBµV/m in a larger font. The measuring range is from 3 – 103 dBµV/m (EMI 241) or 5 – 105 dBµV/m (EMI 240) with a resolution of 0,1 dBµV/m.

At the same time, the instrument calculates, in connection with the current spacing, a reference field strength at a distance of 3 m to the building and displays it in a smaller font in the row above the menu bar. If the reference field strength exceeds the set limit, a warming message will appear on the display. A warning signal sounds at the same time over the loudspeaker.

32.9 Setting the identifier

The measuring instrument has a help setting for setting the identifier of the frequency identification generator. Application note “AN002 – Measuring electromagnetic interference” contains information on how to set and change the identifier for KFG 242.
If a character received from the identifier is marked showing that this character is one that can be changed with two buttons on KFG 242, this character will be displayed inverted on the display. If no character is displayed inverted (normal mode), it means that there is no character that is currently selected for modification.



32.10 Remote supply

The measuring receiver can provide a remote power supply for active receiving antennas via the RF input. Antenna EMI 240 (with the EMI 240/V pre-amplifier) and EMI 241 require a supply of 5 V.
The operator may choose between 5 V, 18 V and no remote supply. The supply is short circuit-proof and provides a maximum current of 500 mA. The instrument automatically switches off the remote supply if there is a short circuit or if the current is too high.
The red LED on the RF input lights up as soon as the remote supply is active.

Important! **Before switching on a remote supply, always check the compatibility of the system connected to the remote supply that is selected. Otherwise, terminating resistors may be overloaded or active components may be destroyed.**

32.10.1 Setting the remote supply voltage

Press the **LNB** key to open the selection menu. The possible voltages of 0 V and 5 V can be activated using function keys **F1** and **F2**.

32.10.2 Changing the fixed remote supply voltages

A fixed voltage of 5 V is preset at the factory for the remote supply.
To adjust the voltage in line with the requirements of the active components to be supplied, this voltage can be changed within a range of 5 V to 20 V.
To do this, the voltage must first be activated. Then press the **LNB** key again. The voltage can now be changed in increments of 1 V using the ↑ and ↓ keys. This setting is non-volatile.

32.10.3 Measuring the remote supply current

To do this, the measuring instrument must be in the default status. Press **HOME** to put it in the default status. If remote supply is activated, the measuring receiver measures the amount of DC current that is being supplied through the RF input (e.g. to supply an active antenna) and displays it on the left side of the display in mA. The measuring range extends from 0 mA to 500 mA with a resolution of 1 mA.

Chapter 33 Optical Receiver

33.1 Introduction

RF signals are increasingly being transmitted via fiber optic cables. Optical transmission in broadband networks is gaining importance. While optical transmission in most existing networks still occurs exclusively at network level 2, the trend is moving towards fiber optic distribution up to the subscriber terminals.
Even in the field of SAT-IF distribution, solutions are already available for optical transmission.

Optical fibers:

The optical fiber is the medium through which the light signal is transmitted. There are 2 different fiber types. With multi-mode fibers, the light can move through the optical fibers on multiple “paths” (modes). That results in modal dispersion (distortion), which limits the bandwidth and the transmission distance. With single-mode fibers, on the other hand, the light can only move through the fibers on a single path, preventing modal dispersion and resulting in higher bandwidths. At the moment, almost all the fibers used are single-mode.
They have a core diameter of 9 µm and a sheath diameter of 125 µm. A single-mode optical fiber has an attenuation of approx. 0.3 dB/km.

Optical plug connection:

There are 2 different kinds of fiber optic plug connection. The first one has a straight polish. This version, called PC (physical contact), has a somewhat worse return loss. Connectors with APC (angled physical contact) have an interface with an angle of 8°. PC connectors have blue markings, whereas APC connections have green ones.
Fiber optic plug connections are available in various forms such as FC (threaded connection), SC (plug connection), and E2000 and LC (both with snap/plug connection).
An SC/APC plug connection is built into the measuring instrument.

The measuring instrument is equipped with an optical receiver that converts the light signal back into an RF signal. After the optical receiver, the RF signal behaves as if it had been supplied via the coax input of the measuring receiver. This means that all the measurements available through the RF input can also be taken via the optical input. There is one restriction: For DOCSIS, only the downstream can be measured because the device does not have an optical transmitter for the upstream.

The optical receiver itself is not wavelength-selective. In some systems, light with different wavelengths is transmitted via one and the same optical fiber. This is known as a wavelength division multiplex. In this type of system, the wavelengths must be separated again before the optical receiver because otherwise the signals from the two wavelengths would be mixed in the optical receiver, leading to interference. A patch cable with an integrated wavelength filter should be used for this type of application. But generally, only one wavelength is used, making this unnecessary. In most cases, wavelengths of 1310 nm, 1490 nm and 1550 nm are used.

Optical input power:

The measuring instrument does not have an integrated adjustable optical attenuator element.
As a result, the measuring instrument’s optical receiver can be operated with up to 8 dBm of continuous power. However, the optimal range for the receiver is from -7 dBm to +3 dBm. At lower power levels, the reception quality is reduced because of the receiver noise.

At higher input power levels, the intermodulation products have a negative effect on the performance. In this case, optical attenuation elements should be used.

Example: **Measurements must be taken on an optical transmitter with an output power of 8 dBm. The optical power can be measured directly. However, an attenuation element of 5 to 10 dB should be connected between the transmitter and the receiver to determine the signal quality.**

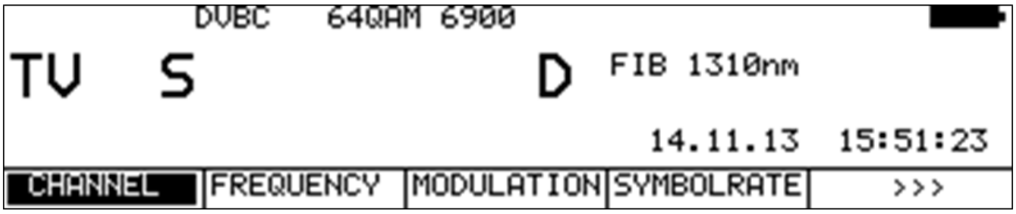
SAT-IF transmission via fiber optics:
There are systems that stack the individual SAT-IF levels in order of frequency. This means that multiple (e.g. 4) SAT-IF levels are transmitted via one optical fiber and one optical wavelength. Other systems use a separate optical wavelength for every SAT-IF level (wavelength division multiplex). Multiple SAT-IF levels can also be transmitted via one optical fiber in this case. The first system (lower cost) requires more effort in the RF range. The complex aspect of the wavelength division multiplex is that each SAT-IF level requires its own optical transmitter, which must be demultiplexed again in the receiver of the wavelength division multiplex using optical filters. The second system has higher quality.
The measuring instrument can receive SAT-IF signals in the range from 910 to 2,150 MHz. With this system, transmission of the level is generally vertical/low. However, this is sufficient for setting up a satellite antenna with an optical LNB. An optical LNB can be supplied with power through the LNB supply of the RF input.

33.2 Cleaning the fiber optic plug connection

The weak point of every optical transmission system lies in the splice and plug connections. For plug connections, it is important to ensure that the contact surfaces are very clean. But the ferrules of a fiber optic connection must also remain free of dust so that no contamination reaches the connectors' interfaces when they are plugged in. Industry-standard cleaning sets are available for this purpose. Immediately after cleaning the plugs and connections, you should put dust covers on them unless you are going to use them again right away.
The measuring instrument's fiber optic connection is equipped with a hinged lid that seals the connection as soon as the plug is removed. However, you must still ensure that the area around the lid remains free of contamination.

33.3 Activating the optical input

You can activate the instruments optical input using **RANGE** -> **FIBRE-IN**.

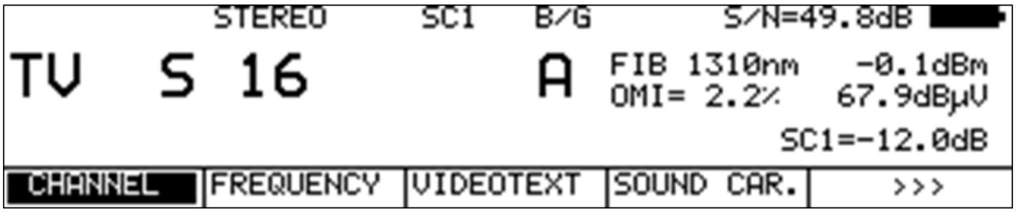


If the instrument's optical input is activated, “FIB XXXXnm” will appear in the display. XXXXnm stands for the wavelength set, e.g. 1,310 nm. Now you can set a specific measuring range, e.g. TV. The spectrum analyzer also uses the signal from the optical receiver.

33.4 Setting the wavelength

As previously stated, the integrated optical receiver is not wavelength-selective. However, you must set the wavelength used because it is required for measurement of the optical power and the optical modulation index (OMI).
The responsivity of the integrated photodiode depends on the wavelength.
Using **MODE** -> **SETTINGS** -> **LAMBDA** you can set the wavelength as 1,310 nm, 1,490 nm or 1,550 nm.

33.5 Measuring the optical power



Optical transmission involves modulation of the intensity of the light power.
The measuring instrument measures the average optical power in dBm. This power is also measured when the light is supplied from an unmodulated laser source. In this case, the instrument can be used as a purely optical power measuring instrument.

Start the measurement by entering the frequency/channel and pressing **ENTER** to confirm.

33.6 Measuring the optical modulation index (OMI)

The optical modulation index (OMI) is comparable with the modulation index for an amplitude modulation. The amplitude (intensity) of a carrier – here, the light – is modulated. The greater the difference between the maximum intensity and the minimum intensity, the greater the OMI and the RF voltage (level) after the optical receiver. There are now two options for specifying the OMI. One option is selectively measuring the OMI for a specific channel or a OMI for a channel. This measurement only takes the RF power within the channel bandwidth into account. The total OMI measurement or OMI sum takes the entire RF power after the optical receiver into account. For this purpose, the instrument measures the average RF power after the optical receiver in the range from 5 to 2,150 MHz. Signals outside of this frequency range are included in the OMI sum in attenuated form.
In professional optical transmitters, the total OMI is adjusted to a fixed average value using an AGC. This means that it is independent of the frequency plan of the RF signal supplied. However, the channel OMI can change based on the frequency plan (configuration with ATV, FM, DOCSIS and DTV channels). The attainable signal-to-noise ratio depends on the channel OMI. For ATV signals, a value of around 4% is ideal. Generally, the OMI sum ranges from 16 to 20%.

The measuring receiver can measure both the channel OMI and the OMI sum. After the receiver is tuned, the instrument displays the channel OMI (see above). The OMI sum is displayed in analyzer mode in the FULLSPAN setting. The OMI is specified in %.

Note! **The level specified after the OMI value corresponds to the internal RF level after the optical/electrical converter. This information is only relative. This specification is primarily used to determine the relationships between the levels of the individual channels.**

A brief overview of the relationships between optical power, RF level and OMI is provided below.
If the optical power is increased by 1 dB for optical transmission, the RF voltage increases by 2dB after the optical receiver, while the optical modulation index (OMI) remains unchanged. The RF voltage is proportional to the square of the optical power.
If the optical modulation index is doubled (e.g. increased from 2% to 4%) with the same optical power, the RF voltage after the optical receiver increases by 6 dB. This means that the OMI and RF voltage are linearly proportional to one another.

Chapter 34 Upstream Monitoring System UMS

34.1 Introduction

The Upstream Monitoring System (UMS) is a measuring system consisting of an instrument in the headend and one or several handhelds for field operation. The UMS permits to measure the return path in a DOCSIS network. The following measurements can be carried out with this system: wobbling (frequency sweep), TILT measurement, BER measurement, MER measurement, constellation diagram, real-time spectrum. The measurements can be performed during regular modem upstream activity.

The data transmission from the headend to the handhelds is done via transport stream and DVB-C modulation. If the headend is equipped with a transport stream multiplexer, the UMS data stream may be added to an existing DVB-C-channel.

Further information can be found in the Application Note "AN006 - Upstream Monitoring System UMS" on www.kws-electronic.de under "SUPPORT" -> "Application Notes".

34.2 Headend Settings

Before putting the UMS into operation several settings have to be made at the headend. The menu for the basic settings may be called up via **MODE** -> **SETTINGS** -> **UMS SETUP**.

34.2.1 Configuration

Device-specific settings for the UMS operation mode can be made via these menu items.

34.2.1.1 Auto-Start

With **CONFIG.** -> **AUTO-START** the headend may be set such that the UMS function will be started immediately after switching on the instrument. It is recommended to activate AUTO-START if the instrument is permanently installed in a headend. In this way the instrument is ready for operation again after a power failure.

34.2.1.2 Keyboard locking

Via the menu item **CONFIG.** -> **KEYB.LOCK** the keyboard locking can be activated.
If the instrument is in a headend, it is recommended to switch it on to ensure that the UMS function is not turned off by mistake. The keyboard locking may be deactivated by the key combination **HOME** -> **3** -> **1** -> **0** -> **ENTER.** Subsequently the instrument may be operated normally for 10 s. However, if the UMS function is not left within this time, the keyboard locking will be activated again.

34.2.1.3 Power save

Via the menu item **CONFIG.** -> **POWER SAVE** a power-saving mode can be activated. In this setting the TFT, the LCD backlight and the keyboard lighting are switched off shortly after the UMS function started.

34.2.1.4 TS Output

By selecting the menu item **CONFIG.** -> **TS-OUTPUT** the interface for the transport stream output can be set. This menu item is only available for instruments with IP output. Otherwise the ASI output is a standard factory setting.

In case of instruments with IP output the interface for the transport stream output can be defined under **CONFIG.** -> **TS-OUTPUT** -> **ASI** or -> **IP**.

For the transport stream output via IP the instrument has a second Ethernet connector located on the left side of the instrument. The standard is Fast Ethernet 10/100Base-T.
When transmitting the transport stream via an IP network, the transport stream packets are encapsulated in IP packets. UDP/RTP is used as protocol. Up to 7 TS packets can be accommodated in one UPD/RTP packet.

The TS/IP interface can be configured under **CONFIG.** -> **TS-OUTPUT** -> **TSoIP CONF** This includes IP address, subnet mask, standard gateway and data encapsulation. As a second independent Ethernet interface is concerned here, these settings must not be mixed up with those in "Chapter 31.3“. These settings are completely independent. The IP settings for this Ethernet interface can be made under **TSoIP CONF** -> **IP-ADR**, **SUBNETMASK**, and **STDGATEWAY**. For transmitting the transport stream via the UDP/RTP protocol, the IP address and the port of the receiver still have to be set. This can be done by using the menu item **TSoIP CONF** -> **DEST IPADR**. The input after ":" is the destination port.

Unicast and Multicast
UDP/RTP packets may be transmitted via a point-to-point connection (Unicast) and a point-to-multipoint connection (Multicast). For Multicast a reserved destination-IP-address range is defined which includes the address range from 224.0.0.0 to 239.255.255.255.
If the IP data stream of the instrument is to be sent to several receivers, a destination address from the above stated range is to be set.

Data encapsulation
The transport stream packets can either be encapsulated in the IP packets by UPD or UDP/RTP. By choosing the menu item **ENCAPSULA.** -> **UDP** or **UDP/RTP** the data encapsulation can be configured.
Always 7 transport stream packets are packed into one IP frame.

The MAC address of the second Ethernet connector may be obtained by selecting the menu item **MACADR**. It is firmly linked to the hardware of the instrument

34.2.2 Transport stream settings

Via the menu item **TS-PSI** an input window can be opened in which some transport stream settings can be made. In the UMS mode the instrument provides a DVB-conform transport stream with several data streams: PES (Packet Elementary Stream) and SI (Service Information).

Via the input window the following parameters can be determined:
Provider name: 16 characters are available for the name
Service name: 16 characters can be used
In addition the following PIDs may be entered in decimal form:
PMT-PID, ServiceID, PES-PIDspec, PES-PIDconst, PES-PIDmeta, PES-PIDtele

34.2.3 Network settings

By selecting the menu item **NET** an input window may be opened where some settings as to the cable network can be made. 16 characters each may be used for the network name and the name of the cluster. The handheld uses this information for identifying the network.
In the setting RefLevel in [dBμV] a reference level may be entered which is taken for all measurements of the UMS. This reference level is comparable to that of the CMTS to which all connected cable modems adjust. If the same upstream level is available at the RF input of the headend device as at the CMTS, then this reference level should be set to the same value as in the CMTS (e.g. 60 or 75 dBμV).

Under TSDelay in [ms] a value for the system-dependent delay of the transport stream from the output of the headend device to the input of the DVB-C-modulators can be set. In case this delay which may arise due to the IP distribution of the transport stream, is in the range of 100 ms and more, an adequate value has to be entered under TSDelay. Alternatively the factory setting of 0ms may be maintained.

34.2.4 Handhelds

All handhelds which are to be used in UMS, have to be registered in the headend device with their serial numbers. Signaling from the handheld to the headend is done via ASK-modulated telemetry carriers whose frequencies have to be in the upstream frequency range.
By choosing the menu item **HANDHELD** an input window may be opened in which all handhelds with their serial numbers and telemetry carriers can be registered.
At the same time a system graphics is displayed on the screen which shows all frequency inputs of UMS.
A telemetry carrier is a sine tone assigned to a handheld with its frequency. The communication of the handheld with the headend is done via this frequency. Up to 10 handhelds may be operated at a headend device.

34.2.5 Modem Upstreams

As the UMS works during active modem operation, in no case shall there be any collisions with the upstream frequencies of the cable modems in the network. Therefore the UMS has to know on which upstream frequencies and with which bandwidth (symbol rate) the cable modems send in the network.
By selecting the menu item **UPSTREAMS** an input window may be opened where all active modem upstreams with their symbol rate can be entered. Up to 8 active upstream frequencies can be entered. When entering the frequency 0, an upstream can be erased from the system. Valid symbol rates are 0.32 MSym/s, 0.64 MSym/s, 1.28 MSym/s, 2.56 MSym/s and 5.12 MSym/s.
Here the input is also supported by the display of a system graphics.

34.2.6 Bit error rate measurement (BER)

The UMS supports a BER measurement in the upstream path. For this purpose e.g. at the user's station modulated upstream carriers are fed in by the handhelds and evaluated in the headend. The measurement results will then be sent back to the handheld. This measurement may be performed during active DOCSIS operation. However, these test carriers must not overlap with the modem frequencies. The system supports the BER measurement at four different frequencies. Taking into account the modem frequencies these can be freely distributed on the return path.
Via the menu item **BER-MEAS** an input window can be opened in which up to four test frequencies with their symbol rates and modulation schemes may be entered. When entering the frequency 0, a test carrier can be erased from the system.
Valid symbol rates are 0.32 MSym/s, 0.64 MSym/s, 1.28 MSym/s, 2.56 MSym/s and 5.12 MSym/s.
Admissible modulation schemes are QPSK, 16QAM, 64QAM, 256QAM.
Here the input is also supported by the display of the system graphics.

34.2.7 TILT measurement

Apart from the sweep function the UMS also supports a special TILT function.
Here the handheld sends simultaneously 4 pilot carriers which the headend measures and sends back to the handheld in real time. This function is provided for the "adjusting" of return path amplifiers and the setting of tilt position equalizers.
This measurement may be performed during active DOCSIS operation. However, these pilots must not overlap with the modem frequencies. The pilots for the tilt position measurement may be distributed freely in the return path range.
Via the menu item **TILT-MEAS** an input window may be opened where the four pilot frequencies can be entered. Here the input is also supported by the display of the system graphics.

34.2.8 Forward path measurement

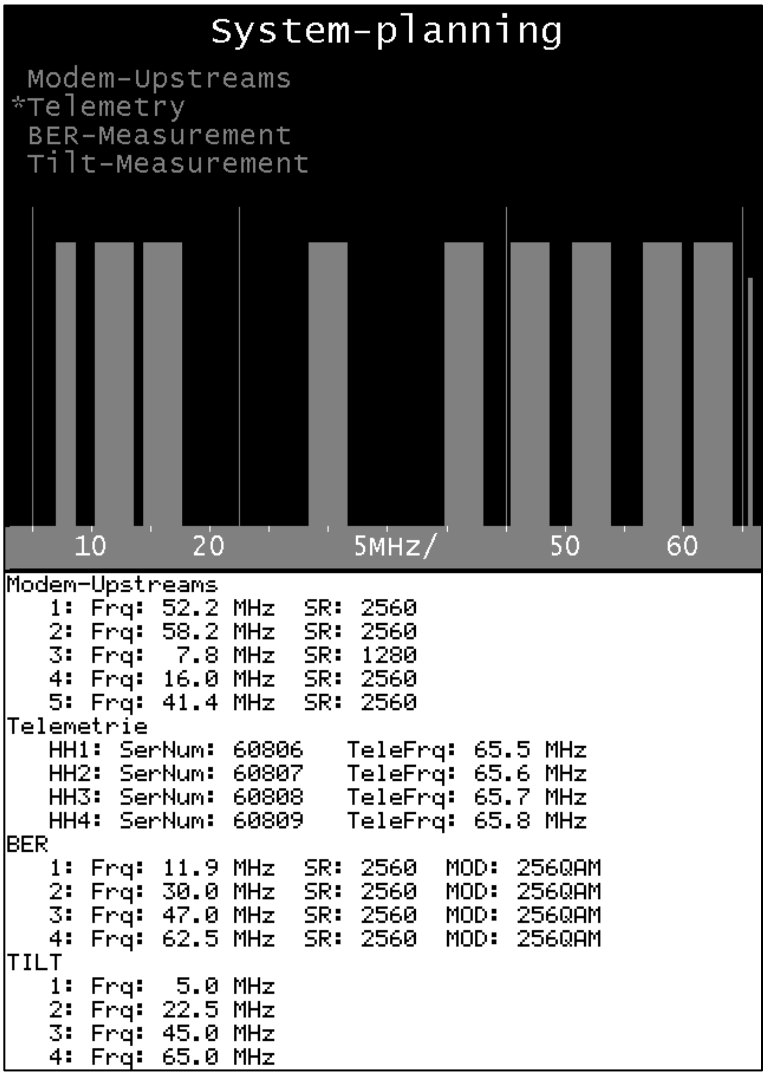
The UMS may also be configured for measurements in the forward path. For this purpose certain downstream frequencies can be set in the headend device which the handheld can measure systematically. The idea here is that it is possible to define at a central point which measurements shall be performed and recorded in situ via the handhelds in the forward path.
Via the menu item **DNSTREAMS** an input window may be opened several forward frequencies and their symbol rates and modulation schemes can be entered. When entering the frequency 0, a test carrier can be erased from the system.

34.2.9 Export/Import of UMS settings

All UMS settings may be stored in a file and stored back again from the file or copied on to a further headend device.
By selecting the menu item **EXPORT** an input window may be opened in which a file name can be entered and the storage medium (USB stick or FLASH disk) may be chosen. The data are stored on a *.UMS file, as soon as the cursor is moved to the selection **START** and the **ENTER** key is pressed.
By selecting the menu item **IMPORT** the list of all *.UMS files can be called up. By choosing the desired file and by pressing the **ENTER** key, the UMS settings from the file are transferred to the headend device.

34.3 System planning

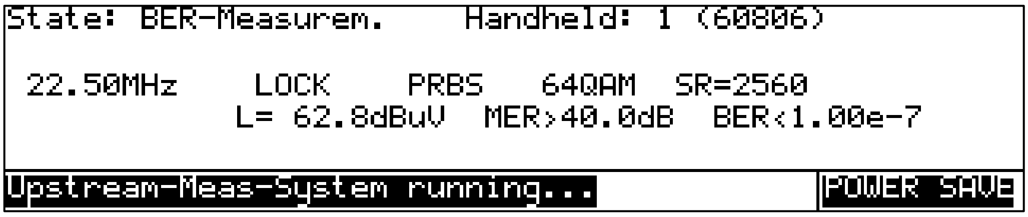
To support the input of various test frequencies in the return path range, the instrument disposes of a graphical representation of the system where all frequencies of the system are shown with their bandwidths. This graph is always displayed if a frequency in the system changes or is added. In case a frequency is put in which leads to a collision in the system, a relevant error message appears. If a faulty setting is not corrected, the UMS cannot be started, as it might possibly disturb the operation of the cable modem.
A system planning can be exported as bitmap file. If the key **PRINT** is pressed when the system planning is displayed, an input window is opened in which the file name and the memory location can be entered. The following illustration shows an example printout of a system planning.



The height of the frequency bars does not state anything, it just serves for a better differentiation. The width of the bars refers to the symbol rate used. The active modem frequencies are displayed in light blue in the system planning.
The test frequencies for the bit error rates and MER measurement are shown in green. The sine tones shown in dark blue are used for TILT measurement. They should be distributed over the complete frequency range as evenly as possible.
The telemetry frequencies shown in yellow may be distributed at will in the return path range. It is recommended to occupy either the upper or the lower return path area.

34.4 UMS startup

Unless "AUTO-START" has been set in the configuration, the UMS function can also be started manually.
For this purpose the instrument first has to be switched to the RC (return channel) range. This is done via **RANGE** -> **REV.CHA.**. By **MODE** -> **UMS** the upstream monitoring system in the headend is started. At first all hardware modules are initialized. Subsequently the return path spectrum can be seen on the screen. If the energy saving mode is activated, the screen switches off automatically after a short time.



The above illustration shows the LCD display during a bit error rate measurement. In this case a QAM signal is fed into the system at a user's station via the handheld and the headend device measures the reception level, MER and BER. On the upper line the current status of the upstream monitoring system and the serial number of the handheld can be seen which initiated the bit error rate measurement.
Here the system operates in the power-saving mode, i.e. the screen is turned off.
By pressing key **F5**, menu item **POWER SAVE**, the display may be switched on for a short time until the instrument returns to the power saving mode within short.

Chapter 35 Definitions and Explanations

35.1 The Level

The level in dB indicates how much the voltage or power value is above or below the reference value. A variety of units are defined for specification of the level. The specification of the unit defines the reference value. This is why they are referred to as absolute levels.

dBµV:

If the level is specified in dBµV, the reference value is the voltage 1 μV_{RMS}.

dBµV = 20 lg (V_{in}/1 µV); (V_{in} in µV)

dBmV:

If the level is specified in dBmV, the reference value is the voltage 1 mV_{RMS}.

dBmV = 20 lg (V_{in}/1 mV); (V_{in} in mV)

dBm(W):

While a voltage is defined as the reference value for dBµV and dBmV, a power is defined for dBm. This reference power is 1 mW.

dBm = 10 lg (P_{in}/1 mW); (P_{in} in mW)

Conversion:

The following relationship is used for converting dBmV into dBµV:

dBµV = 20 lg ($10^{-3}/10^{-6}$) + dBmV
dBµV = 60 + dBmV or dBmV = dBµV – 60

The conversion of dBµV into dBm is only defined when the impedance is specified.

With this as a given, the following formula is used:
dBµV = 10 lg ($Z_{in}/10^{-9}$) + dBm (Z_{in} = input impedance in Ohm)

Since the measuring receiver has an input impedance of 75 ohms, the following applies:
dBµV = 108.75 + dBm or dBm = dBµV – 108.75

Example:

0 dBmV =	60 dBµV =	-48.75 dBm
0 dBm =	108.75 dBµV =	48.75 dBmV
80 dBµV =	20 dBmV =	-28.75 dBm

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