Contents

Chapter 1

Notes 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 ensure safe and proper operation, the user must observe all the notes and warnings contained in this instruction manual.

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

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

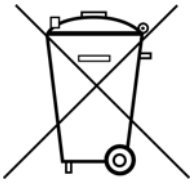
You may operate this instrument using mains voltage between 100 V and 240 V with 50 Hz and 60 Hz.

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 $70V_{eff}$ ($60V_{eff}$ = 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 12 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 is automatically calibrated at the factory if returned for service.

1.6 Service

Service address: see back cover of operating manual.

Chapter 2

Technical Data

Subject to change

FREQUENCY RANGES			
SAT			910 – 2,150 MHz Resolution 500 kHz IF/transponder frequency
TV			44.75 – 867.25 MHz Resolution 50 kHz Frequency input / channel input
FM (VHF)			87.4 – 108.2 MHz Resolution 50 kHz
RC (Return channel)			5 – 65 MHz Resolution 50 kHz
OPERATION			
Input			Illuminated silicone keypad (numeric keypad)
Monitor			5.5" TFT, VGA resolution (640X480)
Display			Separate LCD for measured values (320X64)
User Prompting			In German, English, French
Audio reproduction			Integrated loudspeaker, headphone jack
RF INPUT			IEC socket / 75 Ohm (DIN 45 325)
Return loss			> 12 dB (5 – 867.25 MHz) > 10 dB (910 – 2.150 MHz)
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	25 – 120 dBµV
Resolution			0.1 dB
Measuring accuracy			± 1.5 dB (at 20°C) ± 2.0 dB (0°C – 40°C)
Units			dBµV, dBmV or dBm adjustable
Measuring bandwidth (RBW(-3 dB))	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
	RC		1 MHz, 200 kHz or 90 kHz
	EMI		120 kHz (-6dB)
	(EMI - Electro Magnetic Interference Measurement)		
acoustic level trend indicator			can be switched on/off

ANALYZER

Measuring bandwidth (RBW(-3 dB))	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
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
MAX hold function	Only with RC	

Switch directly between analyzer mode and receiver mode

SAT ANALOG

Video features	Video bandwidth	5 MHz
	Deemphasis	Per CCIR 405-1
	Inversion	For C-band reception
Audio features	Audio subcarrier	5.00 – 9.75 MHz
Scan function		

DVBS

QPSK demodulator	(Per ETS 300421)
Symbol rates	2 – 45 MSym/s
Measuring parameters	(Per ETR 290)
CBER (before Viterbi)	$1.00 \cdot 10^{-8}$
VBER (per Viterbi)	$1.00 \cdot 10^{-8}$
MER	To 20 dB
Resolution	0.1 dB
Measuring accuracy	± 1.5 dB
PE (packet errors)	To $4 \cdot 10^{9}$
	Counts packet errors since the start of measurement
Automatic detection of DVBS/DVBS2 Scan function	(Only with option DVB-S2)

DVBS2 (optional)

QPSK / 8PSK demodulator	(Per ETS 302307)
16APSK, 32APSK	Not supported
FEC 1/4, 1/3, 2/5	Not supported
Symbol rates	10 – 30 MSym/s (2 – 45MSym/s (from Firmware V01.xxx)
Measuring parameters	(Per ETR 290)
CBER (before LDPC)	$1.00 \cdot 10^{-8}$
LBER (per LDPC)	$1.00 \cdot 10^{-8}$
MER	To 20dB
Resolution	0.1 dB
Measuring accuracy	± 1.5 dB
PE (packet errors)	To $4 \cdot 10^{9}$
	Counts packet errors since the start of measurement
Automatic detection of DVBS/DVBS2 Scan function	

TV ANALOG	
Television standards	B/G, D/K, L, I, M/N
Colour standards	PAL, NTSC, SECAM
Sound demodulator	Sound carrier 1 and 2 Decoding of MONO, STEREO and dual sound broadcasts
Sound carrier measurement	Sound carrier 1 and 2 relative to the video carrier, in dB
Resolution	± 1.5 dB
Scan function	

VIDEOTEXT	
ATV	(Per ETS 300706)
Sources	SAT analogue, TV analogue, SCART Zoom function
DVB	(Per ETS 300472) (Only with MPEG-4 decoder)
Sources	DVB-S/S2, DVB-C, DVB-T, ASI Zoom function

SUBTITLE	
DVB	(Per ETS 300743) (Only with MPEG-4 decoder)
Sources	DVB-S/S2, DVB-C, DVB-T, ASI

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

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

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

DVB-C

QAM demodulator	(Per ETS 300163)
Symbol rates	0.5 – 7.2 MSym/s
Modulation scheme	16, 32, 64, 128 and 256 QAM
Measuring parameters	(Per ETR 290)
BER	$1.00 \cdot 10^{-8}$
MER	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)
PE (Packet Errors)	to $4*10^9$ counts packet errors from the beginning of the measurement
Scan function	

J83B

QAM demodulator	(Per ITU-T J83B)
Symbol rates	5.057, 5.361 MSym/s
Modulation scheme	64, 256 QAM
Deinterleaver depths	I=8 / J=16, 16/8, 32/4, 64/2, 128/1
Measuring parameters	(Per ETR 290)
VBER (per Viterbi)	$1,00 \cdot 10^{-8}$
MER	bis 40dB
Resolution	0,1dB
Measuring accuracy	± 1,5dB
PJ (Phase Jitter)	0.40° - 5.00°
Resolution	0.01°
Measuring accuracy	± 10% (of displayed value)
PE (Packet Errors)	To $4*10^9$ counts packet errors from the beginning of the measurement
Scan function	

DOCSIS ANALYZER (optional)		(DOCSIS 1.1: Physical layer according to ETSI ES 201488-2 DOCSIS 2.0: Conforms completely to DOCSIS 2.0)
Downstream demodulator		
	USDOCSIS	See J83B
	EURODOCSIS	See DVB-C
Upstream modulator (DOCSIS 1.1)		
	Modulation scheme	QPSK, 16QAM
	Symbol rates	160, 320, 640, 1280, 2560 kSym/s
	Access method	TDMA
Upstream modulator (DOCSIS 2.0)		
	Modulation scheme	QPSK, 16QAM, 32QAM, 64QAM, 128QAM
	Symbol rates	160, 320, 640, 1280, 2560, 5120 kSym/s
	Access method	TDMA, A-TDMA, S-CDMA
	Encryption	BPI/BPI+
Level	Receive level	minimum 50 dBµV
	Max. transmission level	minimum 114 dBµV
	Measuring accuracy	± 1.5 dB (at 20°C) ± 2.0 dB (0°C – 40°C)

DOCSIS ANALYZER (optional)

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

Evaluation of the upstream equalizer parameters (only with DOCSIS 2.0)
Downstream channel utilization (only with DOCSIS 2.0)
IP synchronization (only with DOCSIS 2.0)
Scalable PING test (only with DOCSIS 2.0)
Time slice analysis (only with DOCSIS 2.0)

Scan function

DVB-T

COFDM demodulator	(Per ETS 300744)
FFT	2k, 8k
Modulation scheme	QPSK, 16QAM, 64QAM
Guard intervals	1/4, 1/8, 1/16, 1/32
Measuring parameters	(Per ETR 290)
CBER (before Viterbi)	$1.00 \cdot 10^{-6}$
VBER (per Viterbi)	$1.00 \cdot 10^{-8}$
MER	To 35dB
Resolution	0.1dB
Measuring accuracy	± 1.5 dB
PE (Packet Errors)	To $4*10^{9}$ counts packet errors from the beginning of the measurement
Impulse response	Attenuation relative to the primary impulse 0-30 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, DVB-S2, DVB-C, J83B, DVB-T
Repetition rate	Real time
3-dimensional display (Status frequency)	In colour
Zoom function	In all quadrants
Stop function	Freezes the diagram
Single carrier display	Only with DVB-T

FM (VHF)

MONO/STEREO indicator	
RDS (Radio Data System)	Station name Dynamic radiotext

Scan function

RC (RETURN CHANNEL)

MAX hold function

MPEG2 DECODER

Video decoding	MPEG-2 MP@HL	ISO/IEC 13818-2
Audio decoding	MPEG-2 Layer I/II	ISO/IEC 13818-3

MPEG4 DECODER (optional)		
Video decoding	MPEG-2 MP@HL MPEG-4 AVC	ISO/IEC 13818-2 ISO/IEC 14496-10 ITU-T H.264
Audio decoding	MPEG-2 Layer I/II MPEG-2 AAC MPEG-4 AAC Dolby Digital AC-3	ISO/IEC 13818-3 ISO/IEC 13818-7 ISO/IEC 14496-3

COMMON INTERFACE (CI)	
	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 (optional)		
Input	Input level Connection	500 – 880 mV_{PP} BNC socket
Input impedance		75 Ohm
Output	Output level Connection	Typ. 800 m V_{PP} BNC socket
Output impedance		75 Ohm

DVI		(Only in conjunction with MPEG-4 decoder) Digital video output for connection of a TV with DVI/HDMI input
Source		DVB
Output impedance **Difference output level**		100 Ohm Typ. 1 V_{PP}

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

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

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

REMOTE CONTROL (optional)	
	through ethernet interface SNMPv1 protocol

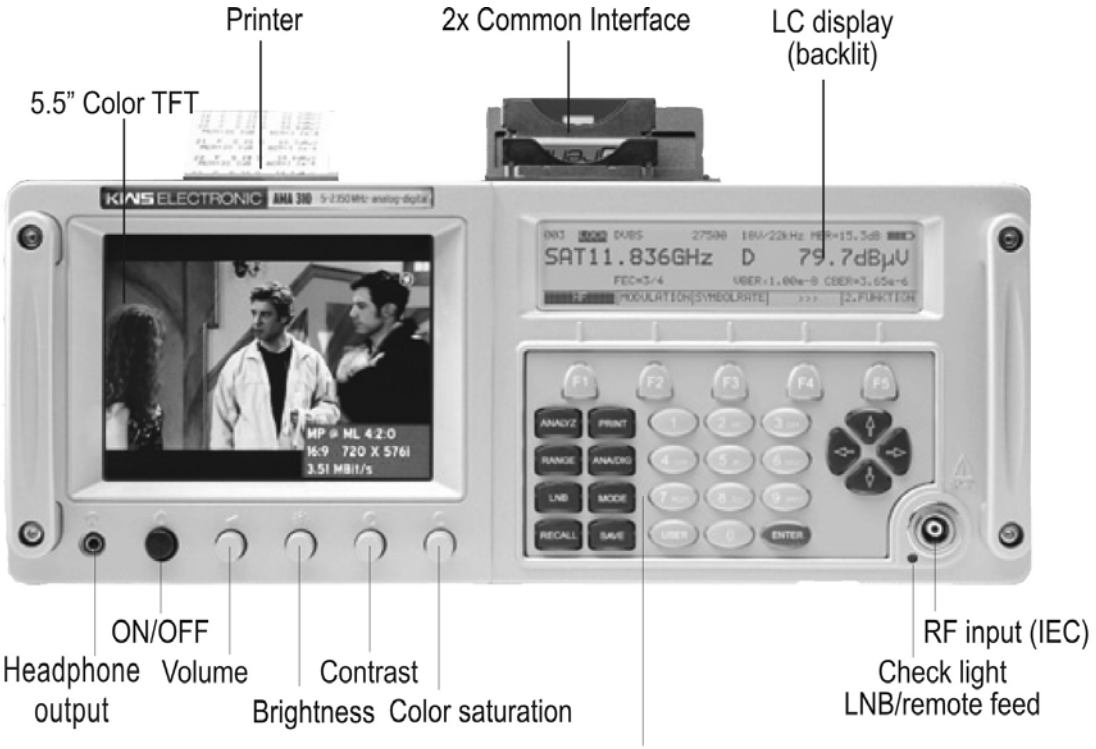
ELECTRO MAGNETIC INTERFERENCE MEASUREMENT (EMI) (optional)		
		Evaluation of the 13-digit identifier for the KFG 242 frequency identification generator and measurement of the interference field strength in connection with the Peilset, consisting of the EMI 240/Y Yagi antenna, EMI 240/V pre-amplifier and EMI 240/K adapter cable, or with the EMI 241 antenna
Measuring range		3 – 103 dBµV/m (with EMI 241) 5 – 105 dBµV/m (with EMI 240)
	Resolution	0.1dB
	Measuring accuracy	± 1.5dB (at 20°C) ± 2.0dB (0°C – 40°C)
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		To 500 mA (short circuit-proof)
22 kHz modulation	SAT only	0.8 V_{PP}
DiSEqC	SAT only	V1.0, V1.1, V1.2, V2.0, UNICABLE
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. 45 W
External 12 V		Through extra-low voltage jack per DIN 45323
	Voltage	10 – 15 V DC Max. current 4 A
Battery		Lithium ion battery pack
	Capacity	14.4 V / 6.75 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

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 unter „Software“ – „AMA.remote“) Power cable IEC measuring cable 75 ohm Manual USB stick Leather case

Chapter 3

Control and Connection Elements, Pin Configurations

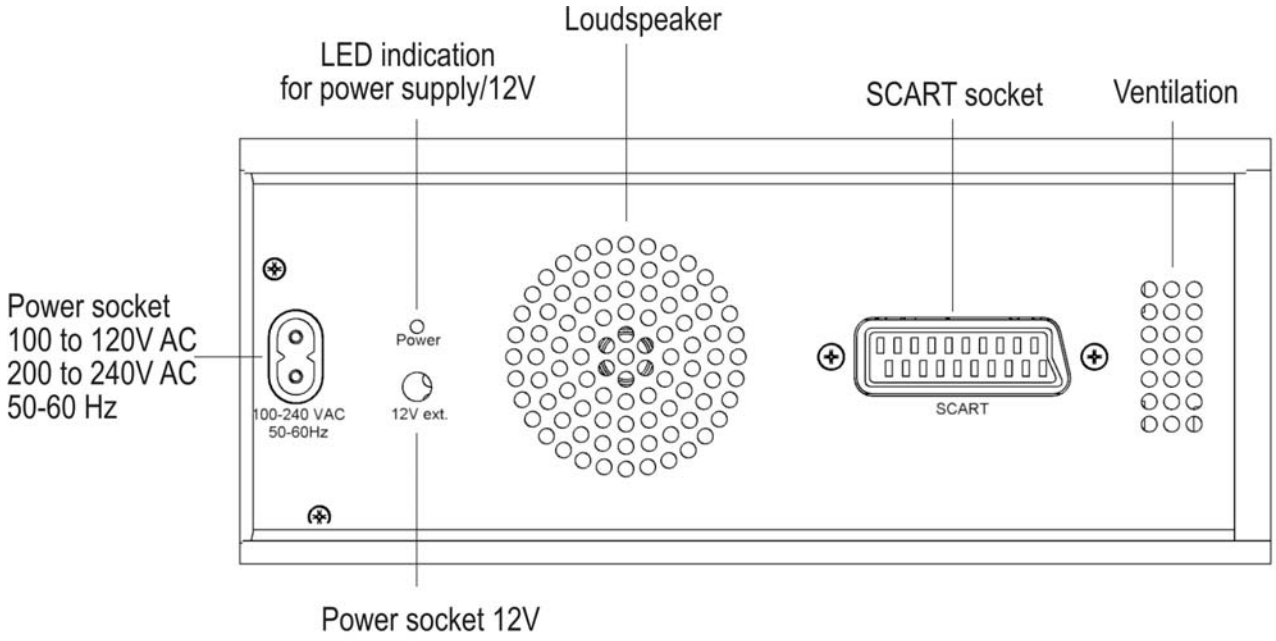
3.1 Front panel



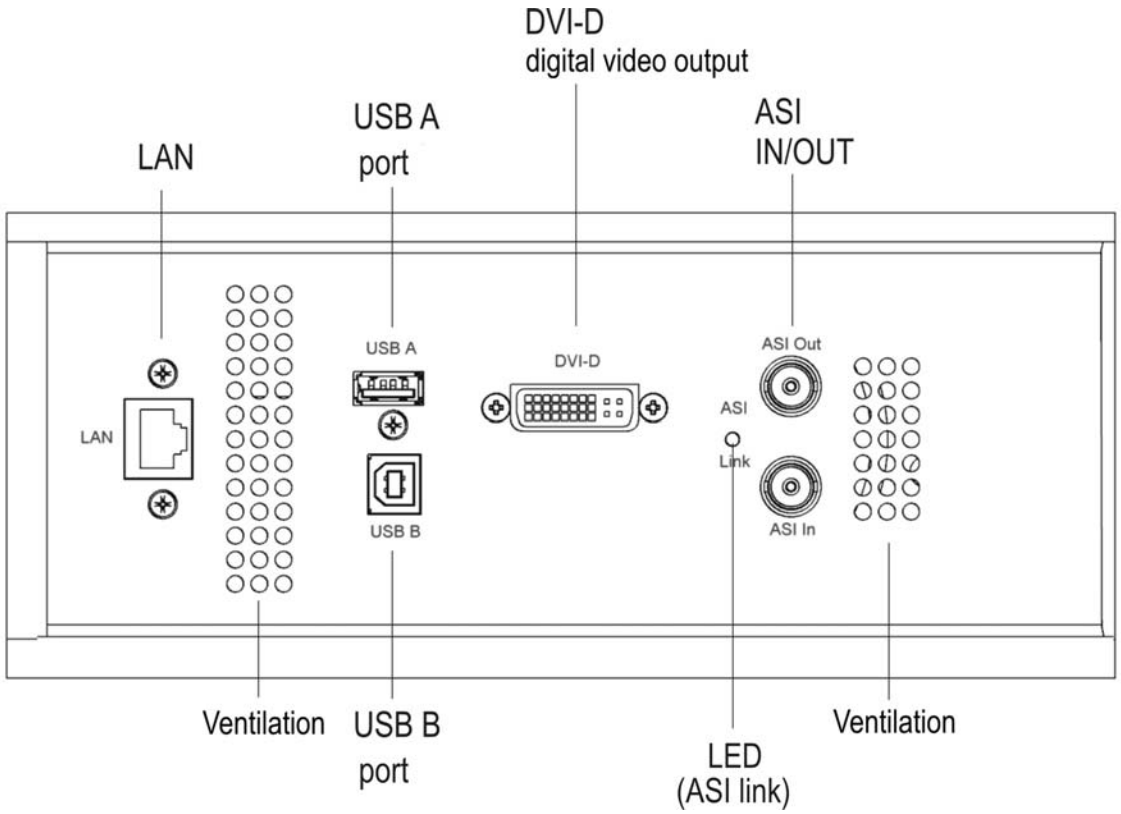
Keypad assignments (Keypad backlit)

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

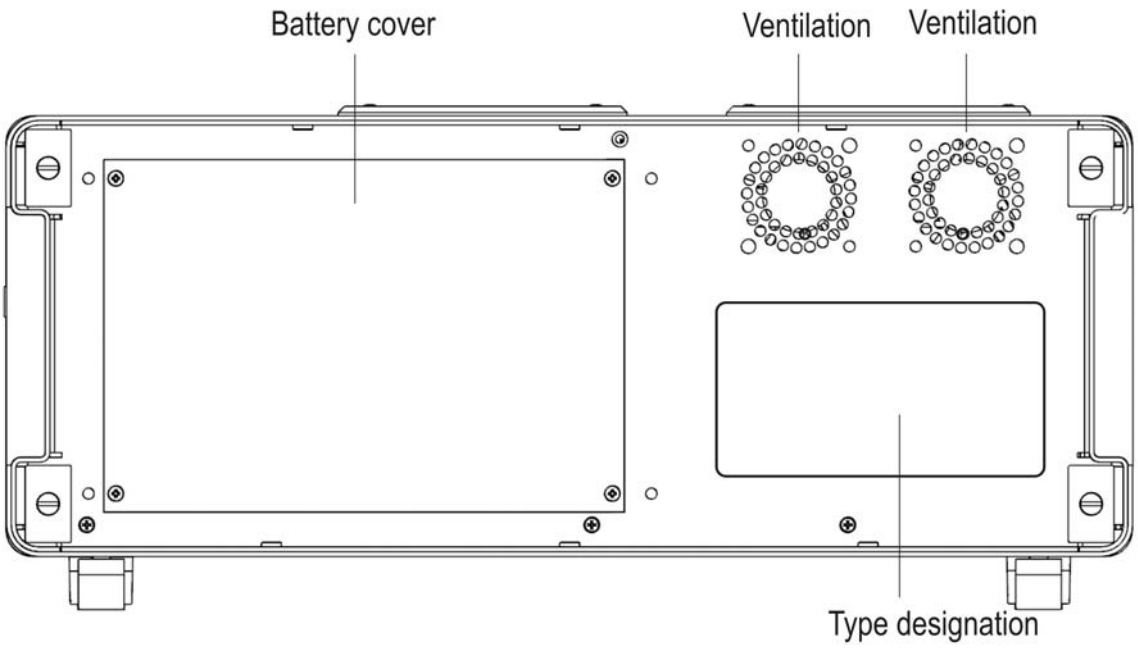
3.2 Left side view



3.3 Right side view

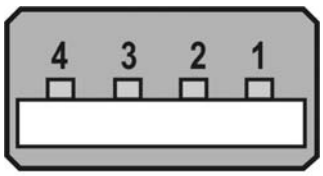


3.4 Rear panel



3.5 USB-A

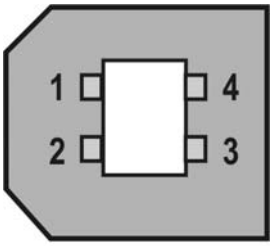
Pin 1 = V_{CC} (+5 V)
Pin 2 = Data D -
Pin 3 = Data D +
Pin 4 = GND



Socket A

3.6 USB-B

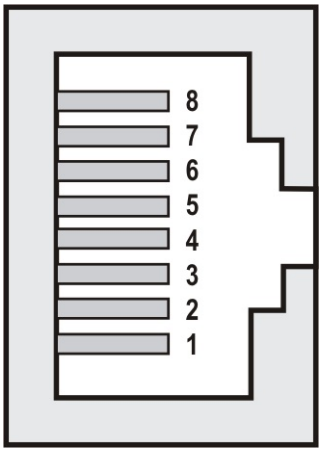
Pin 1 = V_{CC} (+5 V)
Pin 2 = Data D -
Pin 3 = Data D +
Pin 4 = GND



Socket B

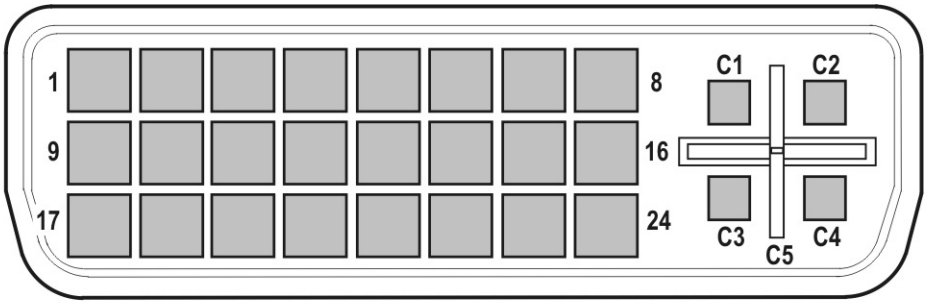
3.7 Ethernet

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.



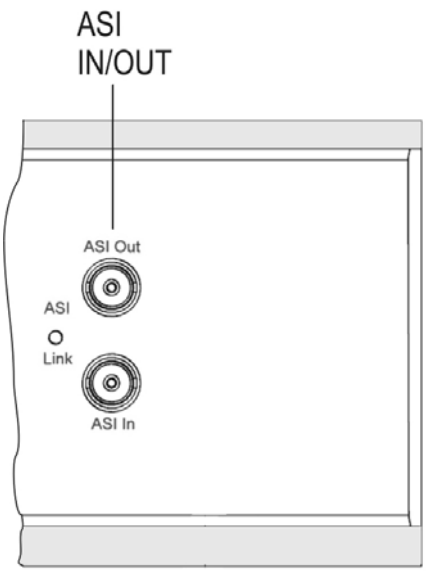
3.8 DVI output

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

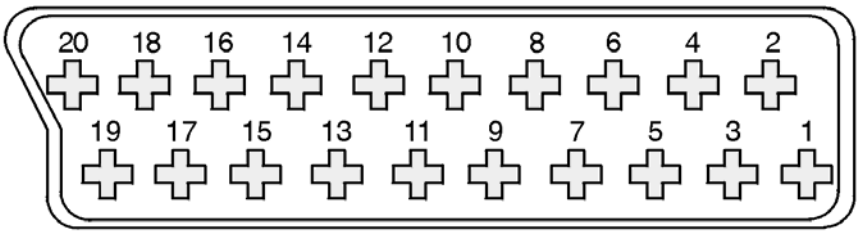


1 = T.M.D.S. Data 2-	11 = T.M.D.S. Data 1/3 Shield	21 = n.c.
2 = T.M.D.S. Data 2+	12 = n.c.	22 = T.M.D.S. Clock Shield
3 = T.M.D.S. Data 2/4 Shield	13 = n.c.	23 = T.M.D.S. Clock+
4 = n.c.	14 = +5V Power	24 = T.M.D.S. Clock-
5 = n.c.	15 = GND	
6 = DDC Clock	16 = Hot Plug Detect	C1 = n.c.
7 = DDC Data	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



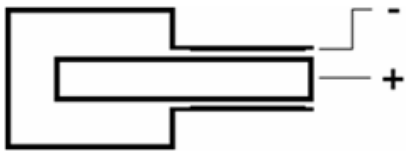
3.10 SCART socket (Euro AV)



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

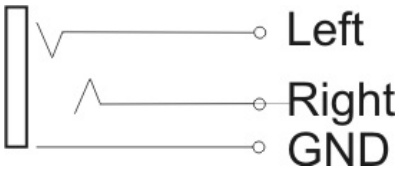
3.11 12 V power supply

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/6.75 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.

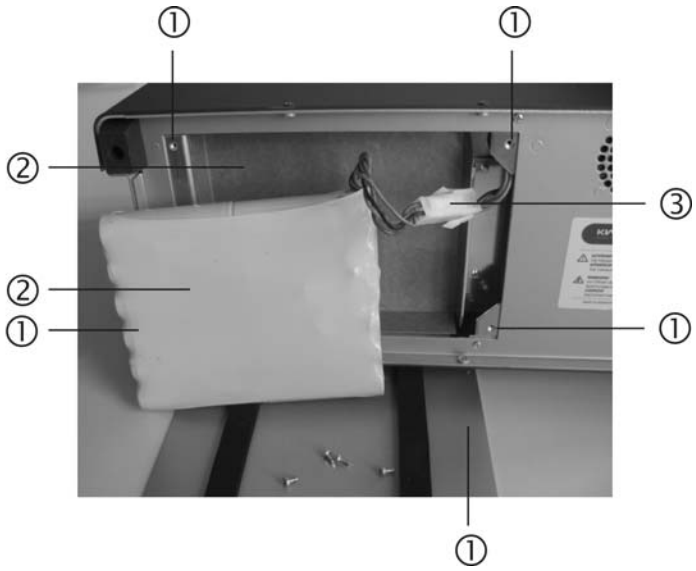
4.2.1 Replacing the battery

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.

Procedure for replacing the battery

Installation in reverse order!

① Open the battery cover by removing the four screws on the back of the instrument
② Remove the battery pack
③ Unplug the battery pack



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 the Calibration of the battery management section).

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.

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. For more, see the Control and connection elements section, paragraph 11. 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.

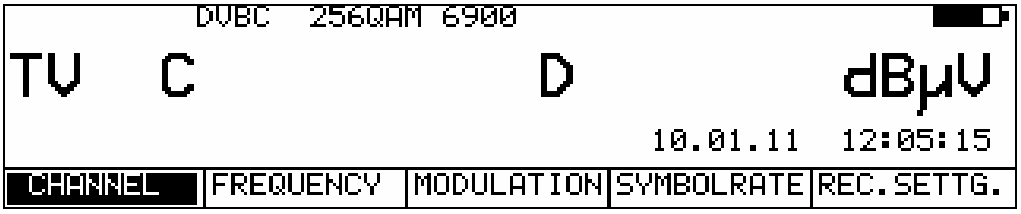
In the subsequent sections, the following notation is used to describe the menu navigation:

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:

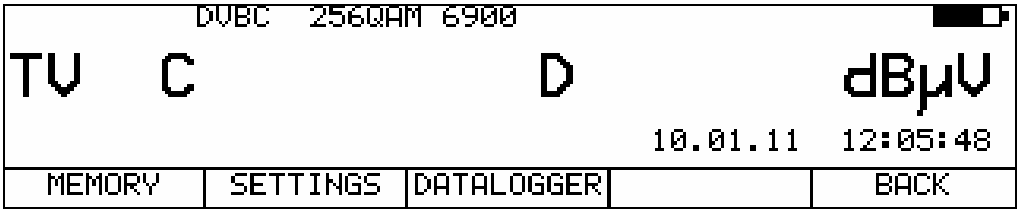
MODE -> SETTINGS -> LANGUAGE -> ENGLISH

The following figures clarify the process:

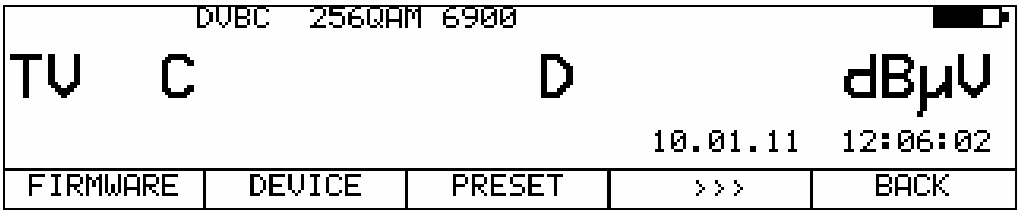


Initial state (e.g. main menu of the operating mode DVB-C).

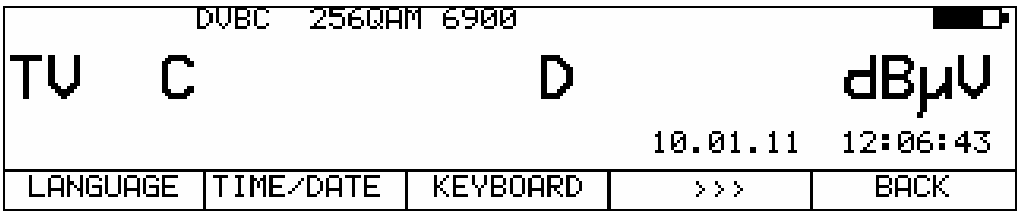
Press the **MODE** key **->**



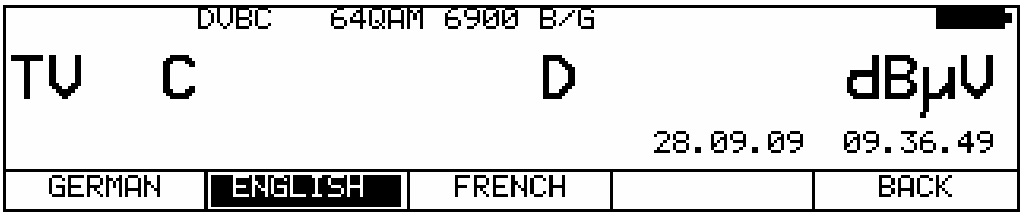
Press the **F2** (**SETTINGS**) key ->



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



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

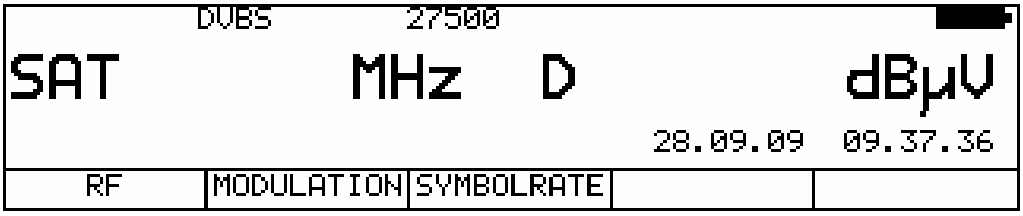


Press the **F2 (ENGLISH)** key **->**
The user interface language is now set to German.

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

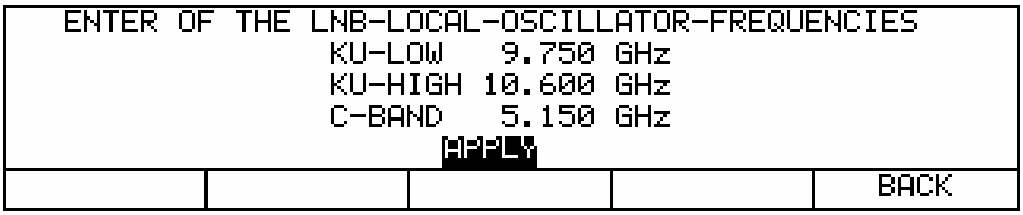
The figure above shows the default status for the entry of the SAT-IF frequency. The menu item **RF** is not activated. Here you can enter in the range 910 – 2,150 MHz.
Invalid entries are ignored.

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

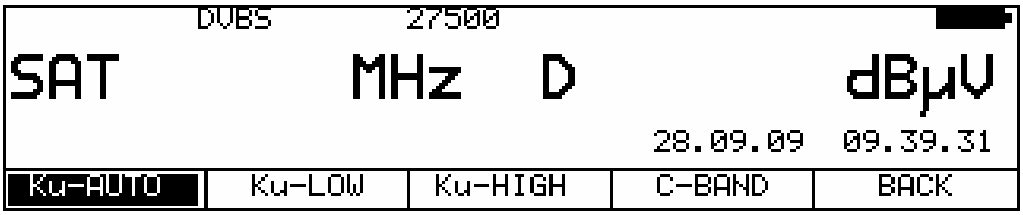
With **MODE ->** **SETTINGS** **->** **LNB-LOs**, you can enter the LO frequencies.



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 11.7GHz. 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 Selection of the operating mode

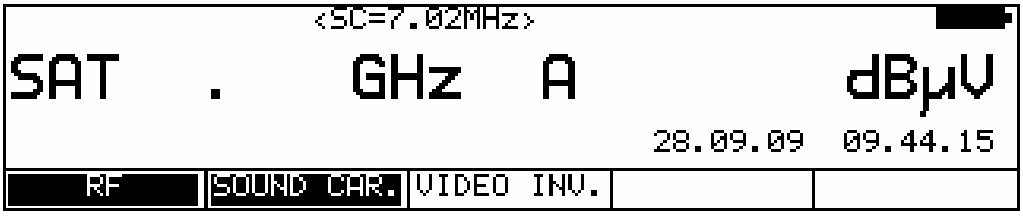
With the **ANA/DIG** key, you can select the operating mode of the measuring instrument in the SAT range.
An "A" on the display stands for analogue mode, while a "D" indicates digital operating mode.

6.2.1 ANALOG (ATV) operating mode

You can receive and measure frequency-modulated TV signals here.

6.2.1.1 Sound carrier setting

The audio signals are transmitted on sound subcarriers. You must therefore set the respective sound subcarrier frequency on the instrument.

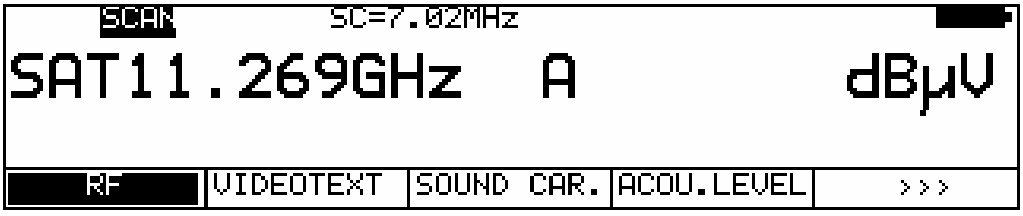


If you press the **F2** **SOUND CAR.** key, the menu item is displayed inverted. Now you can enter a sound carrier frequency in the range of 5.00 – 9.75 MHz using the numeric keypad. Press **ENTER** to confirm the entry. The default setting is 7.02 MHz.

6.2.1.2 Video polarity

Negative video modulation is the default setting. To receive TV signals with positive video modulation, set the video polarity to **inverse**.
You can do this using the menu item **VIDEO INV.** in the main menu of the SAT range.
When **UNICABLE control** is active, the instrument automatically switches to **inverse** video polarity.

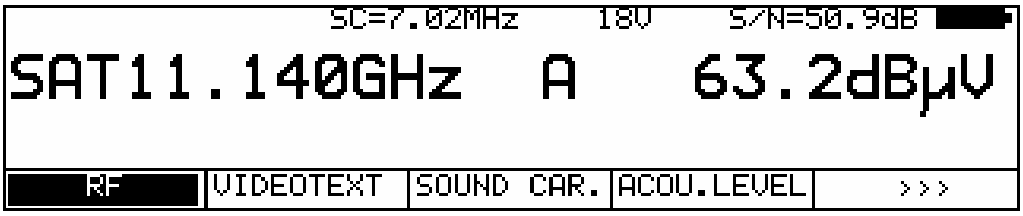
6.2.1.3 Scan



You can use this function to scan the entire SAT frequency range (910 - 2,150 MHz) for analogue TV signals. The scan is then 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**. While the scan is running, SCAN appears on the display (as can be seen above).

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 11.7GHz (see the “LO Assignment” section).

6.2.1.4 S/N measurement (optional)



The S/N (Signal/Noise) measurement is used with analogue 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).

6.2.1.5 Videotext decoder

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

6.2.1.6 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 Scope section.

6.2.1.7 Picture and sound check

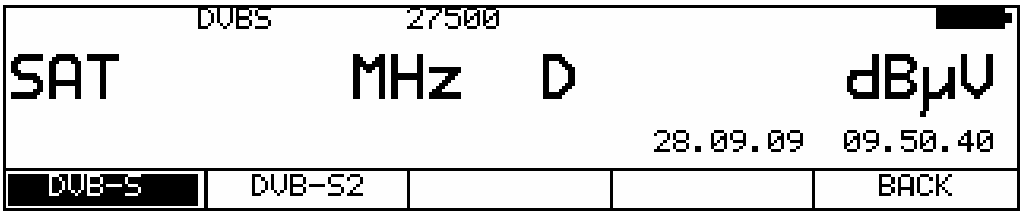
As soon as the measuring receiver is tuned, the TFT screen shows the demodulated video image. At the same time, the internal loudspeaker of the instrument outputs the demodulated audio signal. Video and audio signals are also available on the SCART socket.

6.2.2 DIGITAL (DVB-S/S2) operating mode

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

6.2.2.1 Selection of modulation

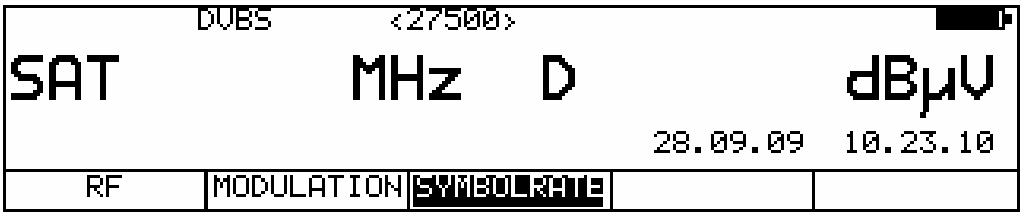
Under **MODULATION -> DVB-S or DVB-S2**, you can select the modulation type DVB-S/S2.



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.

6.2.2.2 Symbol rate input

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



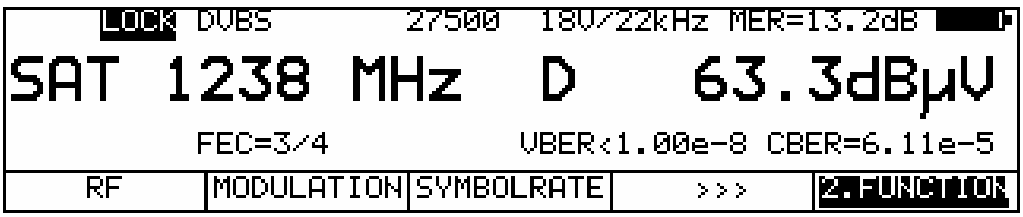
First select menu item **SYMBOLRATE**. The symbol rate indicator then appears in brackets. You can now enter the desired symbol rate in kBd using the numeric keypad. Press **ENTER** to store the setting.
For reference: 27,500 kBd = 27,500 kSym/s = 27.5 MBd = 27.5 MSym/s

Note! For DVB-S, you can set the symbol rate in the range of 2,000 kBd to 45,000 kBd, while for DVB-S2, the range of 10,000 kBd to 30,000 kBd is permitted.
With firmware version V01.xx and higher, you can also set the symbol rate in the range of 2000 kBd to 45000kBd for DVB-S2.

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.

6.2.2.3 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.



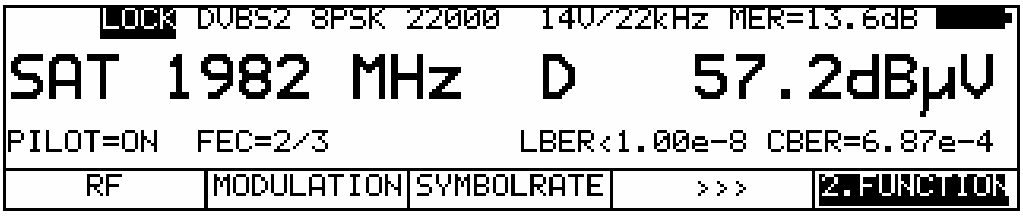
In the digital operating mode, the arrow keys have a dual function. After entry of a new frequency, the menu item **2.FUNCTION** appears in inverse. That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the F5 key in order to activate the first function 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 11.7GHz (see the “LO Assignment” section).

6.2.2.4 DVB-S/S2 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 the parameters of the receiver do not agree, or no DVB-S/S2 signal can be received at this frequency.
If the receiver has synchronised, 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.

6.2.2.5 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.

6.2.2.6 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 analogue transmission methods. The measuring range goes up to 20 dB with a resolution of 0.1 dB.

6.2.2.7 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 Constellation diagram section.

6.2.2.8 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.

6.2.2.9 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
For more, see the MPEG decoder section.

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

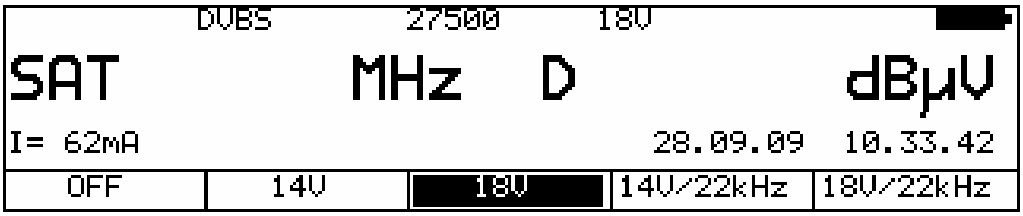
When no line of sight to the measuring instrument exists while lining up a parabolic antenna, an acoustic level trend signal can be switched on. A sound signal is emitted from the loudspeaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and 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

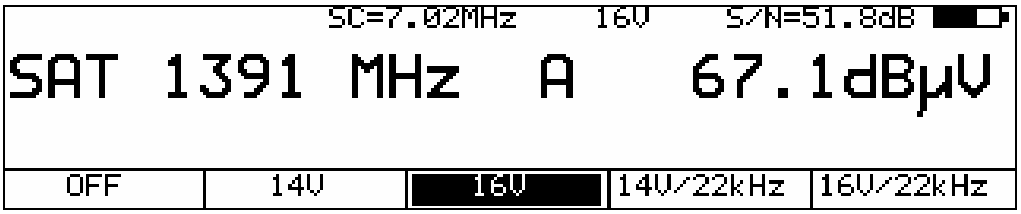
You activate the 14/18 V – 22kHz control (and DiSEqC off) with: **LNB > DiSEqC > OFF**. Afterwards, the LNB supply is set to 0 V. With **LNB > Layer > 14V, 18V, 14V/22kHz, 18V/22kHz**, you can set the desired SAT-IF layer.
If you press the **LNB** key, the LNB menu is displayed. You must first switch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

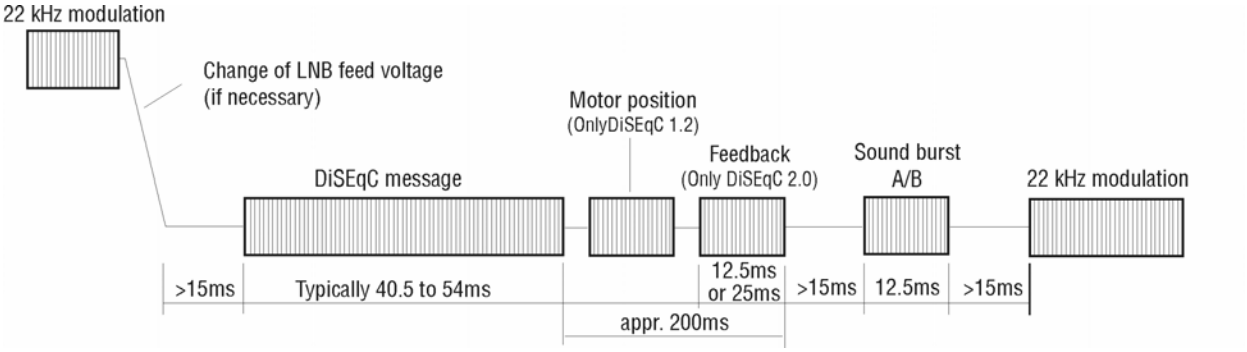
Two fixed voltages (14 V and 18 V) are set ex-works for the LNB supply.
In some cases, it can be useful to change the voltages (for example, to define the horizontal or vertical switching threshold of an LNB or multi-switch).
If the **LEYER** menu is opened as shown above, then the ↑ and ↓ keys can be 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/22kHz 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

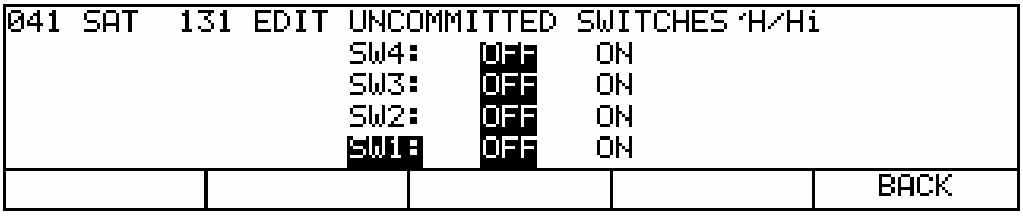
LNB -> DiSEqC -> V1.0 activates DiSEqC standard V1.0.
This allows up to 5 satellite positions with up to 4 SAT-IF layers each to be controlled. You set a SAT-IF layer using **LNB -> LAYER -> V/Lo**, **H/Lo**, **V/Hi** or **H/Hi**.

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.

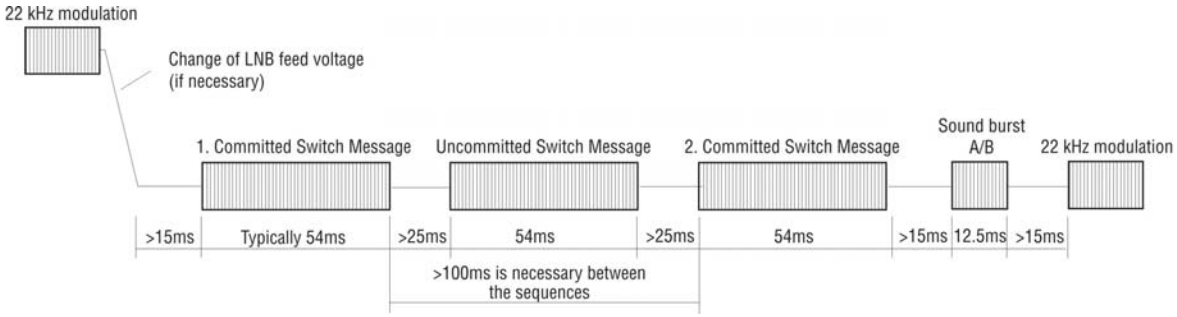
The settings for the SAT-IF layer and the satellite position are identical to those for V1.0. Added to this is the control of 'Uncommitted switches', which is operated under **LNB -> UNCOM.SWIT**. "Uncommitted switches" allow the 16 SAT-IF layers possible with V1.0 to be split into another 16 branches 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.

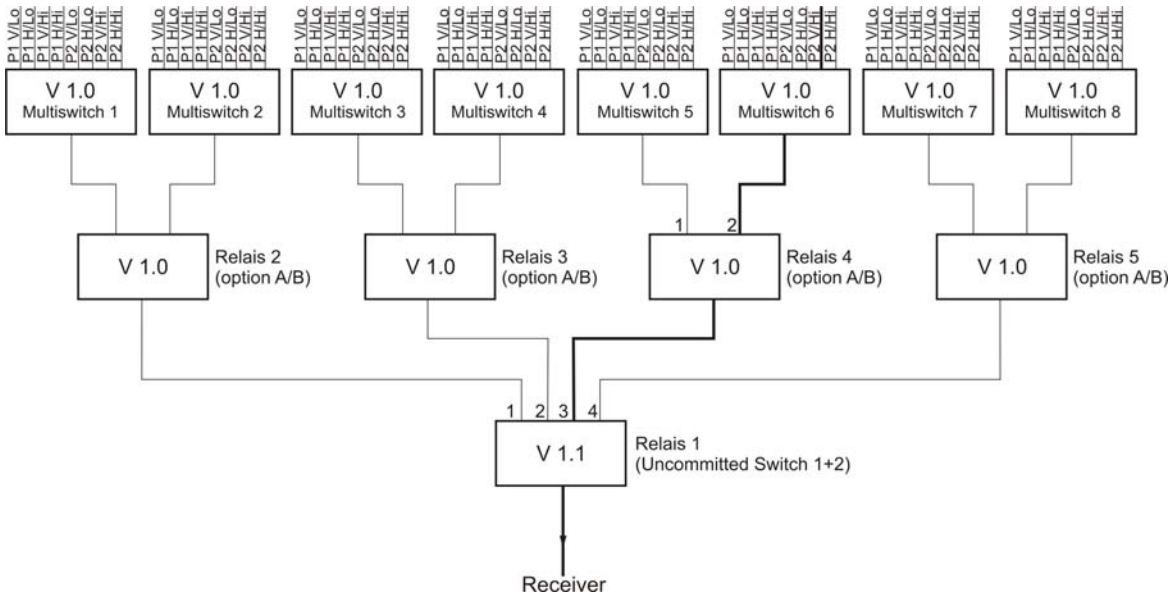
If you press **ENTER**, the settings are accepted.

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

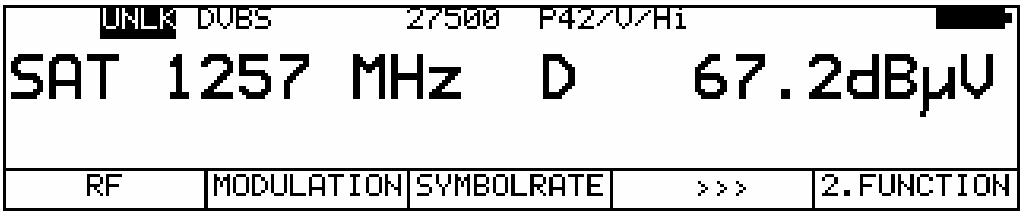
As already mentioned above, DiSEqC V1.1 is capable of cascading. For this, the control sequences must be repeated. DiSEqC components further back in the chain cannot receive the commands intended for them until the earlier components in the chain have processed their commands.
Therefore, DiSEqC1.0 (committed 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:

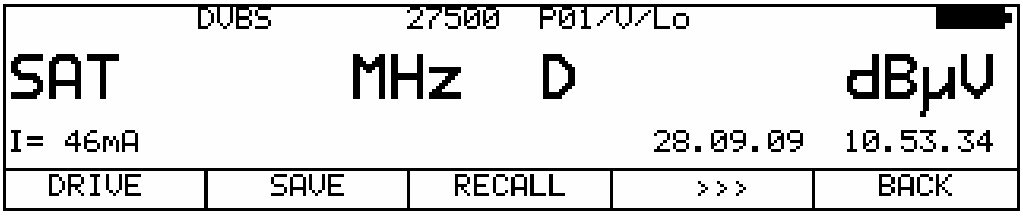
-Set SAT-IF layer to V/Hi
-Set satellite position to P4
-Set ‘uncommitted switches’ to SW1:=OFF und SW2:=ON
-Set repetitions to 2



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

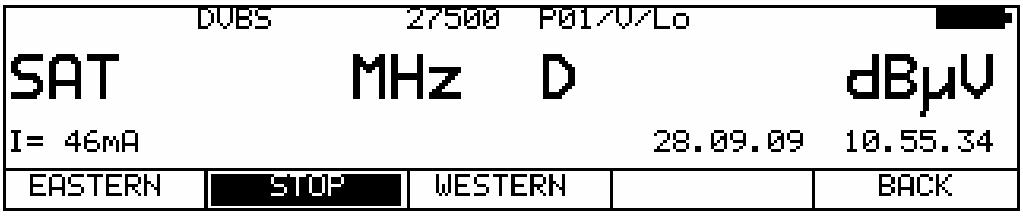
LNB -> **DiSEqC** **->** **V1.2** activates the DiSEqC V1.2 control. V1.2 can be used to control positioners with DiSEqC rotors. As with DiSEqC1.0, up to 4 SAT-IF layers can be operated.



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.



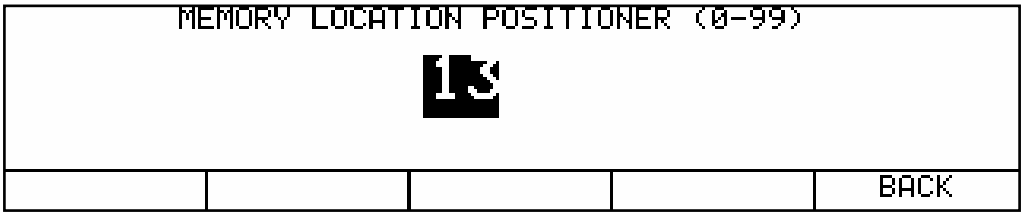
After the menu is opened, the menu item **STOP** (motor is stopped) is activated. If you press the F1 key, the rotor moves in the easterly direction. If you press F3, it moves in the westerly direction. If you press the F2 key, it stops again.

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.

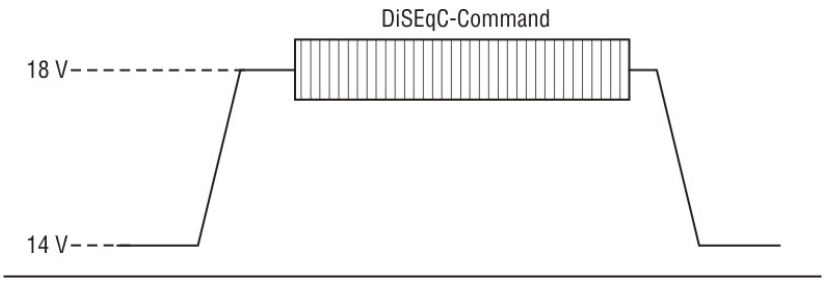
6.4.3.4 DiSEqC V2.0 control

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 (centre frequency of the UB slot or bandpass) in the UNICABLE unit (LNB or multi-switch). The information regarding which transponders should be converted on which UB slots is transmitted to the UNICABLE unit via the 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, polarisation (horizontal and vertical), low or high band, and the transponder frequency to be set.
The following control routine is used in this instrument:

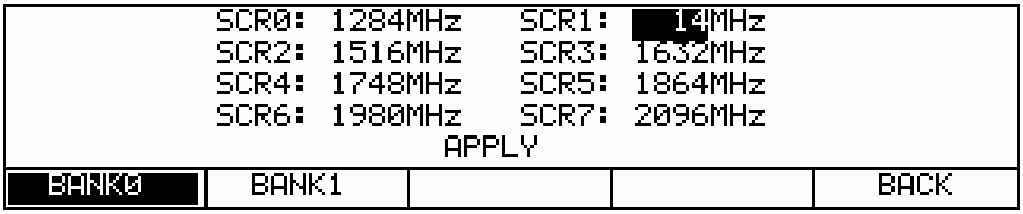


With UNICABLE systems, the signal-generating receiver generates a high DC level as it transmits, which is added to the UNICABLE message (special DiSEqC command). After transmitting the UNICABLE message, the receiver returns to an idle state in which a low DC level is generated. The receiver must return 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 for editing the relationship between the satellite channel router (SCR) address and the centre frequency of the user band (UB) bandpass slot that the measuring receiver is to use. You can obtain these parameters from the data sheet of the UNICABLE unit being used.



Using the ← or → arrow keys, you can move the cursor onto the desired SCR address. With the numeric keypad, you can enter the corresponding centre 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. If the cursor is on the selection APPLY, the input menu is closed and values are stored in non-volatile memory if you press the **ENTER** key. From here on, the measuring receiver operates with UNICABLE control.

SCR-ADR bank:
There are UNICABLE units for 4 and 8 receivers per cable. These units generally operate with different UB centre frequencies. To simplify the procedure for the user, the instrument offers a feature that enables switching between two SCR address banks. That means that the instrument has one bank of SCR addresses for UNICABLE units that operate with 8 receivers and a separate bank of SCR addresses for UNICABLE units that operate with 4 receivers. The UB centre frequencies can also be changed within the two banks as described above. The set bank is non-volatile. That means that the next time the instrument is switched on, it will operate again with these SCR-ADR <-> UB centre 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 two banks via **LNB ->** **SCR-ADR-Bk** **->** **BANK0** or **BANK1**.

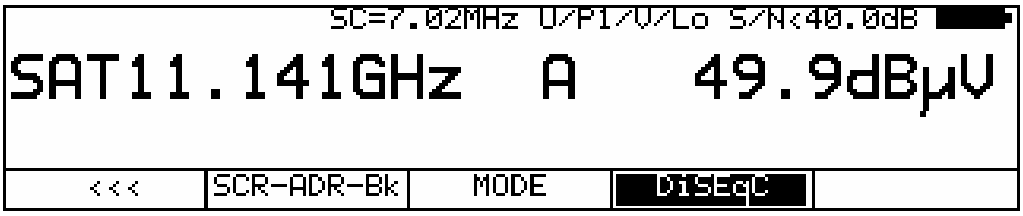
Broadband RF mode:
Some UNICABLE units (LNB) operate only on a single oscillator frequency. This means that the low band and the high band are combined into a one band. This special mode can be set in the measuring instrument via **LNB ->** **MODE** **->** **WIDEBD.RF**. The UNICABLE control is switched 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 Frequency input section. The difference when using the UNICABLE control is that the desired transponder frequency is converted to the centre 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 centre 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.

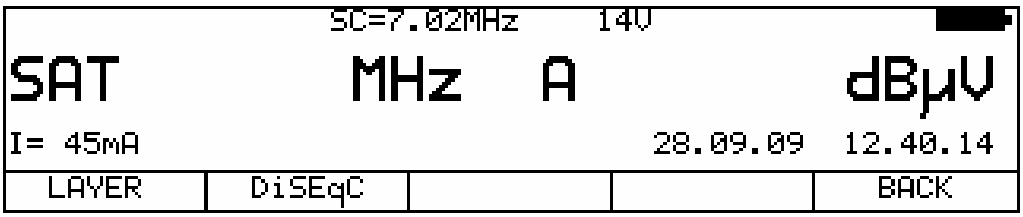


Broadband RF mode:
As described above, these UNICABLE units operate only on a single oscillator frequency, causing the low and high band to be combined in one band. This reduces the number of SAT-IF layers to 2 (vertical and horizontal). If the instrument is in this mode, you can set the vertical (**->** **V**) or horizontal (**->** **H**) polarisation 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.

6.4.5 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.

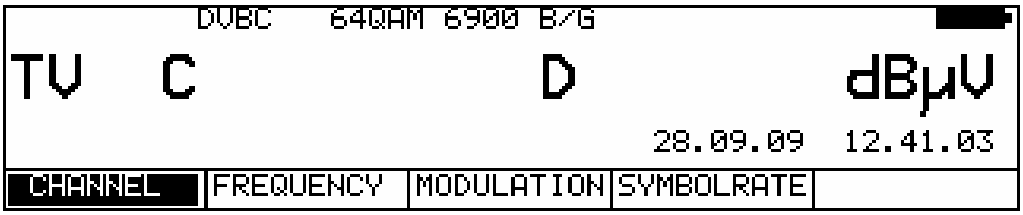


In the above example, a current of 45 mA is measured with a 14 V LNB supply.
If the measuring receiver is tuned, the current indicator disappears from the LCD.

Chapter 7

TV Measuring Range

You access the TV range via **RANGE ->** TV.
This range spans the frequency range of 44.75 to 867.25 MHz.



7.1 Switching between frequency and channel input

The instrument can be tuned by entering the channel centre 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

Using the numeric keypad, you can enter a frequency between 44.75 and 867.25 MHz. 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 centre 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**).
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 analogue mode, while a “D” indicates digital operating mode.

7.2.1 ANALOG (ATV) operating mode

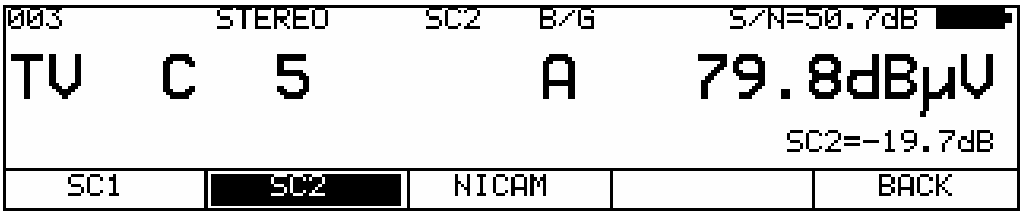
Analogue-modulated TV signals can be received and measured here.
The instrument supports the B/G, M/N, I, D/K and L TV standards as well as the PAL, SECAM and NTSC colour standards.

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. You can find further information about this in the Channel table section.

7.2.1.2 Sound carrier

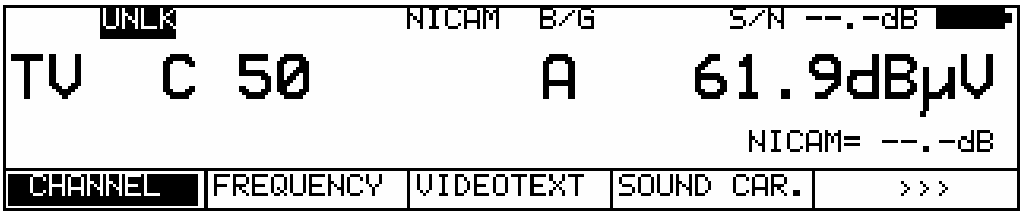
Audio signals are transmitted on modulated sound carriers. Depending on the TV standard, the two sound carriers have different frequency distances from the video carrier frequency.
The sound information can transmit MONO, STEREO or DUAL SOUND (bilingual). The instrument can demodulate both sound carriers 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.

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 analogue sound carrier. This means that a total of 3 (1x analogue 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 analogue 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).



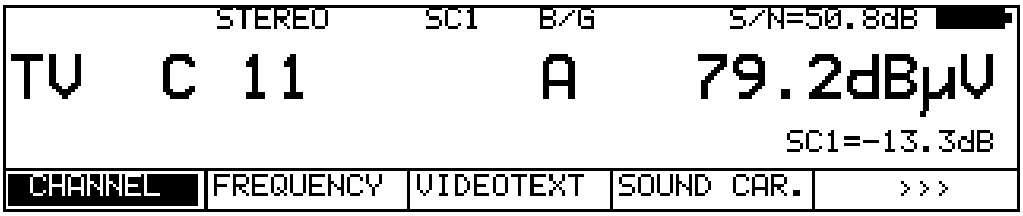
To activate the NICAM decoder, select the menu item **NICAM** under **SOUND CAR.**.

The decoder then attempts to synchronise 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 analogue 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 analogue 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 (optional)



The S/N (Signal/Noise) measurement is used with analogue 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 the Videotext section.

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 Scope section.

7.2.1.8 Picture and sound check

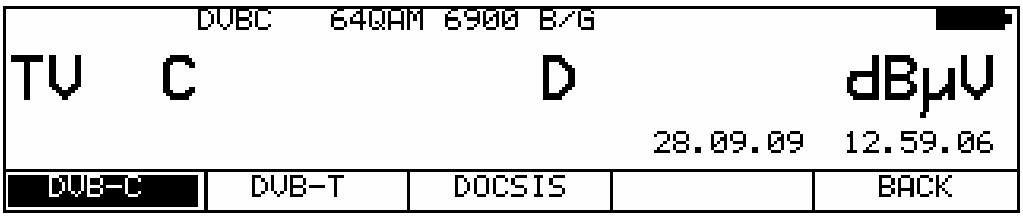
As soon as the measuring receiver is tuned, the TFT screen shows the demodulated video image. At the same time, the internal loudspeaker of the instrument outputs the demodulated audio signal. Video and audio signals are also available on the SCART socket.

7.2.2 DIGITAL (DVB-C, DVB-T, DOCSIS) operating mode

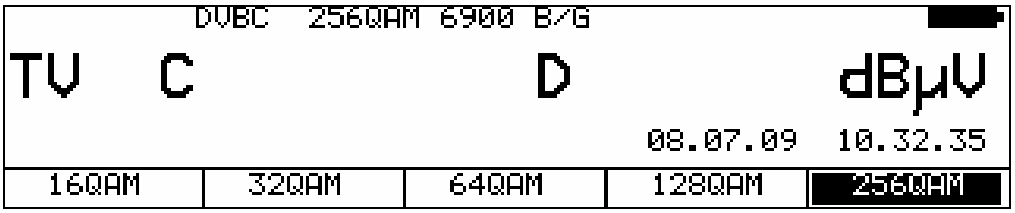
Here you can receive the digitally modulated DVB-C, DVB-T or DOCSIS signals and measure their signal quality.

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.

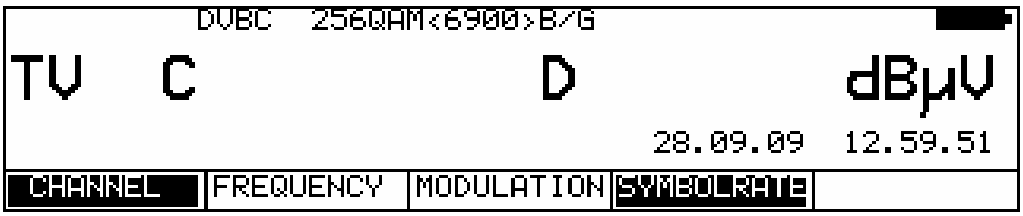


The selections **16QAM**, **32QAM**, **64QAM**, **128QAM** and **256QAM** are also available.
QAM means Quadrature Amplitude Modulation. That is the modulation method with DVB-C.

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.

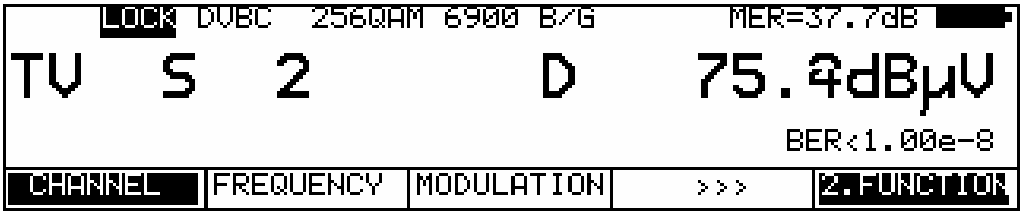
For reference: 6,900 kBd = 6,900 kSym/s = 6.9 MBd = 6.9 MSym/s

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.



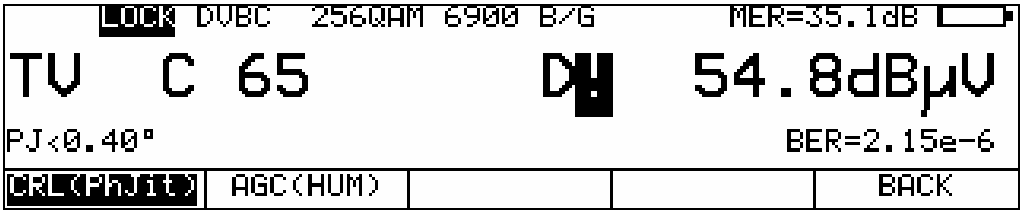
In the digital operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted. That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the F5 key in order to activate the first function of the arrow 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 Secial 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 depth of measurement is generally $1 \cdot 10^8$ 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 analogue 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)

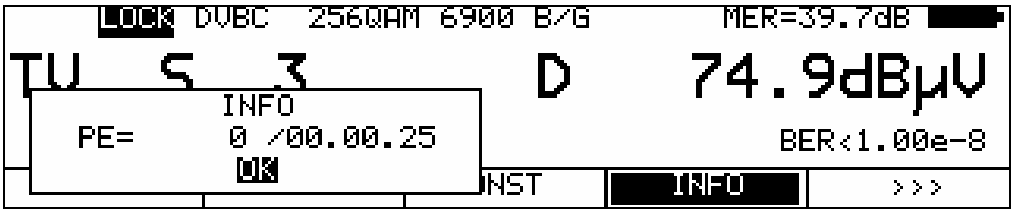
The measuring instrument can measure the phase jitter in a QAM signal. The principle of measurement is explained in ETR290. The measurement is in degrees, with a measuring range from 0.40° to 5.00° and a resolution of 0.01°. The instrument shows the phase jitter on the display as soon as the receiver is working with slower carrier control. See chapter “Carrier control bandwidth”.

7.2.2.1.8 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 Constellation diagram section.

7.2.2.1.9 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.

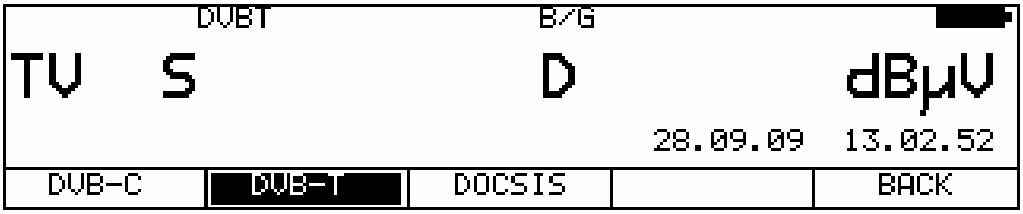


7.2.2.1.10 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
For more, see the MPEG decoder section.

7.2.2.2 DVB-T

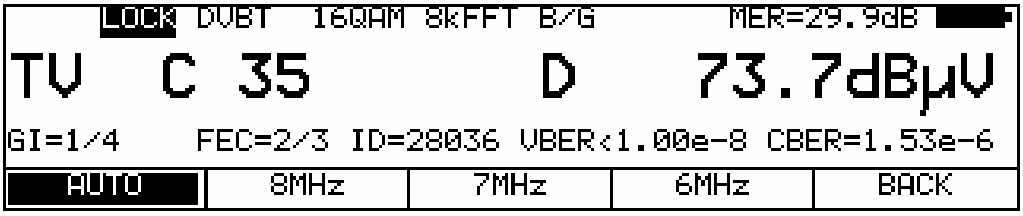
The DVB-T receiver of the measuring instrument is activated via the menu item **MODULATION** -> **DVB-T**.



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

7.2.2.2.1 Selection of the COFDM bandwidth (channel bandwidth)

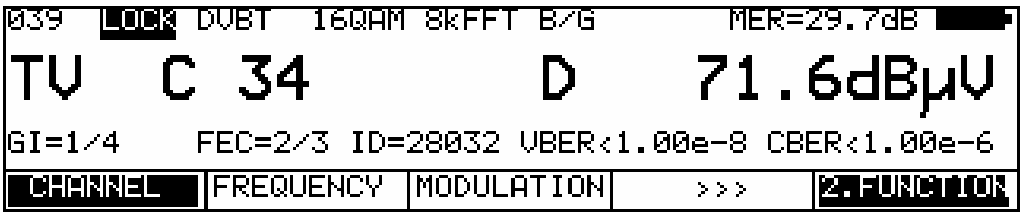
The DVB-T standard provides for transmission in 6, 7 or 8 MHz channels.



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.

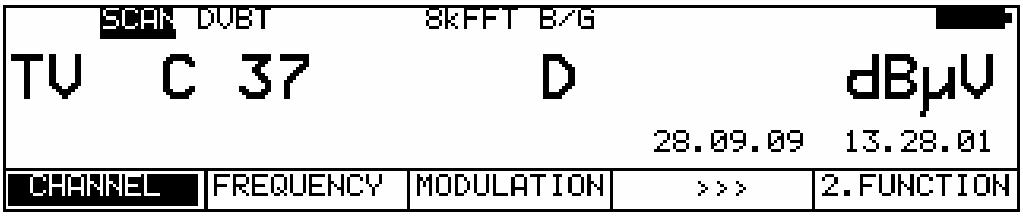
7.2.2.2.2 Scan

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.



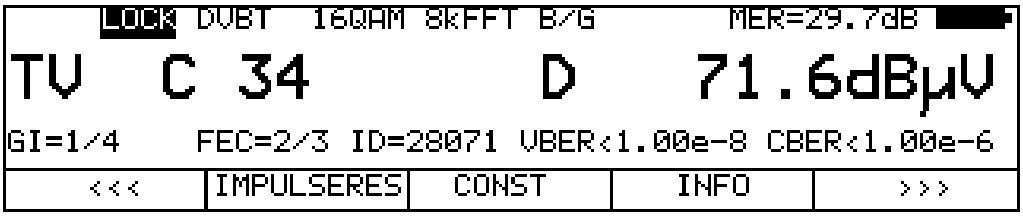
In the digital operating mode, the arrow keys have a dual function. After entry of a new channel, the menu item **2.FUNCTION** is inverted. That means that the MPEG decoder can be operated with the arrow keys. To start the scan, first press the F5 key in order to activate the first function of the arrow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



Once the receiver is synchronised, 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 is $1 \cdot 10^8$ bits for each.

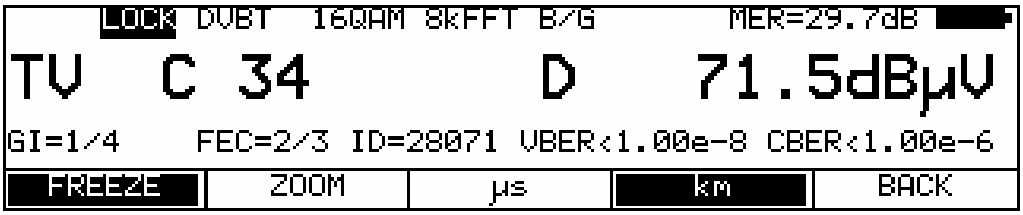
7.2.2.2.5 MER measurement (Modulation Error Rate)

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 analogue transmission methods. The measuring range goes up to 35 dB with a resolution of 0.1 dB.

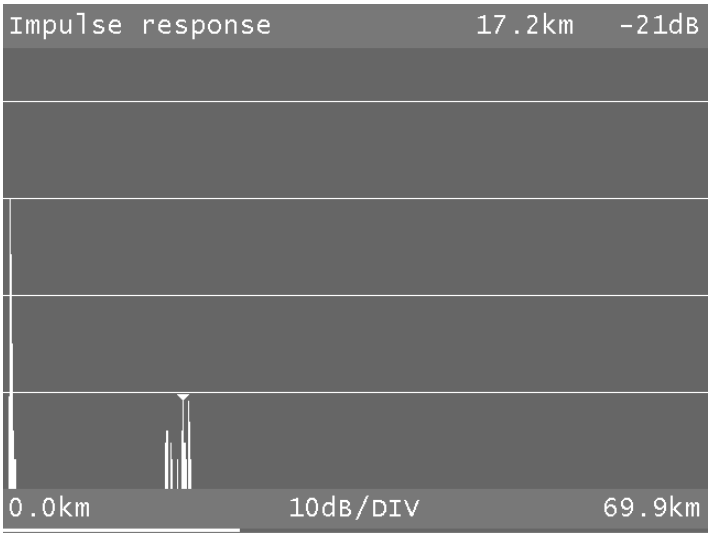
7.2.2.2.6 Impulse response

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: $=3 \cdot 10^8$ m/s. You can end the display of the impulse response via the menu item **BACK**.



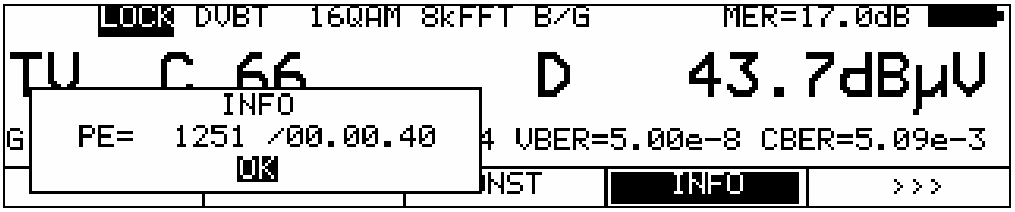
The printed example shows an impulse response with a primary impulse (left picture edge) and several secondary impulses at a distance of approximately 17 km from the primary impulse.
You can move the cursor (small triangle) left and right using the ← and → keys. At the top right edge of the picture, the distance of the secondary impulses and their attenuation (-21 dB) in relation to the primary impulse is displayed.

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 Constellation diagram section.

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 Picture and sound check

For digital television, picture and sound decoding take place in the MPEG decoder.
For more, see the MPEG decoder section.

7.2.2.3 DOCSIS (upsteam)

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.
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	6MHz	8MHz
Transmission frequency range	50…862MHz	112…862MHz

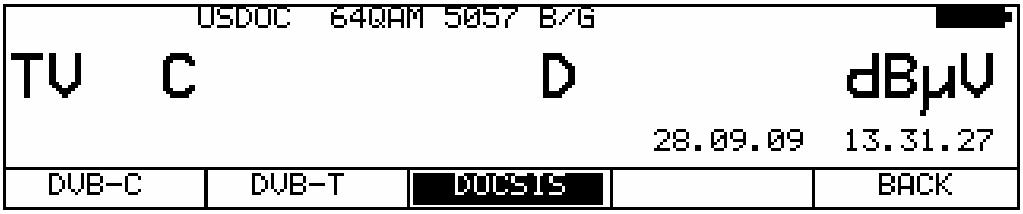
Differences in the downstream:

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

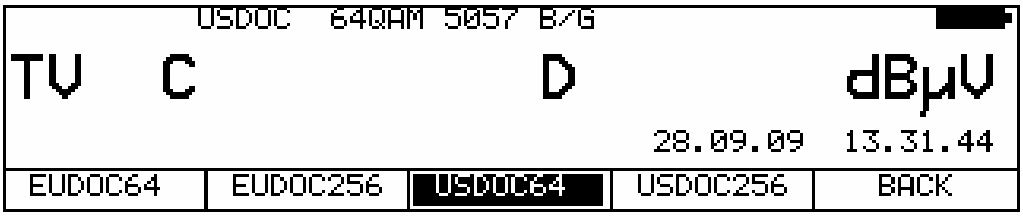
As you can see in the comparison, you can use a DVB-C receiver for the reception of a Euro-DOCSIS downstream signal. It is only necessary to set the symbol rate to 6.952 kBd. For US-DOCSIS, a receiver according to ITU J.83/B is required.

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.

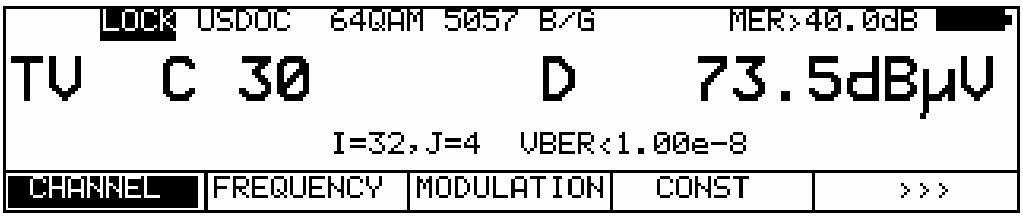
Automatic scan with DOCSIS:
If you enter a new channel, the receiver attempts to synchronise with the current settings (DOCSIS variants, modulation schemes). If this is not successful, the instrument alternatively uses the other settings **EUDOC64**, **EUDOC256**, **USDOC64** or **USDOC256** to receive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

7.2.2.3.1 DOCSIS 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 DOCSIS 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.

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).



7.2.2.3.2 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.

7.2.2.3.2.1 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.

7.2.2.3.2.2 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.

7.2.2.3.2.3 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.

7.2.2.3.3 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.
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.

7.2.2.3.4 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 shown on the display in exponential form. The depth of measurement is generally $1 \cdot 10^8$ bits.

7.2.2.3.5 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 analogue transmission methods. The measuring range goes up to 40 dB with a resolution of 0.1 dB.

7.2.2.3.6 PJ measurement (Phase jitter)

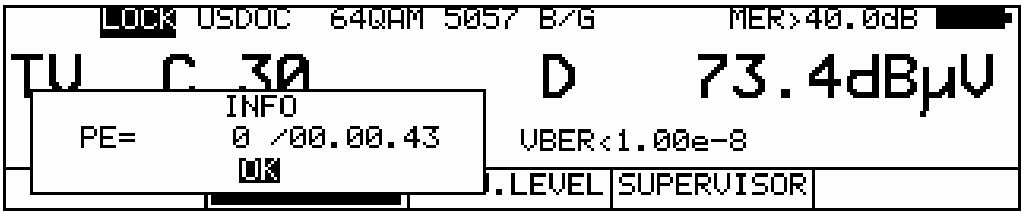
The measuring instrument can measure the phase jitter in a QAM signal. The principle of measurement is explained in ETR290. The measurement is in degrees, with a measuring range from 0.40° to 5.00° and a resolution of 0.01°. The instrument shows the phase jitter on the display as soon as the receiver is working with slower carrier control. See chapter “Carrier control bandwidth”.

7.2.2.3.7 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 Constellation diagram section.

7.2.2.3.8 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.



7.3 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.

7.3.1 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.

7.3.2 Level measurement with analogue 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).

7.3.3 Level measurement with DVB-C, DVB-T 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 centre and extrapolates the channel bandwidth using the bandwidth formula.
The measuring bandwidth is adjusted to the current channel bandwidth.

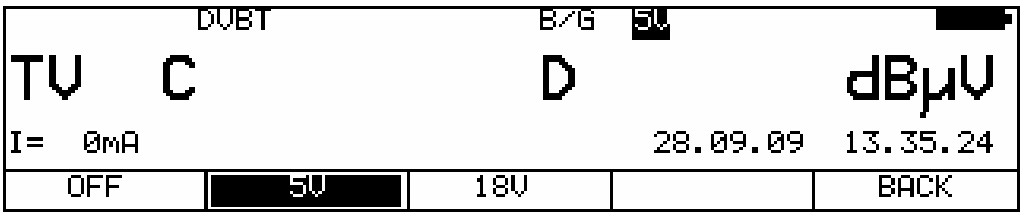
7.4 Remote supply

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 chose 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.

7.4.1 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.

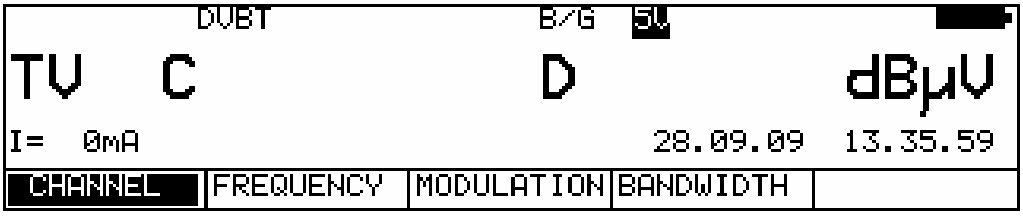


7.4.2 Changing the fixed remote supply voltages

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.

7.4.3 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.

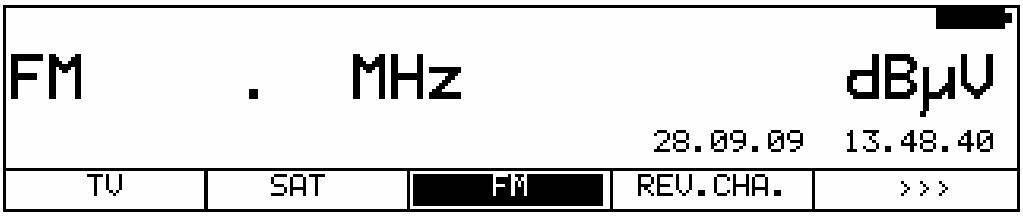


In the above example, a current of 0 mA is measured with a 5 V remote supply.
If the measuring receiver is tuned, the current indicator disappears from the display.

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.

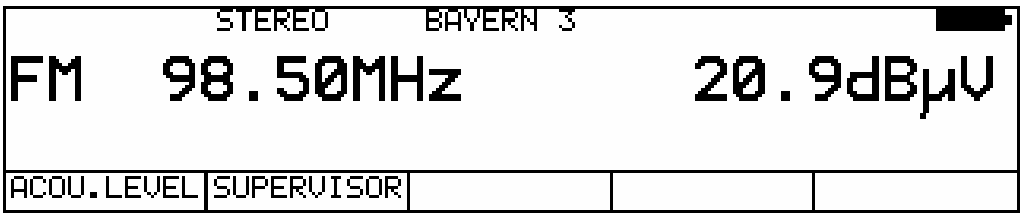
Frequency detuning
If the measuring receiver is tuned, you can carry out a frequency detuning in the 10 kHz grid using the ← and → keys.

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.



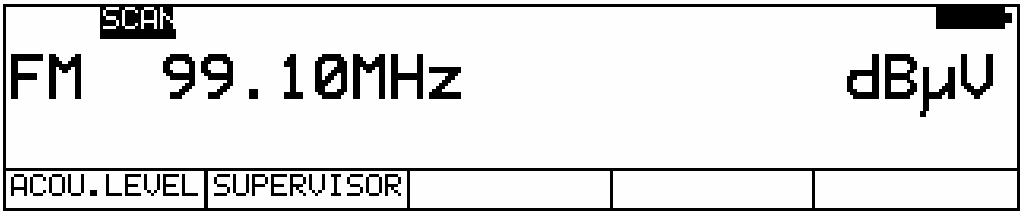
8.4 RDS (Radio Data System)

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 EN 50067.
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 is shown in the top line of the display. In the above example, "BAYERN 3". 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 110 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. 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.

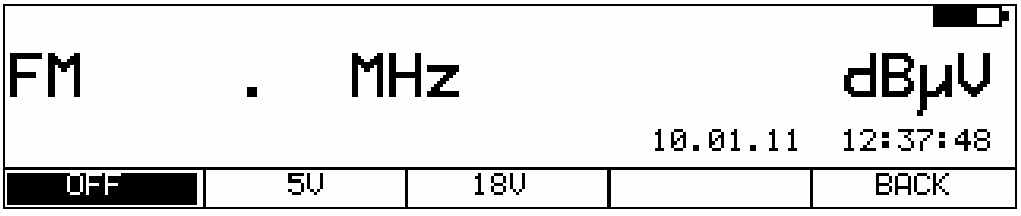
8.7 Remote supply

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 chose 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 1 V increments using the ↑ and ↓ keys. The setting is non-volatile.

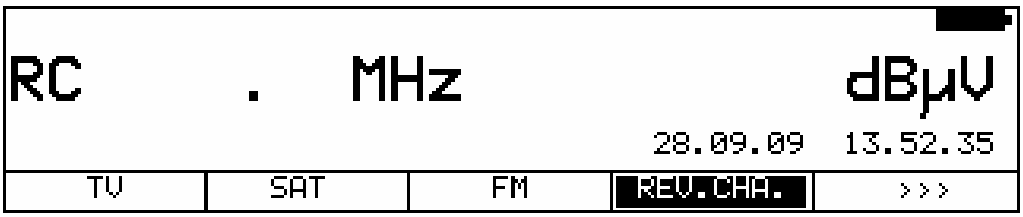
8.7.3 Measuring the remote supply current

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 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.

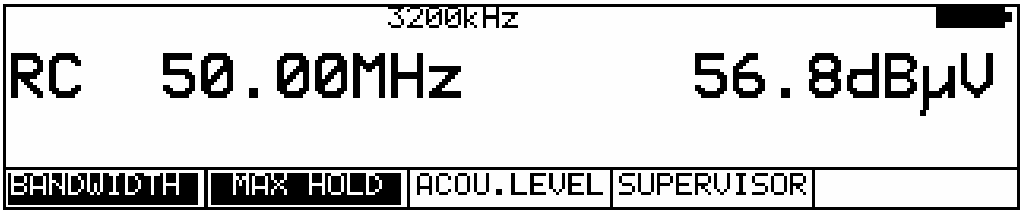
Frequency detuning
If the measuring receiver is tuned, you can carry out a frequency detuning in the 50 kHz grid using the ← and → keys.

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

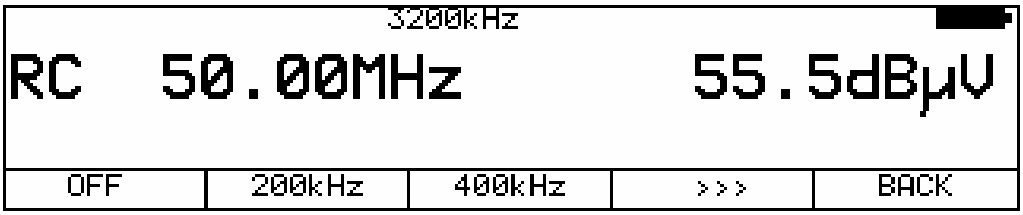
The usable signal on the return path of a cable system is generated by the active (online) cable modem. According to the cluster size of a network, the cable modem can transmit more or fewer frequencies. The registered cable modem may only transmit in certain short time slots. Therefore, the maximum 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: 160kBd, 320kBd, 640kBd, 1280kBd, 2560kBd and 5120 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 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 chose 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 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 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.

Chapter 10

MPEG Decoder

10.1 Introduction

10.1.1 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 digitalisation 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 analogue 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 $2 \cdot 10^{-4}$.

10.1.2 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.

10.2 Operation (MPEG-2 and MPEG-4 decoder)

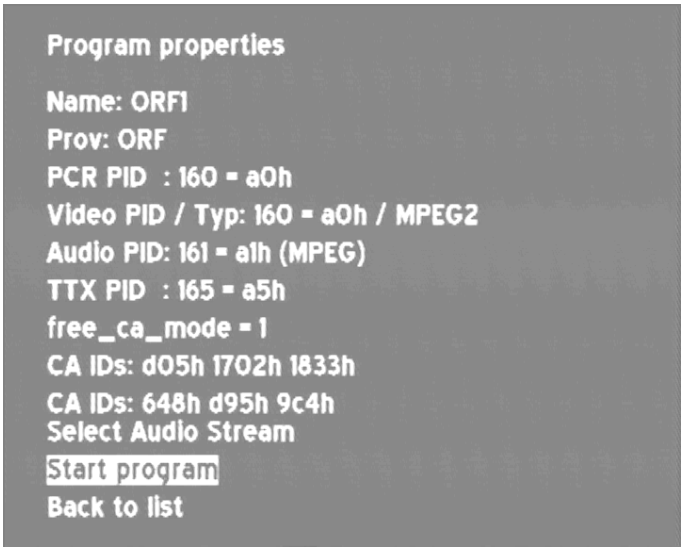
The following section applies to the MPEG-2 decoder as well as the MPEG-4 decoder. Any differences are explained at the appropriate point. “MPEG-4 decoder” in the following refers to the MPEG-2/4 combination decoder.

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 “**????**”, this usually means that it is one of the so-called feed channels (e.g. Premiere Fußball), which only broadcast at certain times.
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 analogue television, most program providers supply videotext. This can be seen if a PID is entered at the TTX position. As explained in the Videotext section, information is transmitted using elementary text streams in the MPEG transport stream. The MPEG decoder decodes the pages.
Consult the Videotext section 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).

10.3 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.

10.4 Measurement and display of the video bit rate

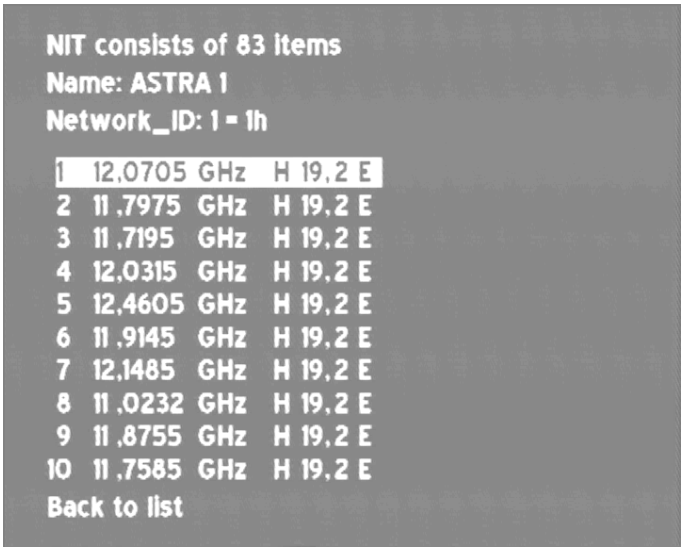
The decoder can measure the current bit rate of the video stream being transmitted while a live picture is played. This is shown in the unit [Mbit/s] in the window described in the **Displaying the MPEG video parameters** section. A time window of 1 s is used for measurement.

10.5 Network Information Table (NIT)

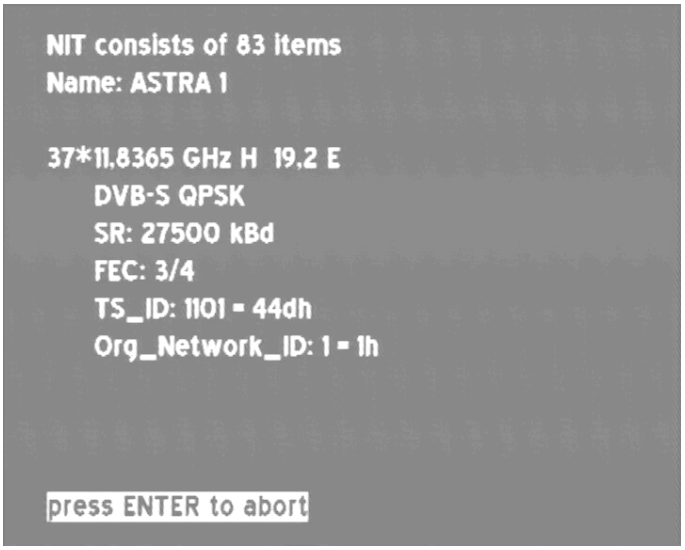
NIT (Network Information Table) is part of the Service Information (SI) range that is transmitted in multiplex in the transport stream along with video and audio programs.
Each transport stream has a separate NIT. The NIT contains information that can be used for navigation (program search) in set-top 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 the “Printer” and
“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, polarisation and orbital position.
An “ * ” after the serial number indicates that the current transport stream originates from this transponder. 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.



The transport stream with the number 1119 (TS_ID) is transmitted on a transponder frequency of 12.7215 GHz at an orbital position of 19.2^{O} East with horizontal polarisation.
Transmission occurs according to 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.

Chapter 11

Constellation Diagram

11.1 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.

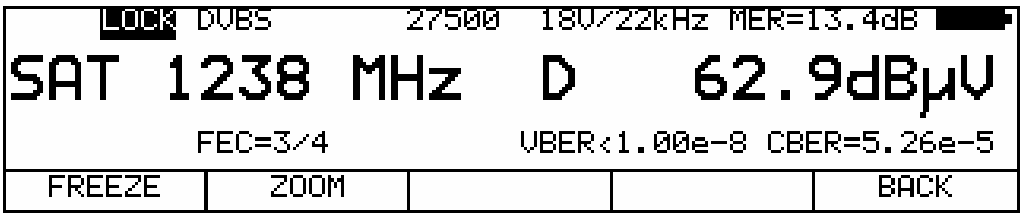
In the ideal case, all signal states are in the centre of the decision fields. A real signal is exposed to variable interferences, however. If you view these interferences as vectors that are superimposed on the ideal signal states, the peaks of the sum vectors depict the deviation from the ideal state. 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 centre 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, analysed and displayed in colour on the TFT according to an analysis of frequency of occurrence. The colour 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.

11.2 Operation

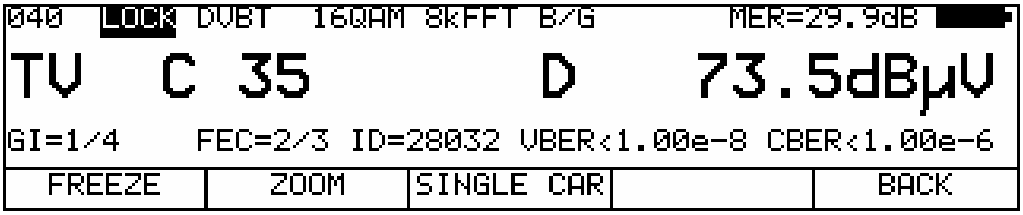
As previously mentioned, you can show the constellation diagram for all digital standards (DVB-S/S2, DVB-C, DVB-T and DOCSIS). You must first tune the measuring receiver in a digital range. You can then access the constellation diagram via the menu item **CONST**. At the same time, a submenu opens through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

11.2.1 Displaying single carriers with DVB-T

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

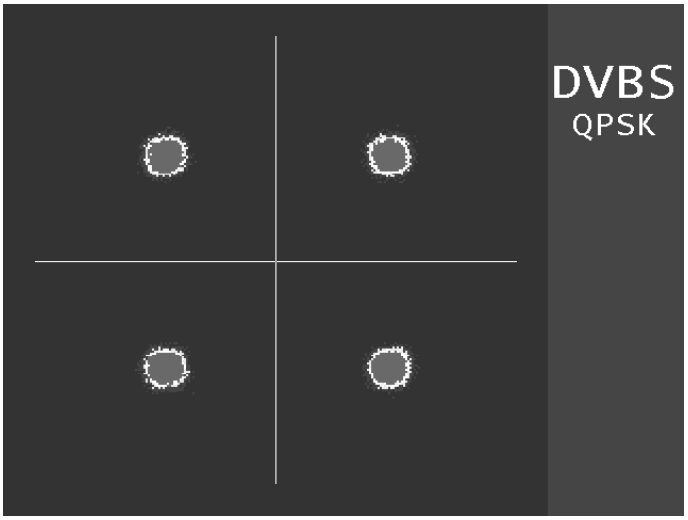


If you access the menu item **SINGLE CAR**, you can enter the number of a single carrier within the COFDM spectrum using the numeric keypad. You confirm the entry by pressing **ENTER.** The constellation diagram of the desired single carrier is then displayed. Due to the fact that a single carrier is only transmitted approx. every 1 ms, 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.

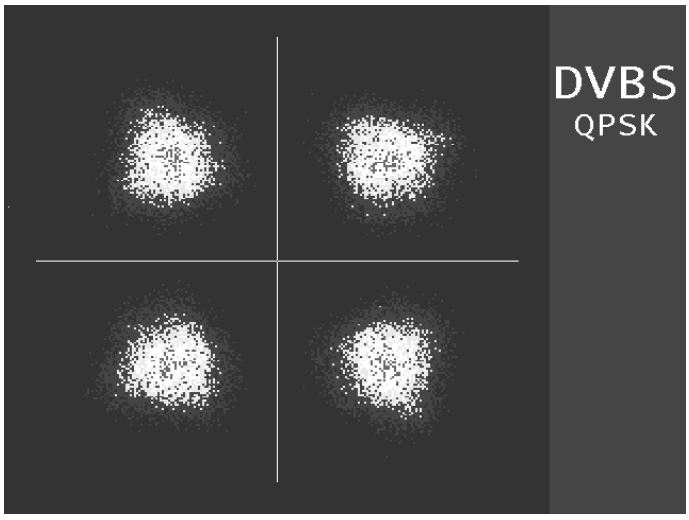
11.3 Examples

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

11.3.1 DVB-S/S2

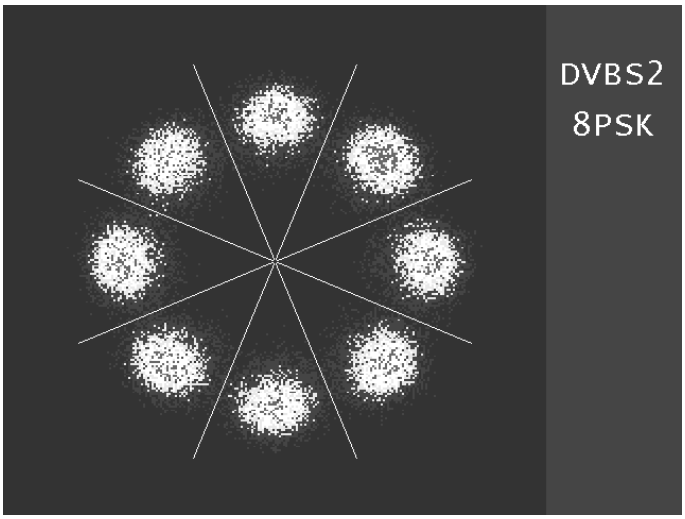


Ideal constellation diagram -> signal source SFU (Rohde & Schwarz)



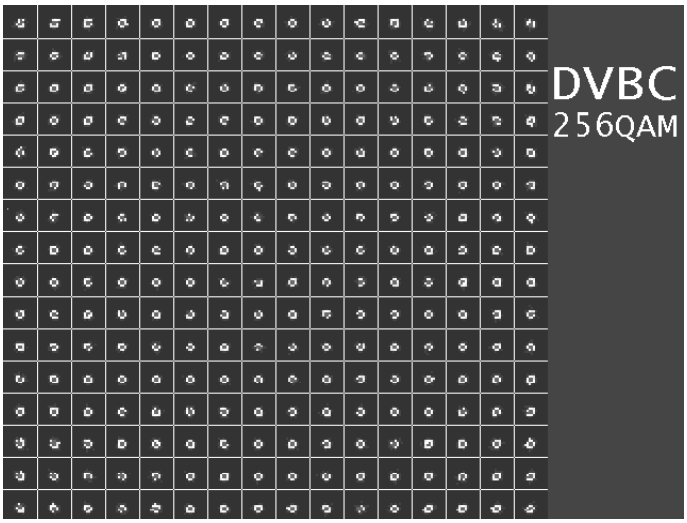
Error: Uncorrelated interference

Cause: Bad cross-polarisation decoupling

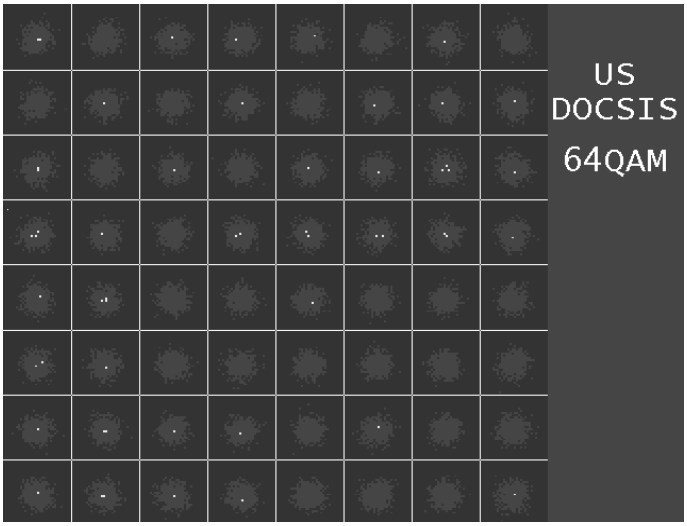


Real 8PSK signal with MER = 14 dB.

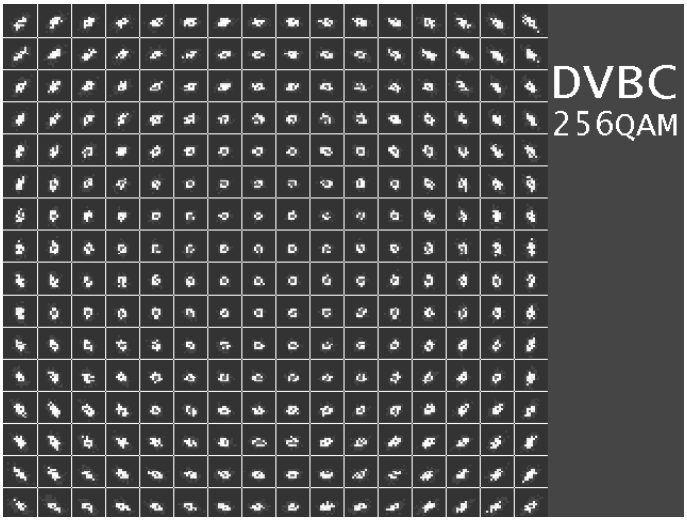
11.3.2 DVB-C/DOCSIS



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

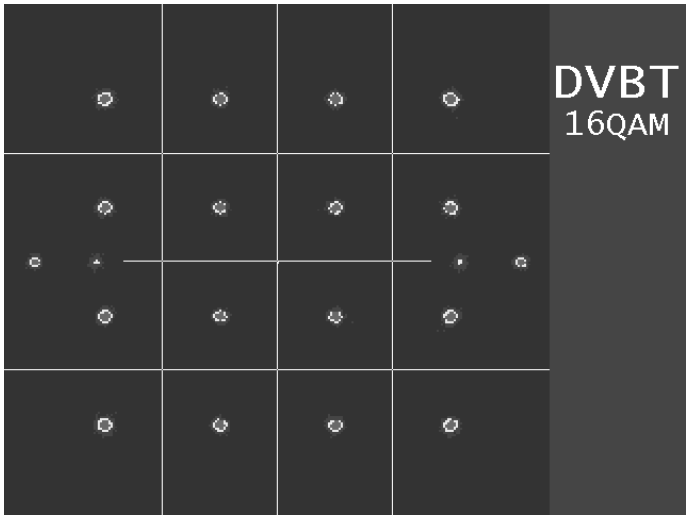


Error: Noisy signal
Cause: Bad C/N -> level possibly too low



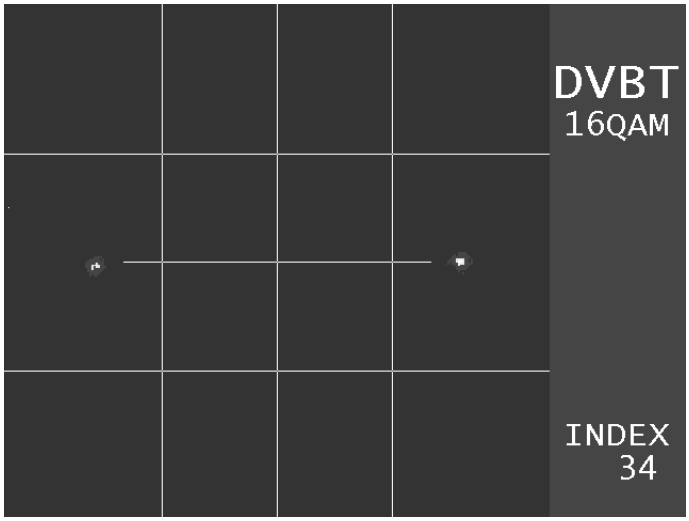
Error: Phase jitter (a low-frequency frequency modulation is impinging on the carrier)
Cause: QAM modulator that is defective or incorrectly set.

11.3.3 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

Chapter 12

Scope (optional)

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 analogue 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.

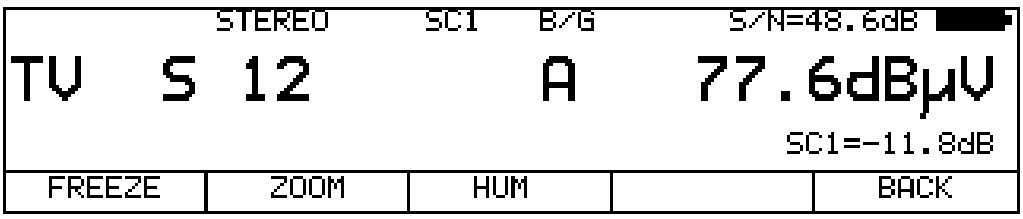
In combination with S/N measurement, you can check whether the line being used for measurement (6) is actually empty. If necessary, you must switch to either line 5 or 7.

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 1 Vpp is present on the SCART socket when terminated with 75 ohm.

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

12.1 Operation

As previously mentioned, you can access the line oscilloscope in the analogue 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 analogue 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.

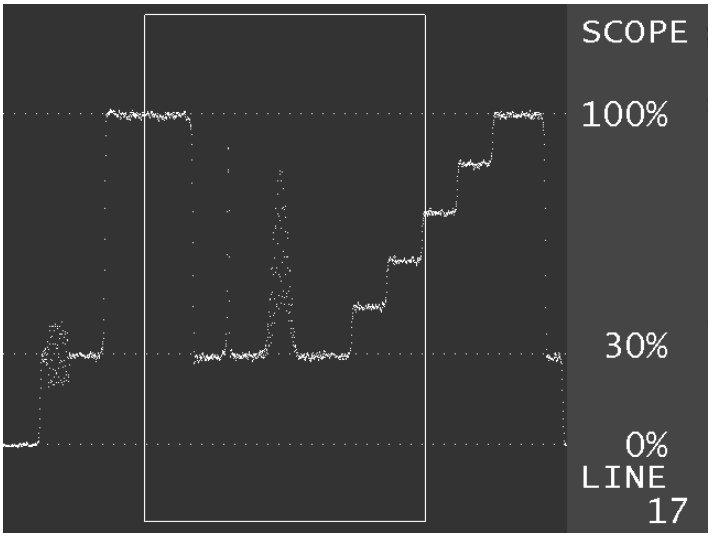


You can enter a line number from 1 to 625 using the numeric keypad. During entry, a cursor appears on the right edge of the TFT screen. You confirm the entry by pressing **ENTER.** **SCOPE** then displays the desired video line.

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

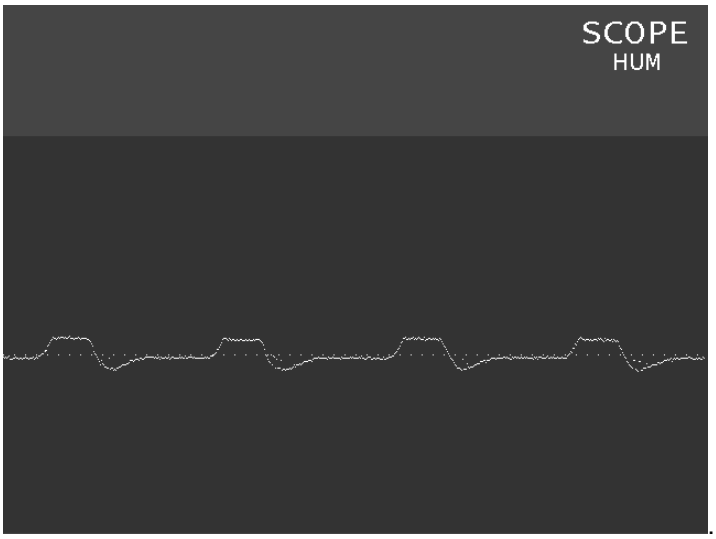
You can enlarge a section of the line by accessing the **ZOOM** function. You can show or hide a white frame in the diagram by pressing ENTER (see the following figure). This frame marks the section that should be enlarged. You can enlarge and shrink this window using the ↑ or ↓ keys, which change the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



12.2 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 analogue 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 13

Videotext

13.1 Videotext on ATV

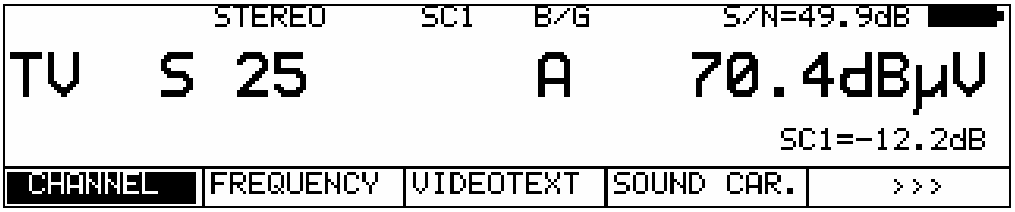
Videotext (or teletext) was introduced at the start of the 1980s as a means of transmitting data. Information is broadcast in the vertical blanking interval between image frames in a broadcast television signal. The bit stream is then modulated onto the corresponding video lines using NRZ encoding (non-return-to-zero). 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.

13.2 Videotext on DVB

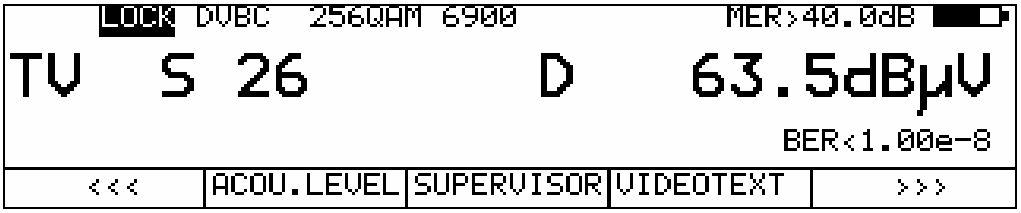
In contrast to analogue television, where videotext is inserted as an additional signal in the vertical blanking interval, DVB uses a multiplexed videotext elementary stream that is inserted directly into the MPEG-2 transport stream. The videotext elementary stream is transmitted together with the video 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 MPEG Decoder section.

13.3 Operation

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

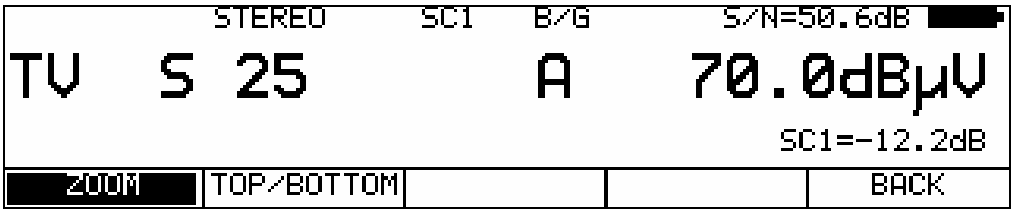


On DVB, the decoder extracts the videotext data from the MPEG transport stream. The videotext decoder can also be called up via the ASI interface.
The instrument must also be tuned in advance in the digital operating modes. Additionally, a video program must also be called up in the MPEG decoder. The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

13.4 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.

Chapter 14

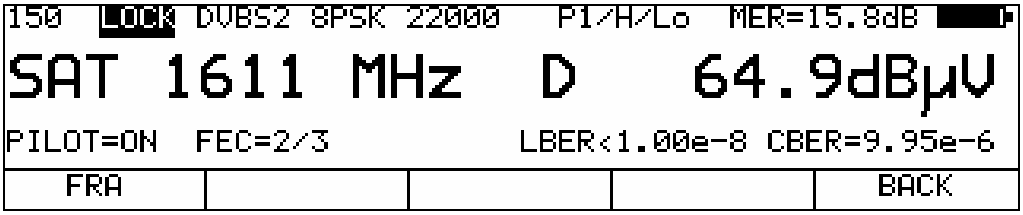
Subtitle

14.1 Subtitle with DVB

In contrast to analogue 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 the **MPEG Decoder** section.

14.2 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.

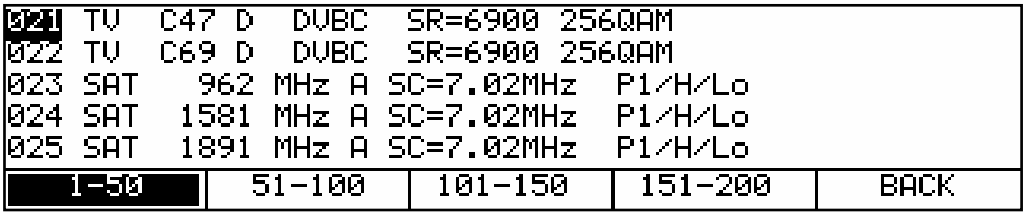


The **SUBTITLE** menu item opens the decoder. If this menu item does not appear, the instrument hardware does not support this function.
Subtitles may be broadcast in a variety of languages. These are then listed in the menu bar, as can be seen in the figure. Subtitles are shown on the current program 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 15

Memory Management

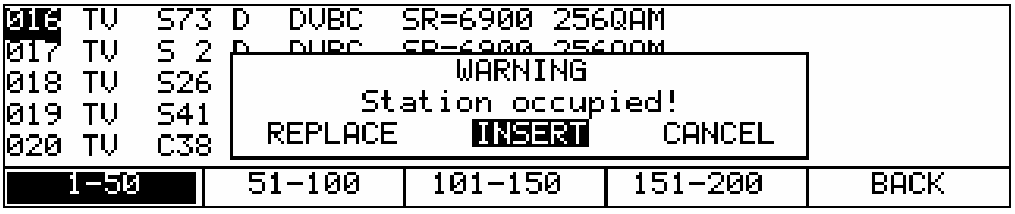
The instrument has a tuning memory with 200 program locations. The memory preview allows the user to get an overview over the tuning memory without having to access all memory locations or having to make corresponding notes when saving. The memory preview is activated when saving and accessing program 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.

15.1 Saving

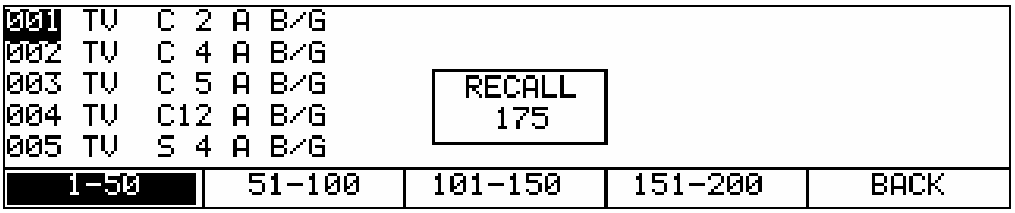
The measuring receiver must first be tuned. You access the memory preview described above using the **SAVE** key. Now the cursor can be moved to the desired memory location. You complete the save by pressing **SAVE** again. If the selected memory location is not empty, the following message appears on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

15.2 Recalling

The memory preview is called up using the **RECALL** key. The desired memory location can now be selected using the cursor.
Alternativ dazu kann über die Zehnertastatur eine Speicherplatznummer von 1-200 eingegeben werden. Das ist nützlich, wenn man die Nummer des gewünschten Speicherplatzes bereits weiß. Somit kann man sich das Navigieren in der Speichervorschau ersparen. In der nachfolgenden Abbildung wurde die Nummer 175 zum Abrufen eingegeben.



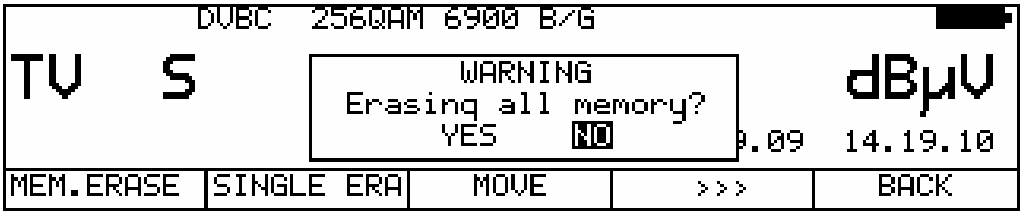
Press the **RECALL** key again or the **ENTER** key to open the memory. The measuring receiver then accepts the settings from the tuning memory. If the memory location is empty, the old settings are kept.

15.3 Memory functions

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

15.3.1 Erasing the memory

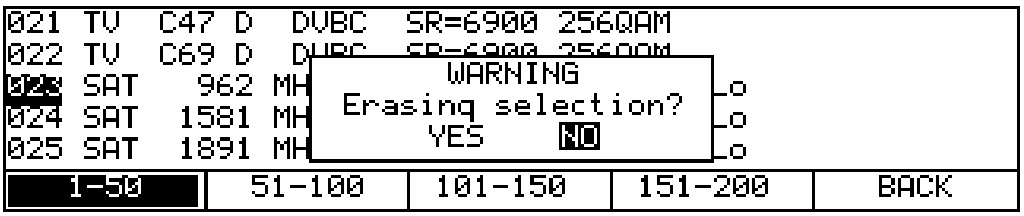
You can erase the entire tuning memory using this function.
After pressing the **MODE** key, select the menu item **MEMORY** -> **MEM. ERASE**. To prevent this from happening unintentionally, the following warning appears:



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

15.3.2 Erasing a memory location

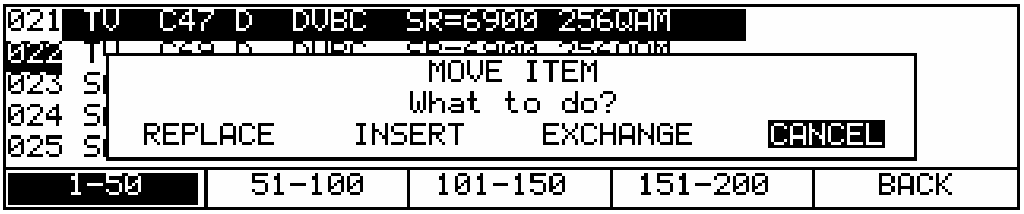
You can erase a single memory location with the tuning memory using this function. You access this function via **MODE -> MEMORY -> SINGLE ERA**.
First move the cursor to the memory location to be erased. After you confirm by pressing the **ENTER** key, the following message then appears.



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.

15.3.3 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 this chapter under item 1 (Saving). With the selection EXCHANGE, the memory locations switch places with each other. In the above example, memory location 21 was exchanged with memory location 22.

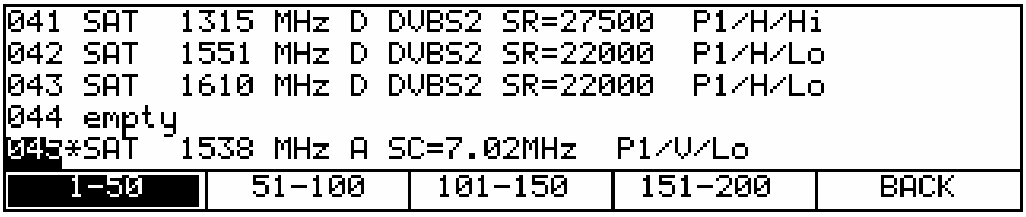
15.3.4 Copying a memory location

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.

15.3.5 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.



15.3.6 Cancelling memory protection

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

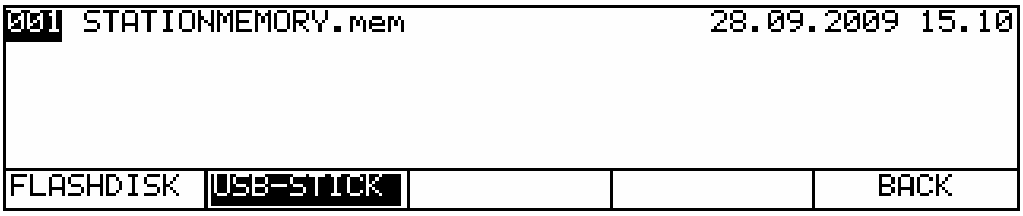
15.3.7 Memory export

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 the next section).

15.3.8 Memory import

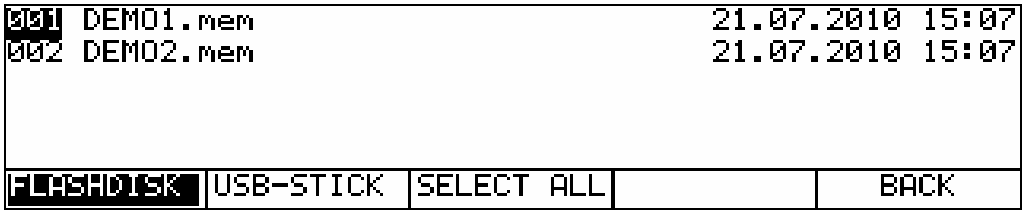
With the memory import function, you can restore to the instrument a copy of the tuning memory created by the memory export function. To do this, access the menu item **MODE -> MEMORY -> IMP/EXPORT -> IMPORT**. Then a selection appears of files that are available for import to the current memory medium.



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.

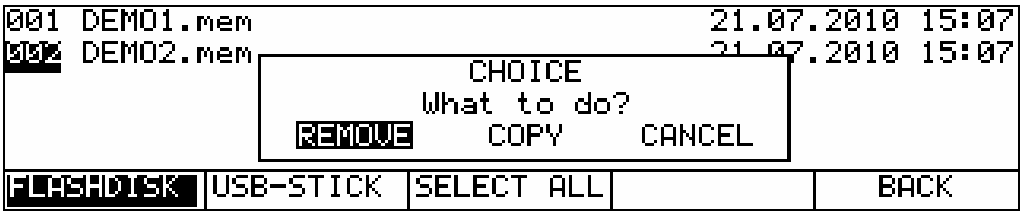
15.3.9 Opening the directory of the MEM files

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.



15.3.9.1 Deleting MEM files

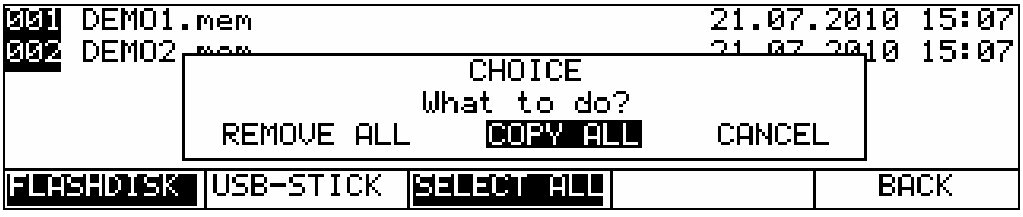
When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



Mit den Tasten ← bzw. → kann die Auswahl **REMOVE** gewählt werden. Wird jetzt die Taste **ENTER** gedrückt, so löscht in diesem Fall das Gerät die Datei DEMO2.MEM von der Flash-Disk.

15.3.9.2 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.

15.3.10 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.

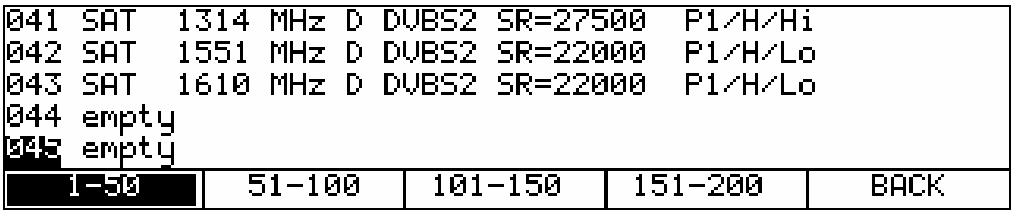
Range	Operating mode
SAT	
	ATV
	DVB-S/DVB-S2
TV	
	ATV
	DVB-C
	DVB-T
	EUDOCSIS
	USDOCSIS
FM	

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.

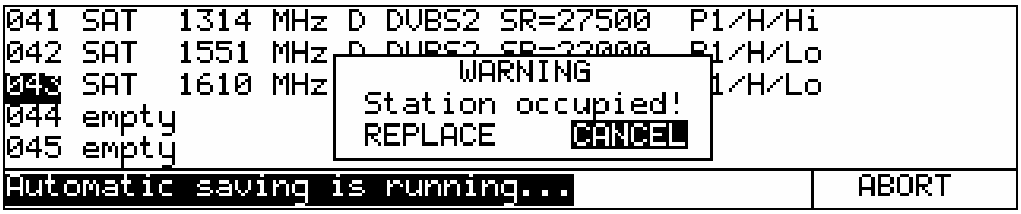
Before using this function, it is advisable to first export the current contents of the tuning memory to a file. See the “Memory export” section for more information. Afterwards, you can erase the entire memory. See the “Erasing the memory” section for more information. If you proceed in this way, you 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.

15.3.11 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 “Memory export” chapter) or to create new files. Files created in this way can then be imported into the measuring instrument (see “Memory import” chapter). The **AMA.remote** software is available for download from www.kws-electronic.de under “Software” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.

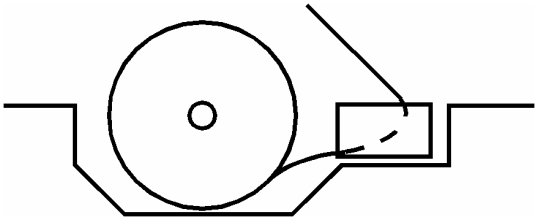
Chapter 16

Printer

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

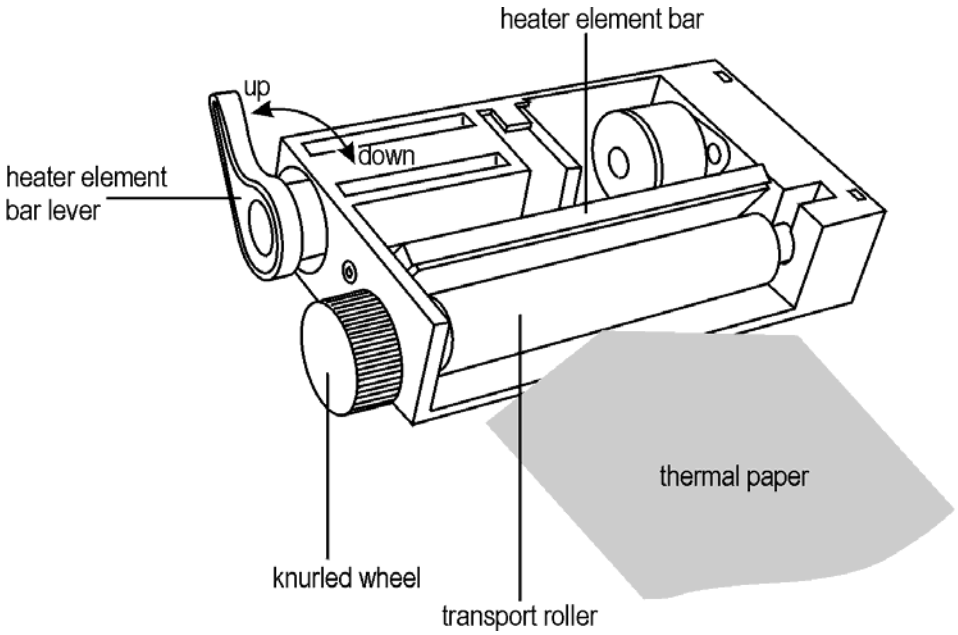
16.1 Paper refill

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.



16.1.1 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.



16.1.2 Automatic paper feed

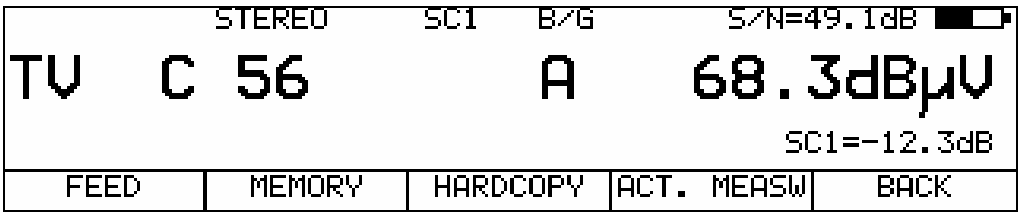
For this, the instrument must be switched on and the heater bar must be on the transport roller (lever down). Then you can insert the beginning of the paper roll under the transport roller. When the paper sensor detects the thermal paper, the printer unit draws in the paper automatically. If the paper 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.

16.2 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.

16.3 Printer functions

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

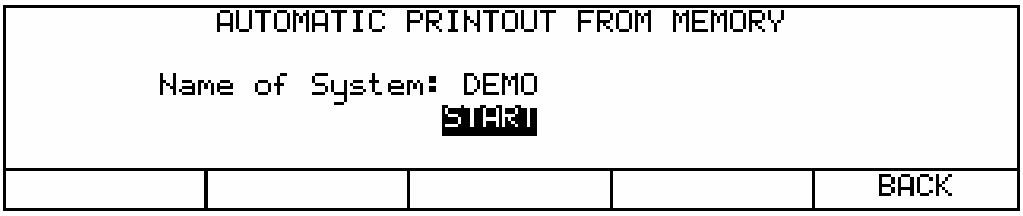


16.3.1 Manual feed

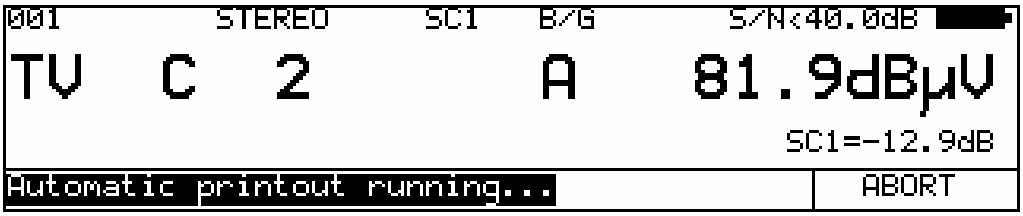
You can cause the printer to carry out a feed at any time by pressing the F1 key. The printer unit feeds the paper forward continuously as long as the key is pressed. During this time, the menu item **FEED** is displayed inverted.

16.3.2 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.

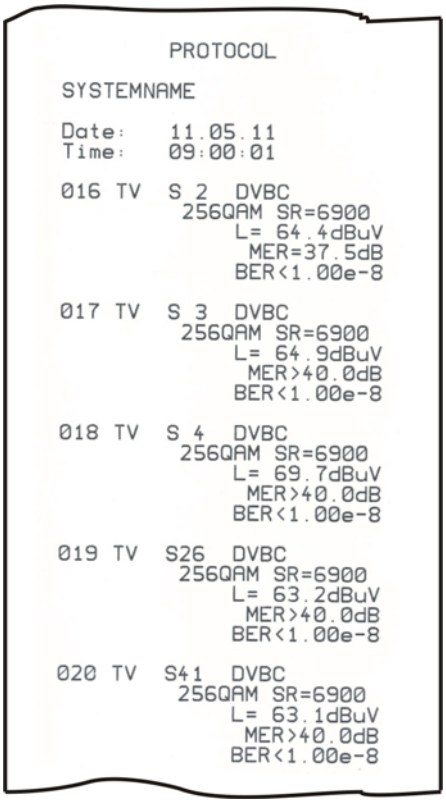


You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. If you press the **ENTER** key, the cursor jumps to START. When you press **ENTER** again, the process starts. In this example, SYSTEMNAME appears in the protocol header of the printout. 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.

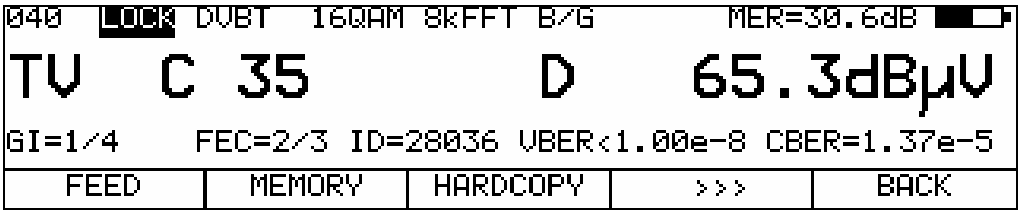
Automatic printout example:



The protocol header can be designed according to each customer. See Chapter „User-defined headers for printing“ and „User-defined logo for printing“.

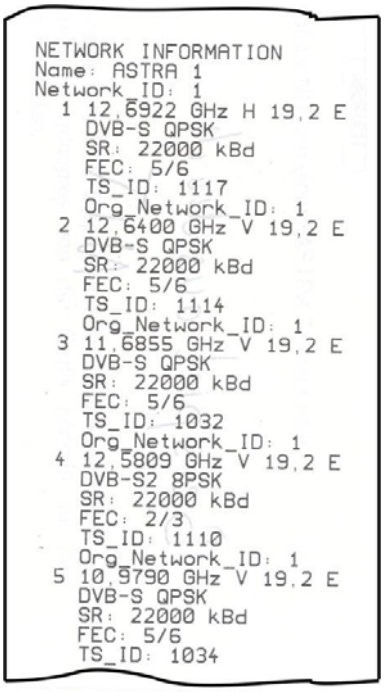
16.3.3 Printout of the NIT

First, the NIT 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, including all details, via the menu item **PRINT -> MPEG-NIT -> PRINTER** .



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

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

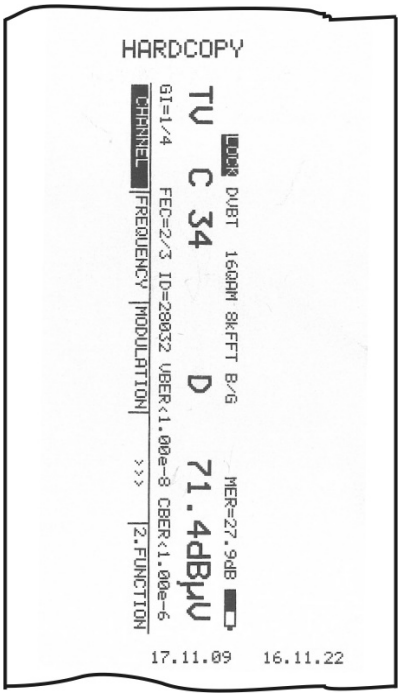


16.3.4 Hard copy

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.

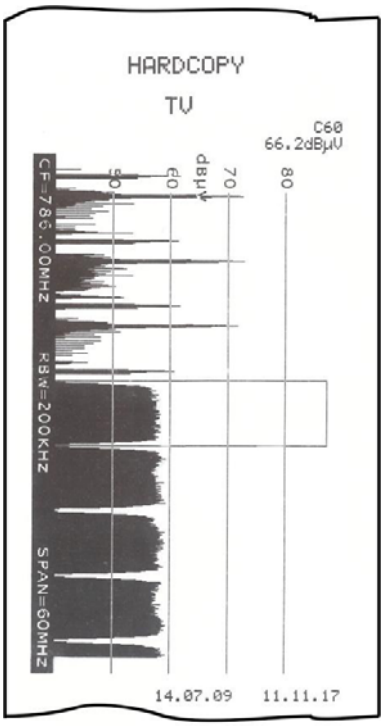
16.3.4.1 Hard copy of the LCD

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.



16.3.4.2 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.



16.3.5 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 17

File Output

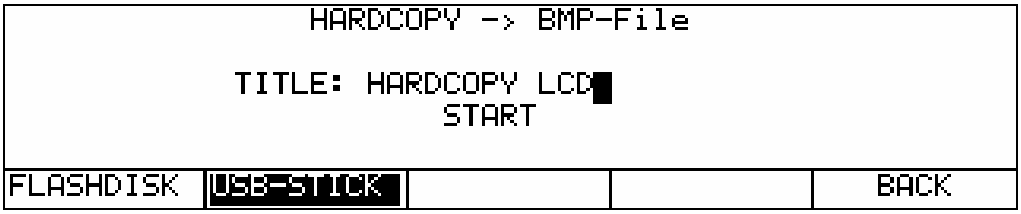
The operating system of the measuring receiver supports the FAT32 file system.
Various outputs can be written into a file using this system. A USB stick or the internal flash disk can be used as the storage medium.

17.1 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.

17.1.1 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**.



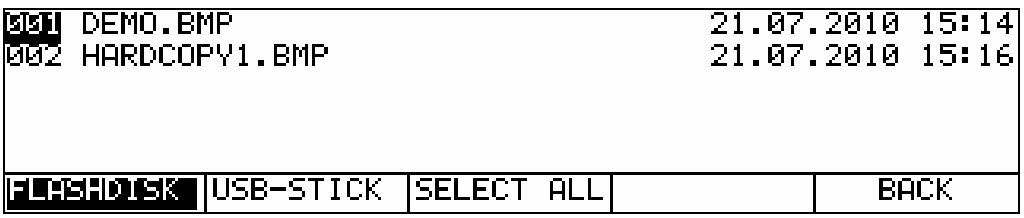
You can use the ← and → keys to move the cursor. You can enter a name up to 20 characters long using the numeric keypad. After the **ENTER** key is pressed, the contents of the LCD (before the **PRINT** key was pressed) are written into a BMP file under the previously entered name. In this example, a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

17.1.2 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).
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.

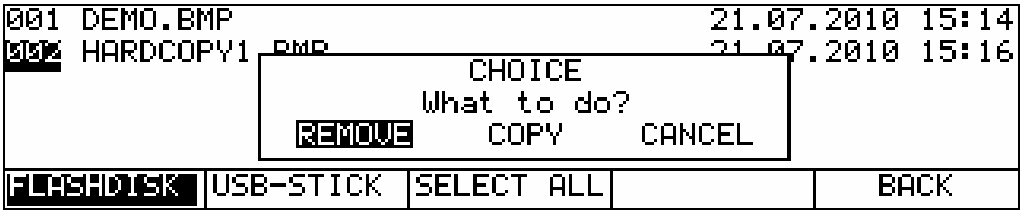
17.1.3 Calling up the directory of the BMP files

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.



17.1.3.1 Deleting BMP files

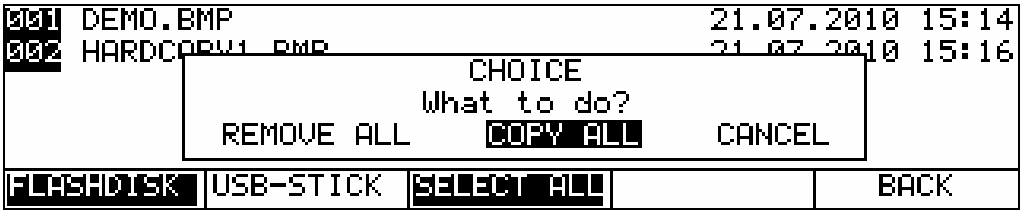
When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. After pressing the **ENTER** key, the following selection is displayed.



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.

17.1.3.2 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.

17.2 NIT (network information table)

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

17.2.1 Saving the NIT as a text file

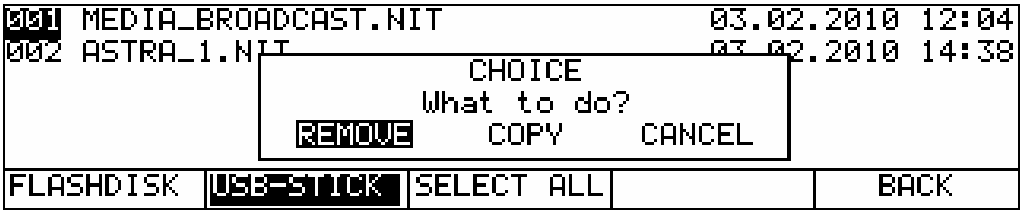
The NIT can be saved as a text file with the .NIT file extension in this manner. The file name is generated automatically from the NIT header.
The NIT must first be exported as described in the NIT section. The complete list (including all details) can then be output in a NIT file using the **PRINT ->** **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.

17.2.2 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.

17.2.2.1 Deleting NIT files

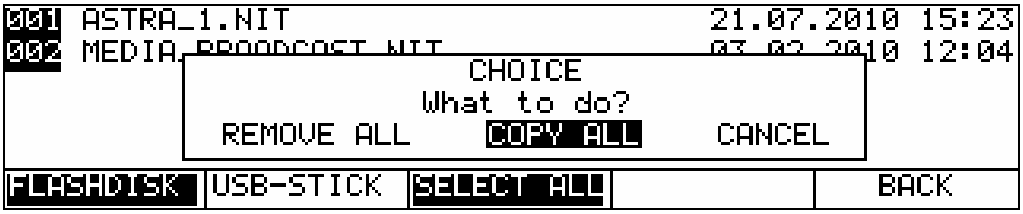
When the directory is open, you can move the cursor to the desired file name using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



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.

17.2.2.2 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.

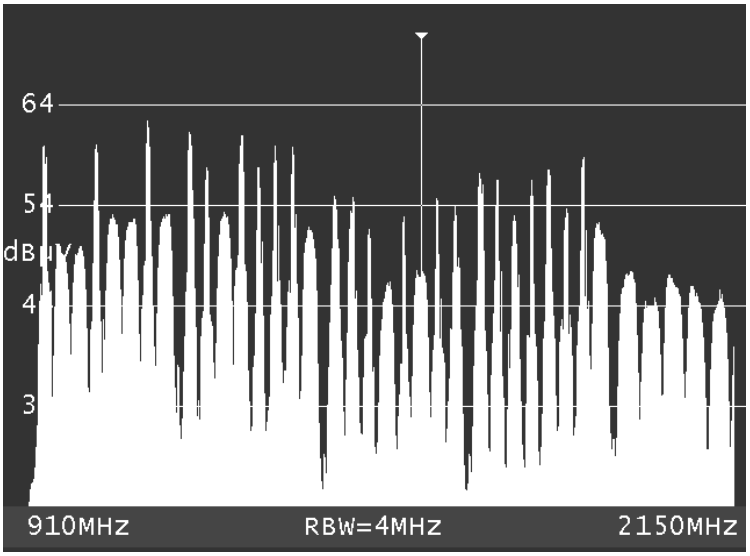


You can use the ← and → keys to select **COPY ALL**. In this example, all NIT files are copied from the internal flash disk to a USB stick when the **ENTER** key is pressed.

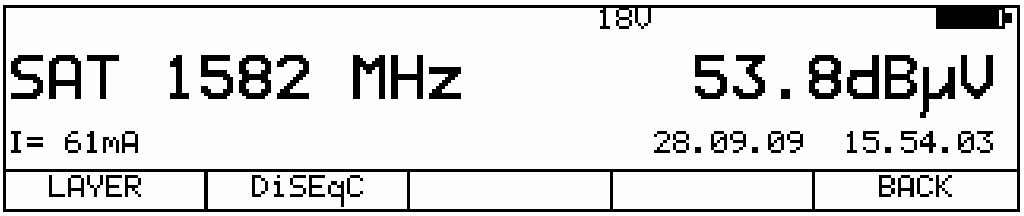
Chapter 18

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 centre 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.



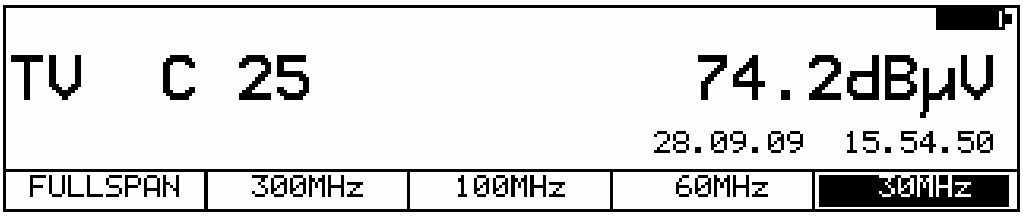
In addition, the set LNB supply, the measured LNB current and current time are shown.

18.1 Accessing the analyzer

You must first set the desired measuring range via the menu items **RANGE ->** **SAT**, **TV**, **FM** or **REV.CHA.**. 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 centre frequency of the last UB slot that was activated.

18.2 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.

18.3 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.

18.4 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 centre 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 analogue or digital. With analogue 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.

18.5 Switching between frequency and channel mode

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

18.6 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 analogue and digital channels. With analogue 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.

18.7 Input of the centre frequency

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

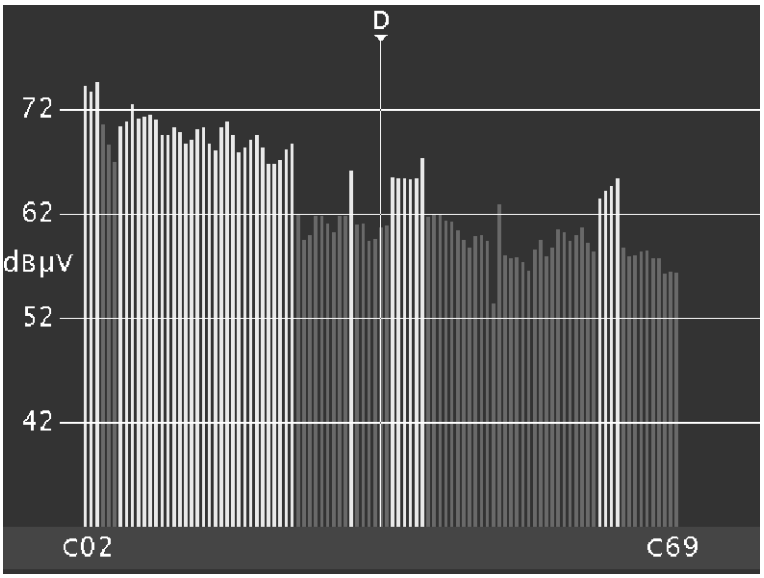
TV range in the channel input mode:
Using the **menu item** **CHANNEL**, you can switch between the input of C channels and S channels. Now you can type in a channel number using the numeric keypad. After you confirm with the **ENTER** key, the measuring instrument displays the spectrum around the set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

18.8 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”.

18.9 Level diagram in the broadband cable 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 analogue 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.

18.10 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 centre frequency of the transponder, the instrument detects whether it is an analogue 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 Cursor section, the instrument can distinguish between analogue 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.

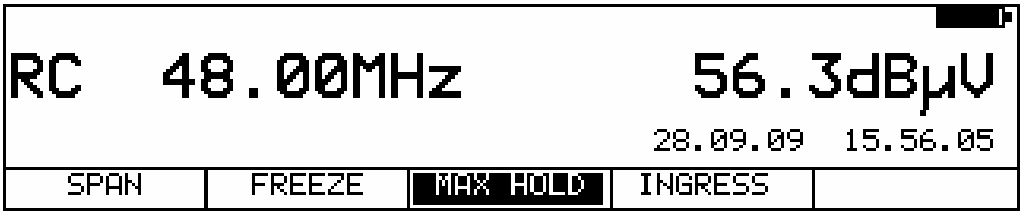
If it is a digital channel, the instrument switches to the last digital mode that was active (DVB-C, DVB-T or DOCSIS).

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.

18.11 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.

18.12 Max hold function



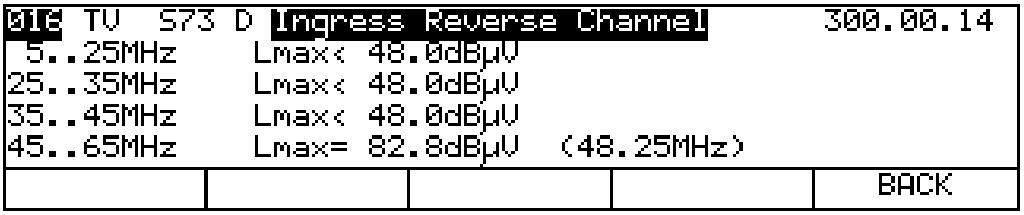
This function can be switched on and off via the **menu item** **MAX HOLD**. The menu item is then displayed inverted. The spectrum is only updated when the level increases. Since with an active return path, the spectrum changes depending on the activity of the connected cable modem a reasonable representation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

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

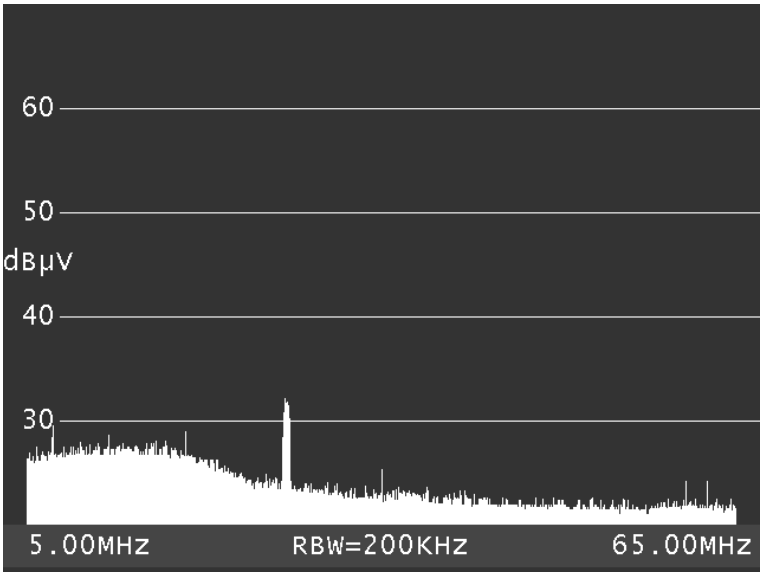
18.13 Ingress measurement in the return path

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.



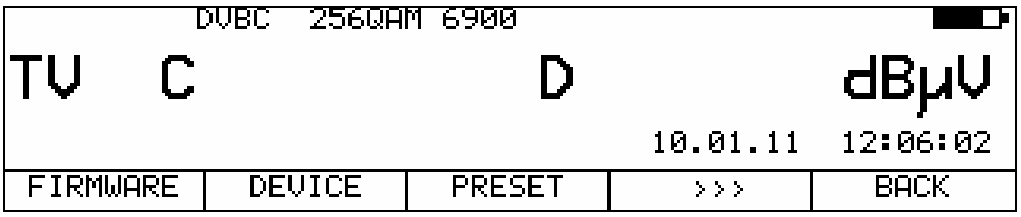
18.14 Activating the remote supply

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 19

Instrument Management

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



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

19.1 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.

19.2 Query software version

The user can query the software version (firmware) using this function. To do this, access the menu item **MODE -> SETTINGS -> FIRMWARE -> INFO**. The instrument then shows the current firmware version and the software version of the MPEG decoder.

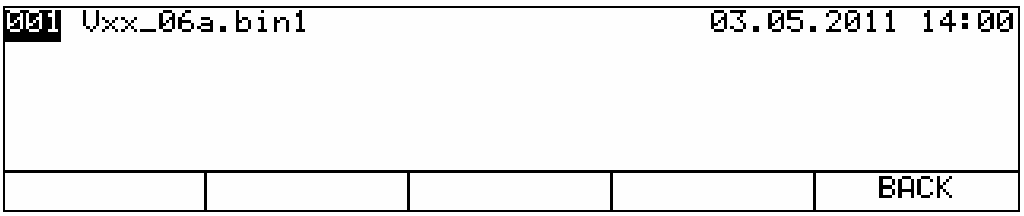
You can close the INFO window again by pressing **ENTER**.

19.3 Software update

The user 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. This file can be requested from the manufacturer or downloaded from the webpage www.kws-electronic.de.
This file should then be copied to the included USB stick using a PC.

To be on the safe side, the instrument should be connected to the mains before the update is carried out.
Never switch off the instrument while the update is running. Doing so would cause the old firmware to be deleted, while the new firmware would not yet be completely saved.

For update insert the USB stick into the instrument and select the menu item **MODE -> SETTINGS -> FIRMWARE -> UPDATE**. A selection of all saved .bin files is then displayed. Use the ↑ and ↓ keys to move the cursor to the desired file.



Start the software update by pressing **ENTER**. The instrument deletes the old version from memory and writes the new software onto the internal flash memory.
This takes approximately 45 seconds. As soon as the update is complete, a short beep sounds and the instrument boots with the new firmware.

Caution: 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.

19.4 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.**.

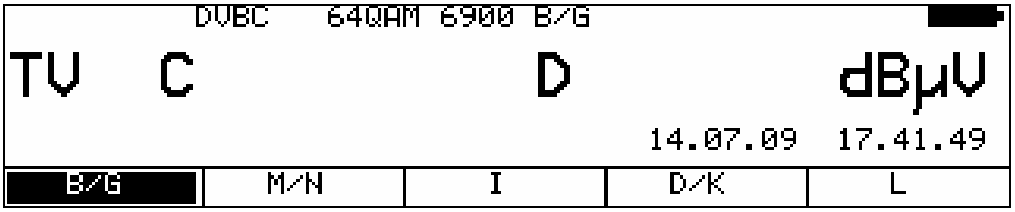
You can close the INFO window again by pressing **ENTER**.

19.5 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.

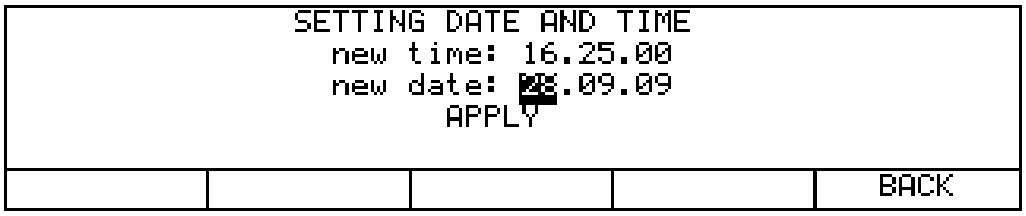
19.6 TV standard

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 (Analogue 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.



19.7 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.

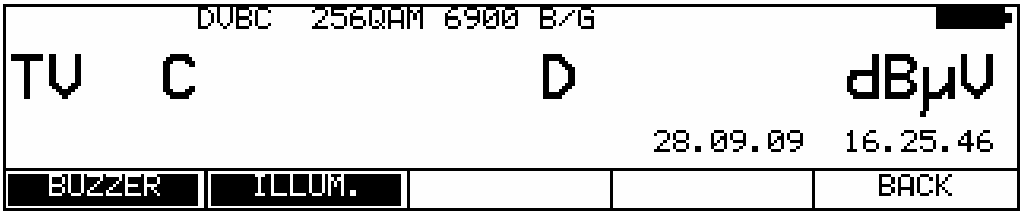


You can use the ← and → keys to move the cursor to the desired entry field.
You can now change the entry using the numeric keypad. Confirm every entry using the **ENTER** key. The cursor then jumps to the next field.

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

19.8 Keypad settings

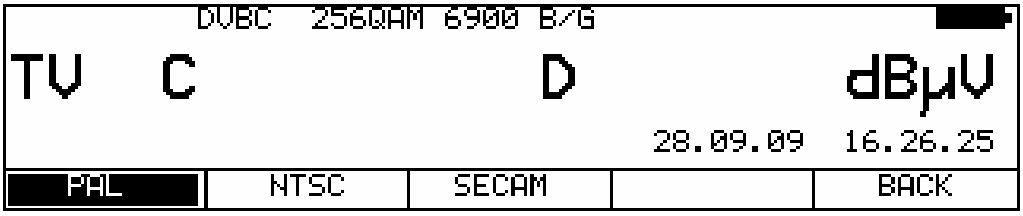
Using the menu item **MODE -> SETTINGS -> DEVICE -> KEYBOARD**, you can switch the key illumination and buzzer off and on.



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

19.9 Colour standard

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

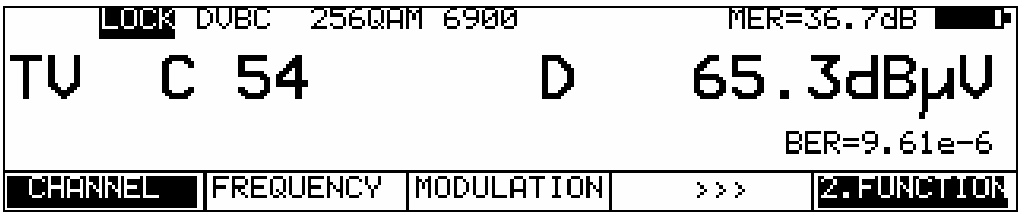


This setting also applies to an external FBAS video signal that is fed in through the SCART socket. This setting is non-volatile but is not incorporated in the tuning memory. The default setting is PAL.

19.10 User-defined channel table for TV

In addition to the preset channel tables, which the instrument uses in connection with the TV standard that is set, a user-defined channel table can be loaded into the instrument. The **AMA.remote** PC software can be used to create a separate table that is then exported to a file. The instrument can import via USB the file that ends in “CHA” via USB. To do this, 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 -> 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
CHAN. 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 “Software” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.

19.11 Formatting the internal flash disk

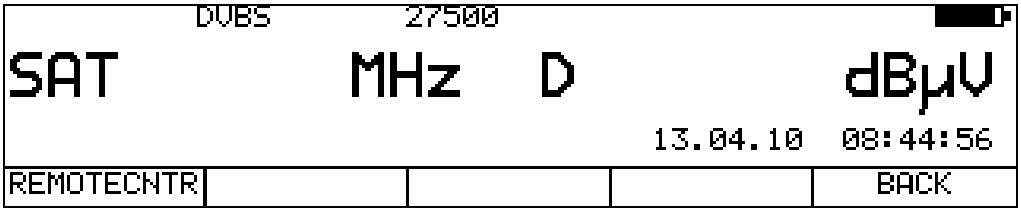
The instrument is equipped with a 64 MByte flash disk. The data medium is formatted in the factory. You can reformat the flash disk via **MODE** -> **SETTINGS** -> **FLASH-DISK** -> **FORM.FLDSK**. This causes all files stored by the user to be deleted.

19.12 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.

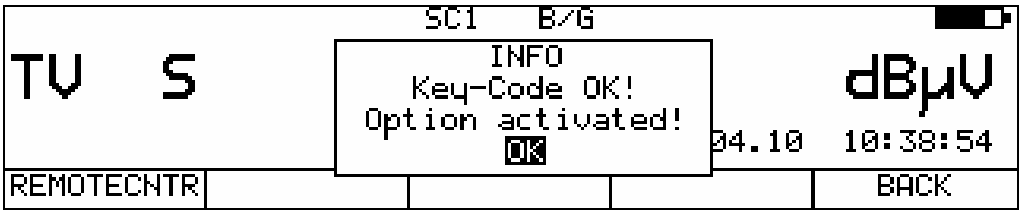
19.13 Activating software options

Software options can be activated by entering an 8-digit key code.
You can request the invdivual 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” option is currently available.

To activate the “Remote Control via SNMP” option, select the **REMOTECNTR** menu item. 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.

Caution: A previously activated option will be deactivated if the code is entered incorrectly. You need the key code from the manufacturer to reactivate the option. Therefore, always store your key codes carefully in case you need them again.

19.14 User-defined headers for printing

Up to six user-defined rows can be added to the standard protocol header of the printout (see the Automatic printout section).
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.

19.15 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 “Support” – “Downloads” – “Application Notes”. This “LogoDemo.bpm” 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.

19.16 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.

19.17 Configuration of the PING test from the DOCSIS 2.0 analyzer

If the measuring receiver is equipped with a DOCSIS 2.0 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.

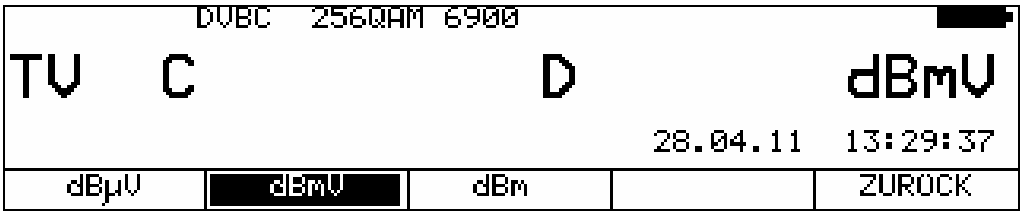
MODE -> **SETTINGS** -> **DOCSISANAL** -> **PING-TEST**-> **PACKETS** is used to set the number of packets to be sent. After calling the submenu, the user can select the number of packets. This number can be changed using the numeric keypad. The allowed value range is from 5 to 100 packets. If a value 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.

The submenus above are available only when the measuring instrument is equipped with a DOCSIS 2.0 analyzer.

19.18 Level measurement unit

MODE -> **SETTINGS** -> **UNITS** -> **LEVEL** is used to switch the measuring receiver between the units dBµV (default), dBmV and dBm (W).



Information regarding the definition of and conversion between units can be found in the **Definitions and Explanations** section.

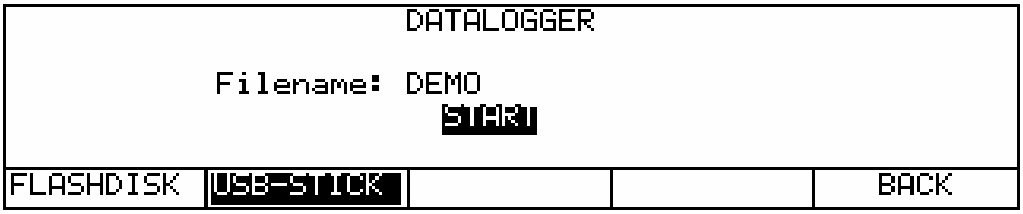
Chapter 20

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**.

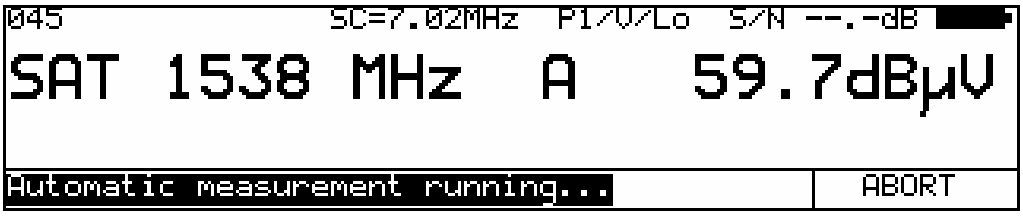
20.1 Creating a set of measurements

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.



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.



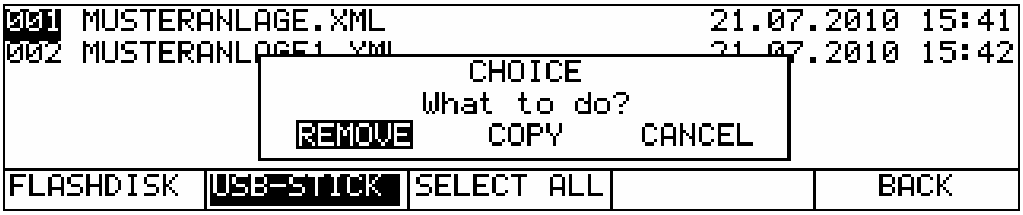
The figure above shows the display during a running set of measurements.

20.2 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.

20.2.1 Erasing a set of measurements

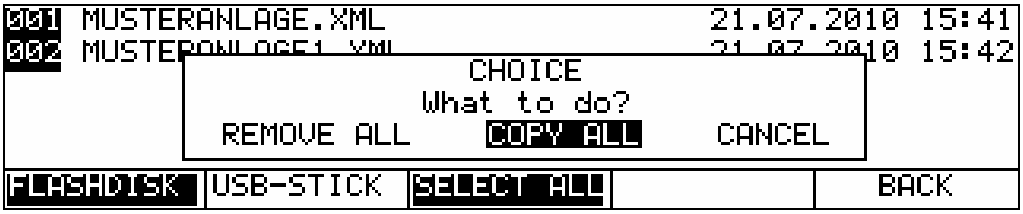
With the directory open, you can move the cursor to the desired set of measurements using the ↑ and ↓ keys. After you confirm by pressing the **ENTER** key, the following choice appears.



Use the ← and → keys to select **REMOVE**. The device deletes the file MUSTERANLAGE.XML from the USB stick when **ENTER** is pressed.

20.2.2 Copying a set of measurements

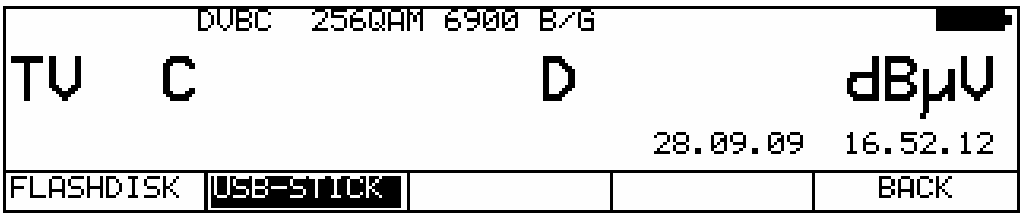
With the directory open, you can move the cursor to the desired set of measurements using the ↑ and ↓ keys. After you confirm by pressing the **ENTER** key, the following choice appears.



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.

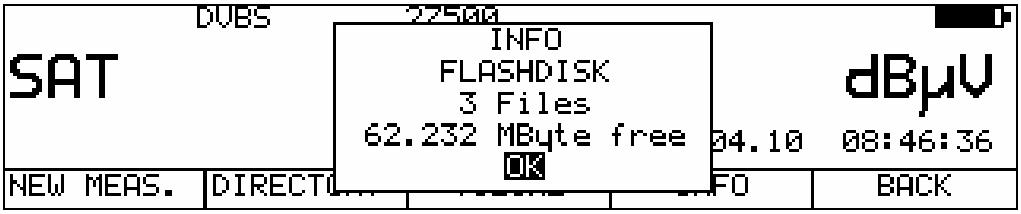
20.3 Select the drive

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.



20.4 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.



20.5 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	CRI!	55.8	34.9	1.13E-6	0.68	
19	172	TV	S40	458.00		DVB-C	256QAM	6900	CRI!	56.1	36.1	1.70E-6	0.69	
20	173	TV	S41	466.00		DVB-C	256QAM	6900	CRI!	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 “Software” – “AMA.remote,” and its exact operation is described in detail in a separate operating manual.

Chapter 21

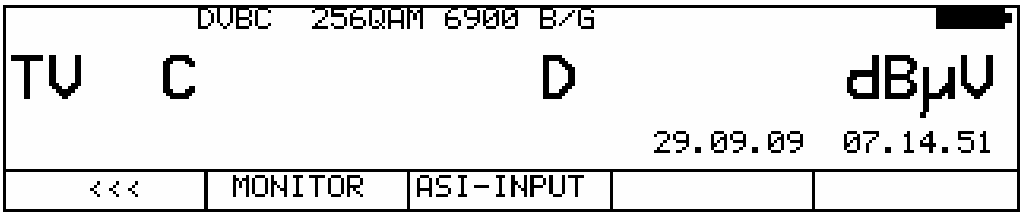
AV Input and Output

21.1 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.

21.2 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 colour are fully functional here.
The following menu bar appears in the monitor operating mode:

21.2.1 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.

21.2.2 Videotext with external video signals

By selecting the **menu item** **VIDEOTEXT**, the videotext of the external video signal is accessed. For more, see the Videotext section.

21.2.3 S/N measurement with external video signals

The S/N measurement is used with analogue 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.

21.2.4 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 Scope section.

Chapter 22

MPEG Transport Stream Interface (ASI, optional)

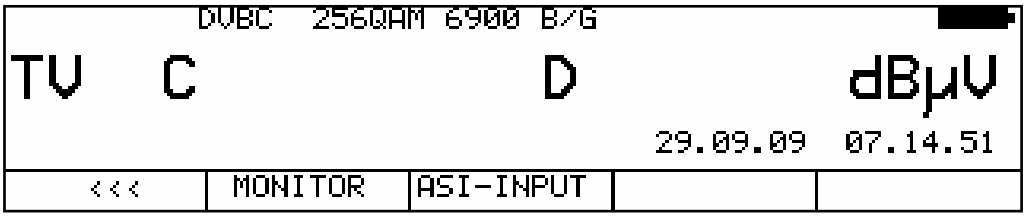
The measuring instrument is optionally equipped with an ASI (Asynchronous Serial Interface) serial transport stream interface. The instrument has an input and an output as a separate BNC socket on the right side of the case.

22.1 ASI output

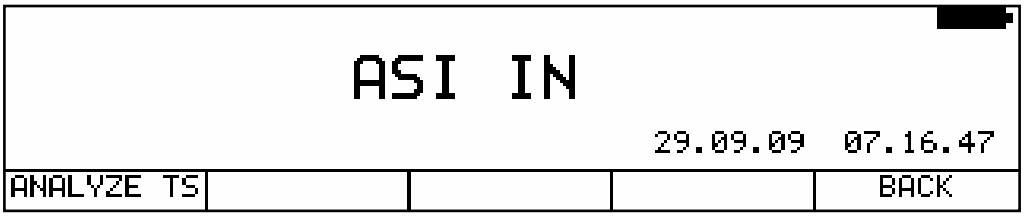
As soon as the measuring receiver receives a valid data stream in the operating modes DVB-S/S2, DVB-C, DVB-T or DOCSIS, it is output 1:1 to the ASI output. There is therefore a signal present on the interface as soon as the MPEG decoder is activated.

22.2 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 the MPEG decoder section.



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.

Chapter 23

DVI Interface (optional in conjunction with MPEG-4 decoder)

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 Signalling). 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.

While a program is played with the MPEG decoder, the ↑ and ↓ keys can be used to switch between the 1920x1080i and 1280x720p formats for the output via the DVI/HDMI port.

Chapter 24

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.

24.1 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 optimised for the stick that is included. This means that you should use this stick whenever possible.

If the software tries to access the USB interface when no stick has been inserted, the following error message appears on the display.

24.2 USB-B

Here the instrument operates as a USB slave. This port is currently used for manufacturer testing purposes only.

Chapter 25

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. Further information can be found in the “Remote Control” chapter.

Chapter 26

Monitoring Program

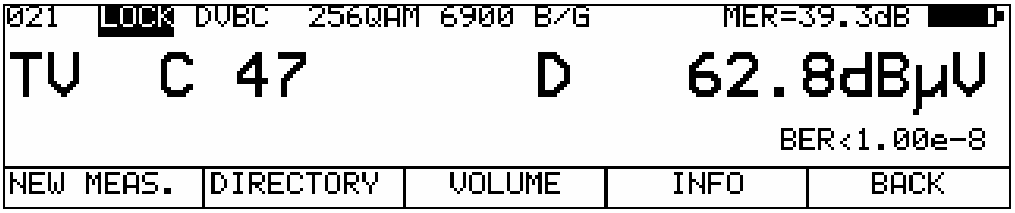
The measuring receiver is equipped with a monitoring program ("Supervisor"). This special function can be called up in all measuring ranges. Using this function, measured values can be monitored over a set time period by specifying tolerances.
Various measurement parameters can be monitored depending on the measuring range. The following table provides an overview.

Range	Operating mode	Monitored parameters
SAT		
	ATV	Level, S/N (only with S/N option)
	DVB-S	Level, MER, CBER, VBER, PE (packet errors)
	DVB-S2	Level, MER, CBER, LBER, PE (packet errors)
TV		
	ATV	Level, S/N (only with S/N option)
	DVB-C	Level, MER, BER, PE (packet errors)
	DVB-T	Level, MER, CBER, VBER, PE (packet errors)
	Euro-DOCSIS	Level, MER, BER, PE (packet errors)
	US-DOCSIS	Level, MER, VBER, PE (packet errors)
FM		Level
RC		Level

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.

26.1 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.



26.1.1 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**.**

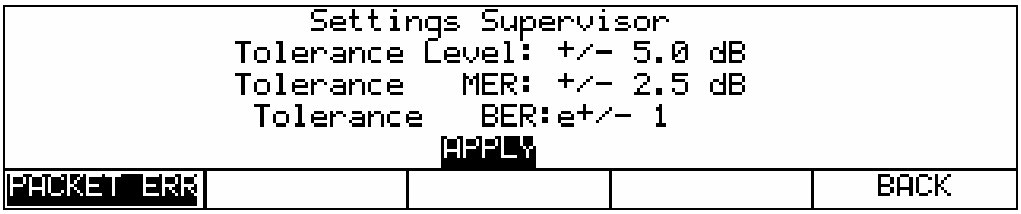
26.1.2 Specifying the destination of the alarm output

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.

26.1.3 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.

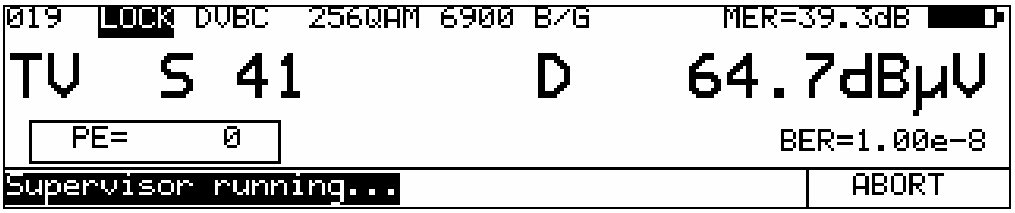
Parameter	Tolerance
Level	+/- 0.1dB - +/- 9.9dB
MER	+/- 0.1dB - +/- 9.9dB
S/N	+/- 0.1dB - +/- 9.9dB
BER	e+/-1 – e+/-3

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.

26.1.4 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.

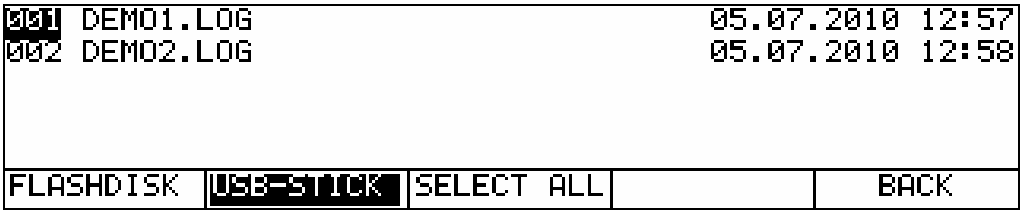
In digital measuring ranges, the PE counter is also displayed in monitoring mode.



The monitoring program can be stopped at any time using **ABORT**.

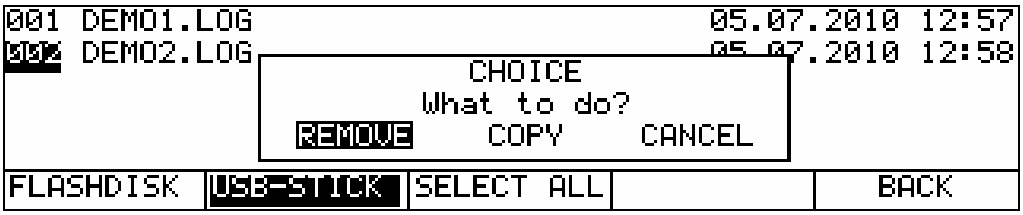
26.2 Managing LOG files

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.



26.2.1 Deleting monitoring logs

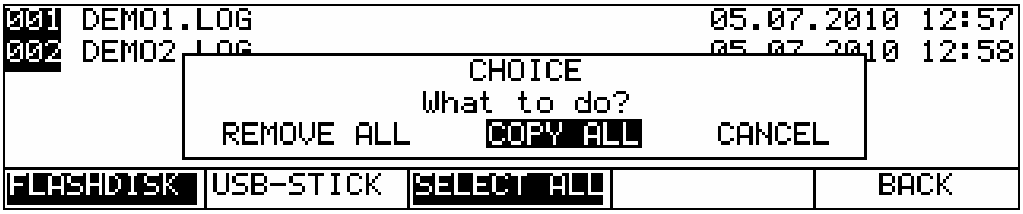
When the directory is open, you can move the cursor to the desired file using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



Use the ← and → keys to select **REMOVE**. In this example, the DEMO2.LOG file is deleted from the USB stick when **ENTER** is pressed.

26.2.2 Copying monitoring logs

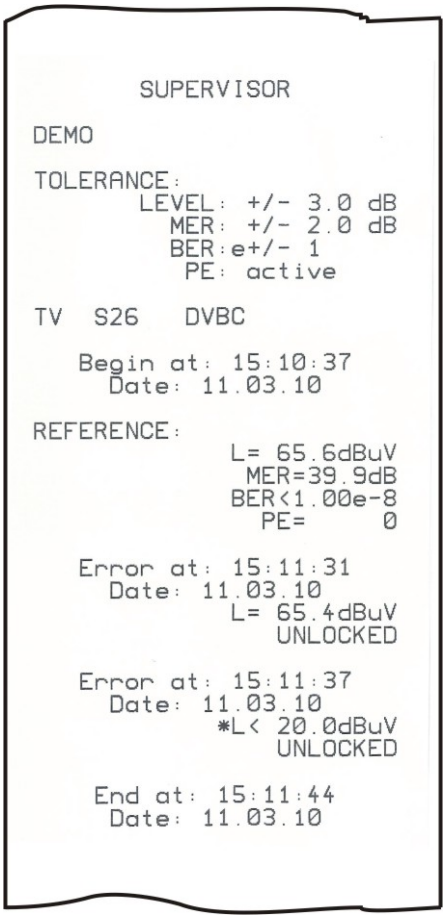
When the directory is open, you can move the cursor to the desired file using the ↑ and ↓ keys. When you press **ENTER**, the following selection is displayed.



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.

26.3 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).



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 27

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.

Range	Operating mode	Recorded parameters
SAT		
	ATV	Level, S/N (only with option S/N)
	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)
	EUDOCSIS	Level, MER, BER, PE (Packet Errors)
	USDOCSIS	Level, MER, VBER, PE (Packet Errors)
FM		Level
RC		Level

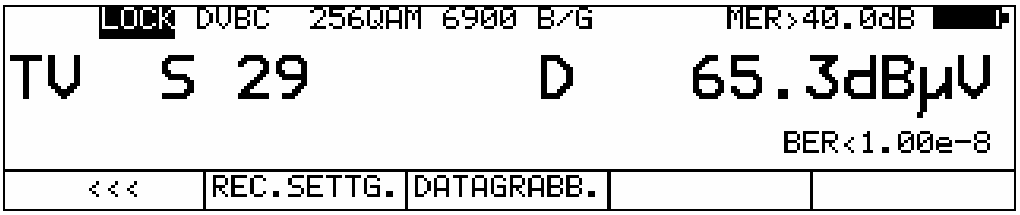
For all measurement parameters apart from PE, the value saved is the one that is active during recording at the time of sampling.
The situation is slightly different when packet errors are captured. During normal measuring operations, packet errors are continuously added up (accumulated). When the DataGrabber 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.

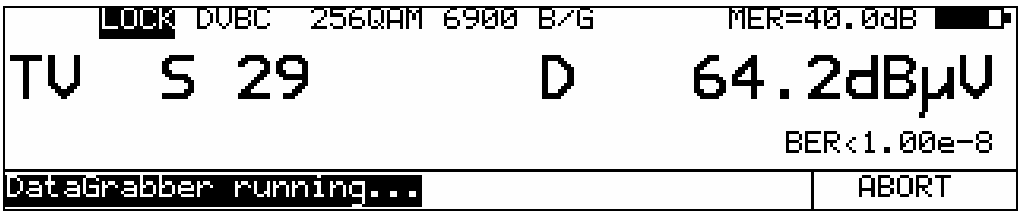
27.1 Starting the recording

The measuring instrument must be in the tuned mode (measuring mode) when the DataGrabber function is started.

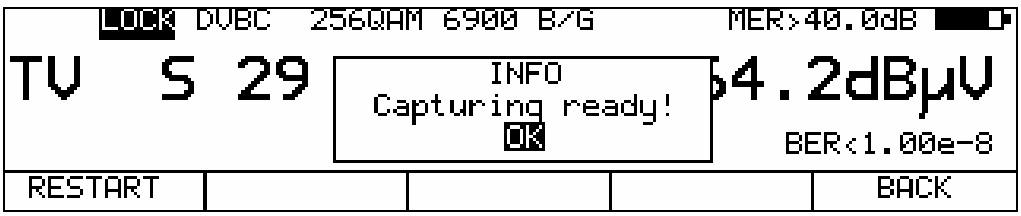


When you call the **DATAGRABB.** menu item, the following submenu appears.

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.



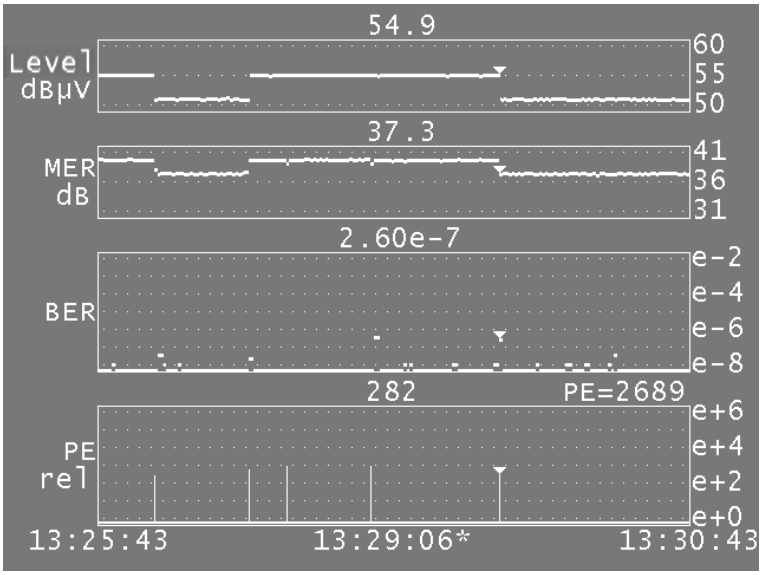
The absolute number of packet errors is also displayed in this operating mode.
You can use the **ABORT** menu item to stop the recording before the specified time period has elapsed. This only stops the recording. Data that was recorded up until this point remains saved on the graphics screen.
If the 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.

27.2 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 2689 packet errors occurred in the period from 13:25:43 to 13:30:43.

27.3 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 the "Hard copy of the graphics" section of the "Printer" and "File Output" chapters.

Chapter 28

Common Interface (CI)

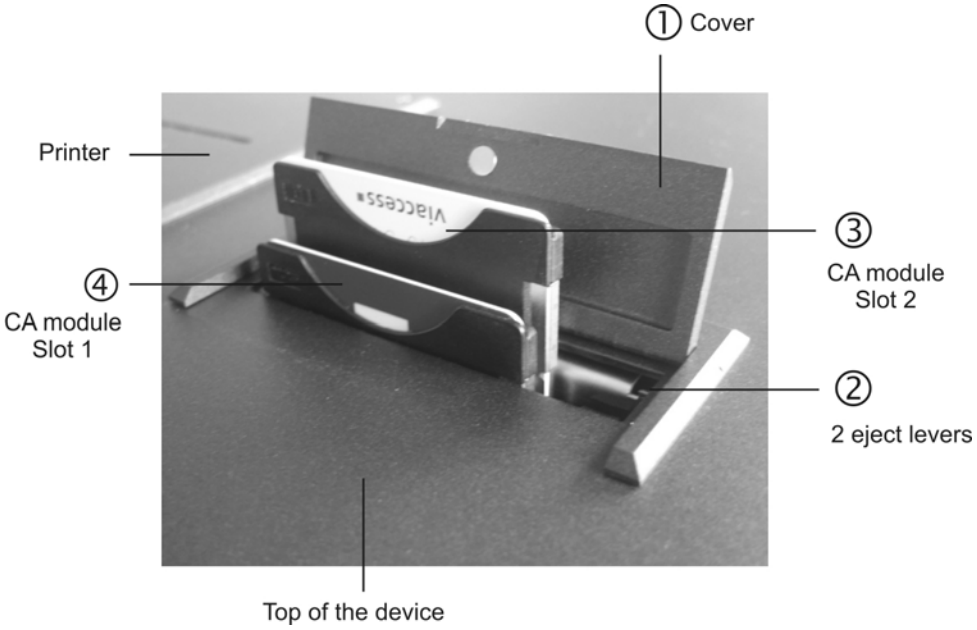
Pay TV providers usually transmit their programs encrypted. For decryption, a CA (Conditional Access) unit must be present in the receiver. This can be permanently integrated into the receiver or inserted into a CI that conforms to the EN50221 standard.
The latter has been implemented in this measuring 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.

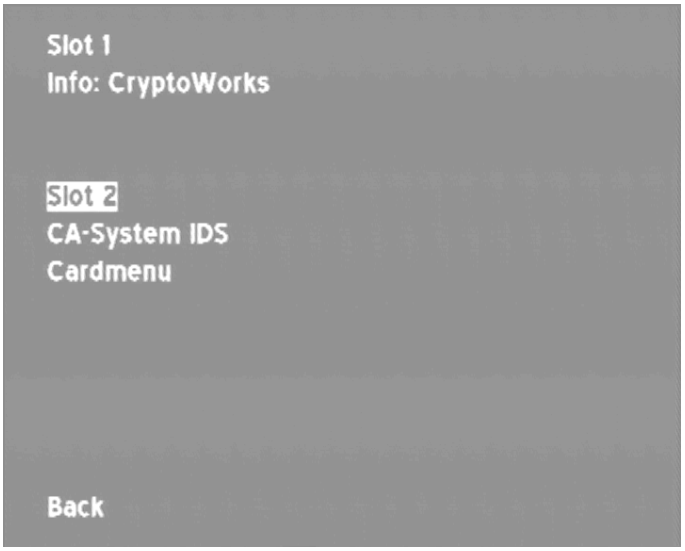
28.1 Changing the CA modules

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 coloured 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.



28.2 Initialising and querying the CA modules

The inserted CA modules are re-initialised every time the MPEG decoder is cold started. This process runs in the background while the decoder builds the program list. After initialisation, 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.

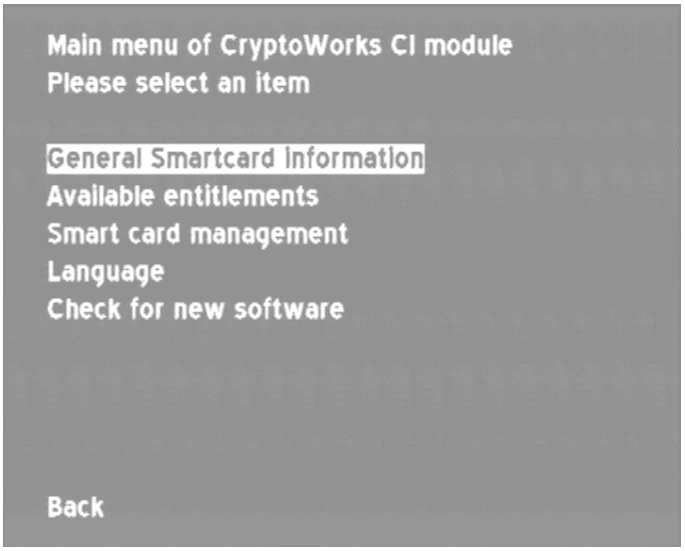
28.3 Card menu

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**.

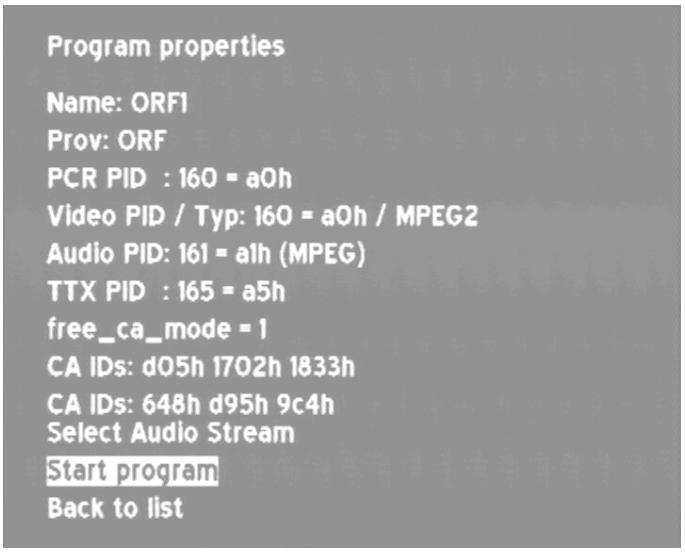
If the module requires entry of a PIN, select the number field using the ← or → keys and choose a number (0-9) using the ↑ or ↓ keys. Press **ENTER** to confirm the entry. The PIN **cannot** be entered using the numeric keypad.

The following figure shows the main menu of an Alphacrypt module:



28.4 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.



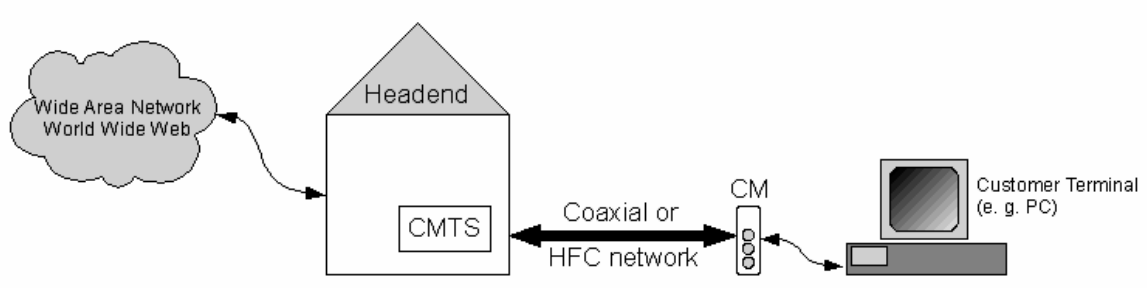
If programs are encrypted, a list of all CA system IDs used appears in the program details. If several CA IDs are listed, this indicates SimulCrypt encoding.

Chapter 29

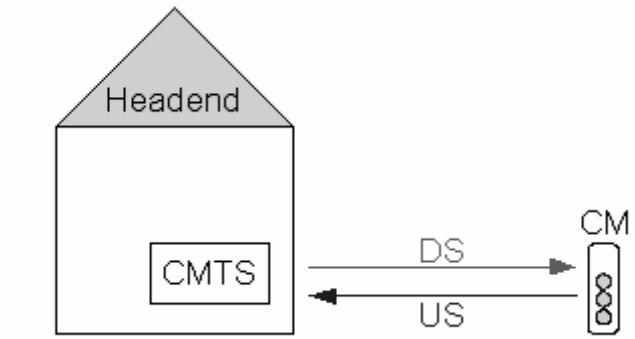
DOCSIS Analyzer (optional)

29.1 Introduction

The analyzer of the measuring receiver conforms to either the DOCSIS 1.1 or the DOCSIS 2.0 specification (depending on which option is equipped). The analyzer of the measuring receiver conforms to the DOCSIS 1.1 specification. 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 Fibre/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.



With DOCSIS, there are two different specifications: Euro-DOCSIS and US-DOCSIS. You can measure both standards with the measuring instrument. The differences are in the DS error protection and the DS channel bandwidths and in the channel spacing and DS and US frequency range (see section TV measuring range -> Selection of the operating mode -> DIGITAL operating mode -> DOCSIS). The content of the messages that are exchanged between the head end and the user is identical in both specifications.

29.2 Connection of the measuring receiver to the multimedia socket

For measurement with the DOCSIS analyzer, you must connect the instrument via an F-plug to IEC-plug adapter with the F-connection of a multimedia socket on which a DOCSIS signal is present.

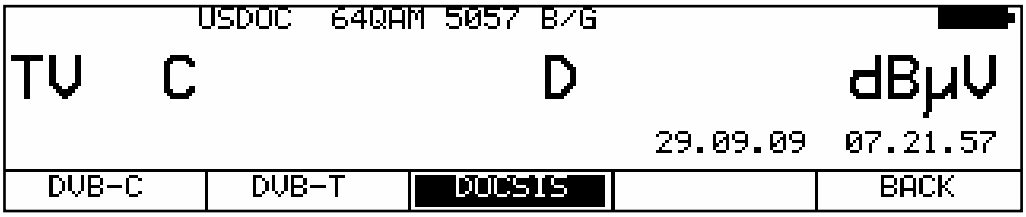
29.3 Measurement of the DOCSIS downstream

For downstream, the same measurement parameters can be recorded as for a DVB-C signal (MER, BER, constellation diagram, packet error measurement, level measurement; see section TV measuring range -> Selection of the operating mode -> DIGITAL operating mode -> DOCSIS). You can also assess the downstream via the spectrum analyzer (see the Spectrum analyzer section).

29.4 DOCSIS analysis and measurement of the DOCSIS upstream

To obtain information about the upstream, the measuring instrument must first be receiving a valid downstream channel. The DOCSIS analyzer receives information about the upstream and the communication with the CMTS.

You activate the downstream receiver of the measuring instrument via the **menu item** **MODULATION** **->** **DOCSIS** in the TV measuring range (see section TV measuring range -> Selection of the operating mode -> DIGITAL operating mode).



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

The associated symbol rate is automatically set.

Automatic scan of the DOCSIS variant:
If you enter a new channel, the receiver attempts to synchronise 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.

The graphic display begins to show a summary relating to the DOCSIS analysis.

In addition to the direct channel entry of a known DOCSIS DS channel, it is also possible to carry out an automatic scan of the entire TV frequency band (see section TV measuring range -> Selection of the operating mode -> DIGITAL operating mode -> DOCSIS -> Scan).

29.4.1 DOCSIS DS parameters

As soon as the receiver has completed the DS synchronisation process, several parameters are shown in the measured value 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 synchronised, the DOCSIS analyzer queries whether valid DOCSIS packets are being received. Is this the case, the indicator on the graphic display under the “Downstream” item changes from “Scan running...” to “Valid”.

29.4.2 DOCSIS US parameters

After a valid DS is detected, the analyzer automatically extracts the upstream parameters from the downstream information. The most important are shown on the graphical display.

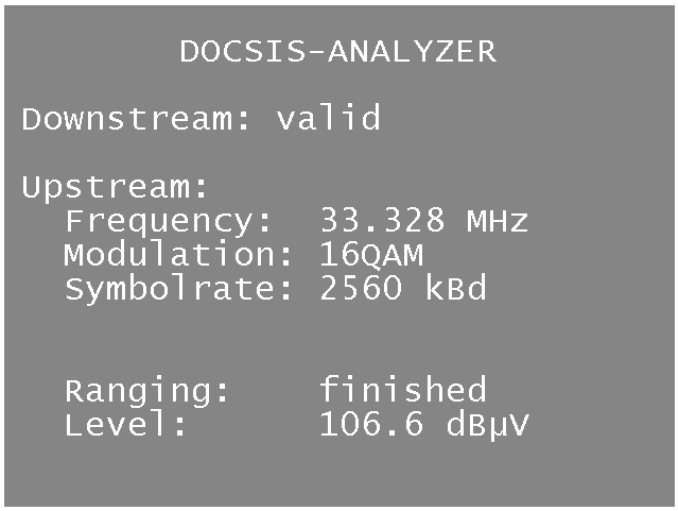
Communication with the CMTS is now established. During this, the transmitting power and other important parameters for problem-free communication between the cable modem and head end are set iteratively. This process is called “ranging.” The current transmitting power is shown on the graphical display. After the first successful ranging, the screen on the graphical display under the “Ranging” item switches from “running...” to “finished.”

After the cable modem and the CMTS have been synchronised, the analyzer switches to a mode for continuous ranging, which means that communication with the CMTS is maintained and the transmitting power on the graphical display is updated after every data exchange.

29.4.2.1 Upstream analysis with the DOCSIS-1.1 analyzer

With the DOCSIS 1.1 analyzer, a statement regarding whether communication between a modem and the CMTS basically functions at the location of the measurement is now possible. Furthermore, the analyzer can be an instrument for lining up return path amplifiers. The following are displayed as measuring parameters: the transmitting frequency, the modulation type which is currently specified by the CMTS for the ranging procedure, the symbol rate and the transmitting power required at the moment.

After ranging is finished, the following screen appears on the graphical display:



Depending on the cable network operator, the US or DS frequency may change automatically during measuring. This happens because in systems with several upstream and downstream frequencies, the CMTS can force the modem to other frequencies for reasons of equal utilization of all channels. The display of measurement values always shows the frequency or channel on which the modem is currently receiving data. The same applies for the graphical display. This display always shows the frequency at which the modem is currently sending data. It is theoretically possible that even the US symbol rate and QAM organization (QPSK, 16 QAM) can change during measuring.

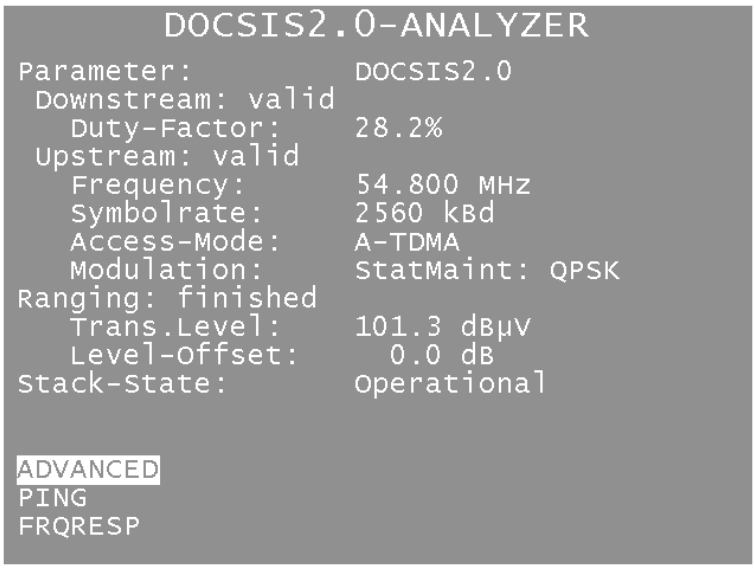
29.4.2.2 Upstream analysis with the DOCSIS-2.0 analyzer

Many more measuring parameters can be defined with the DOCSIS 2.0 analyzer. Even with the DOCSIS 2.0 analyzer, only the most important statement is possible at first, namely, whether communication between a modem and the CMTS basically functions at the location of the measurement. Furthermore, the analyzer can be an instrument for lining up return path amplifiers.

Before measuring with the DOCSIS 2.0 analyzer can begin, however, (and differing from DOCSIS 1.1), the user must wait until the boot time of the (significantly more complex) 2.0 modem is finished. Boot time takes about 11 seconds. When the user activates the DOCSIS analyzer, first a start-up screen will appear on the graphical display showing the progress of the booting procedure as percent. The actual graphical interface of the analyzer will also be displayed here.

The following measuring parameters are available with a functioning DOCSIS connection on the graphical display:
DOCSIS standard (e.g.: DOCSIS 1.1, DOCSIS 2.0)
Downstream channel utilization
US frequency
US symbol rate
US access method
US modulation for the continuous ranging process
US transmission level
US level offset
Synchronisation status with the CMTS

After ranging is finished, the following screen appears on the graphical display.



The uppermost row displays information on the DOCSIS system that is currently being measured. Here, the user can read whether the system is entirely 1.1 or 2.0, or whether mixed-mode is activated from both systems so that modems can communicate with the head end according to both specifications.

The DS channel utilization provides information on how many MPEG packets of the DS data stream carry the DOCSIS PID (packet identification) 0x1FFE in relation to all incoming packets.

Since many DOCSIS modems communicate with the CMTS on the same upstream frequency, modems must share the upstream channel. The access method shows the way in which this occurs. With DOCSIS 1.1, only TDMA (time division multiple access) is available as an access method. In this method, the modems share the upstream bandwidth in such a way that each modem sends only at specified, reserved time slices. With DOCSIS 2.0, A-TDMA (advanced TDMA) and S-CDMA (synchronous code division multiple access) are also available. With A-TDMA, data can be sent also with 64 QAM at a symbol rate of 5120 kSymb/s in upstream, compared to DOCSIS 1.1. With S-CDMA, several modems transmit on the same frequency at the same time. The CMTS assigns the messages to the individual modems based on special codes and the mathematical correlation formula. The access method is specified by CMTS and is binding for all connected modems.

During ranging, the modem receives correction values regarding transmitting power from the CMTS. These correction values can be read under the “Level offset” item on the graphical display. The modem always adjusts its transmitting power in such a way that the level offset is nil. This means that messages that the modem sends to the CMTS arrive with its required level. For example, if a return channel amplifier is set up and then the amplification is varied during the measurement, the offset is not equal to nil. Afterwards, the modem corrects its transmitting power in such a way that the level offset is once again nil the next time ranging messages are exchanged.

If the level offset is constantly unequal to nil, an error is present in the return path. (Example: The modem is already sending at 114 dBµV, and the level offset is +9 dB. Now the modem must send at 123 dBµV so that the transmitting power is evaluated correctly by the head end. The modem cannot work with this transmitting power. The error may be caused by a falsely set or defective return path amplifier.)

The “Stack status” parameter provides information on the extent to which the analyzer can synchronise with or log on to the CMTS. At the beginning of a measurement, the modem searches in the downstream for information on how it must send in the upstream. If this data is found, the stack status switches to “UsParameters Acquired”.

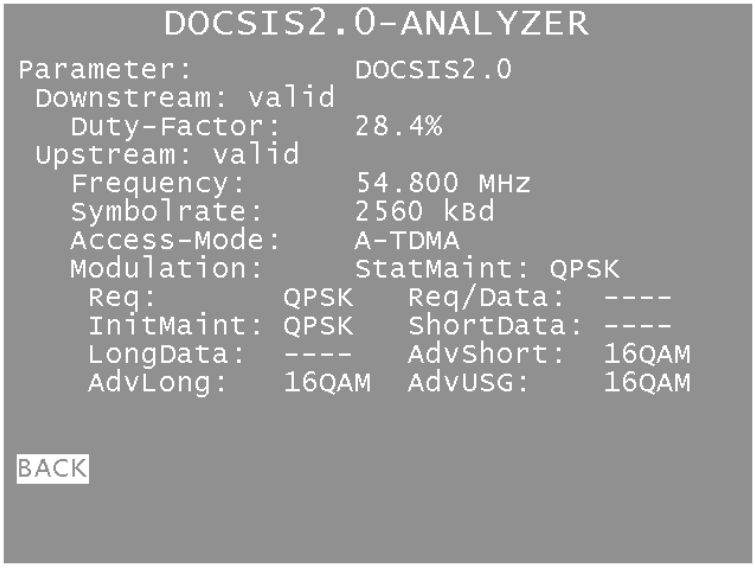
If ranging is successful, the status is “Ranging Complete.” If the modem can find an IP address via DHCP, the status says “DHCP Complete.” If the modem was able to complete fully logging onto the head end, the status changes to “Operational” .

Depending on the cable network operator, the US or DS frequency may change automatically during measuring.

This happens because in systems with several upstream and downstream frequencies, the CMTS can force the modem to other frequencies for reasons of equal utilization of all channels. The display of measurement values always shows the frequency or channel on which the modem is currently receiving data. The same applies for the graphical display. This display always shows the frequency at which the modem is currently sending data. It is theoretically possible that other US parameters can change during measuring.

29.4.2.3 More advanced upstream time slice analysis with the DOCSIS 2.0 analyzer

As soon as the ranging process starts, the arrow keys and **ENTER** can be used to select the “ADVANCED” menu item in the graphical display. Here, the user receives information on which time slice types which are specified in the DOCSIS 1.1 and 2.0 standard, are currently supported by the CMTS and which modulation type is to be used to transmit in this time slice. The display of DS data and the most important US parameters still appears in the upper portion of the graphical display.



Press **ENTER** to exit the display.

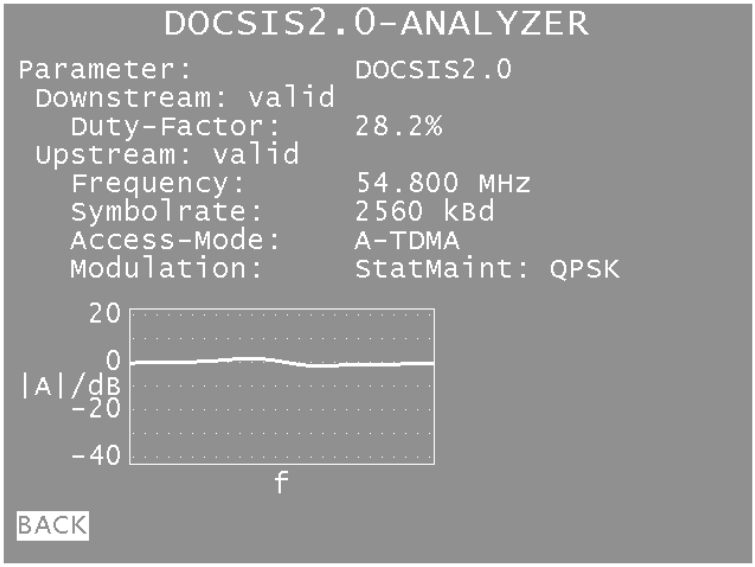
29.4.2.4 Upstream frequency response analysis with the DOCSIS 2.0 analyzer

As soon as the ranging process is finished, the arrow keys and **ENTER** can be used to select the “FRQRESP” menu item in the graphical display.

The various DOCSIS specifications provide an equalizer for the upstream sender of the modem. This equalizer filter can be configured with the filter parameters that the CMTS sends to each modem individually.

The purpose of this filter is to equalize the frequency response between the modem and head end that arises through the upstream transmission link between the modem and head end (for example, through microreflections where the cable is damaged). This means that equalizer parameters can be used to find which frequency response is prevalent within the transmission bandwidth of the modem (e.g. 3.2 MHz at a symbol rate of 2560 kSymb/s). This frequency response can be determined in the “FRQRESP” submenu. If the submenu cannot be entered, the head end is not sending any equalizer data to the connected modems (this feature is optional in the DOCSIS specifications).

The display of DS data and the most important US parameters still appears in the upper portion of the graphical display.



Press **ENTER** to exit the display.

29.4.3 PING test with the DOCSIS 2.0 analyzer

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.

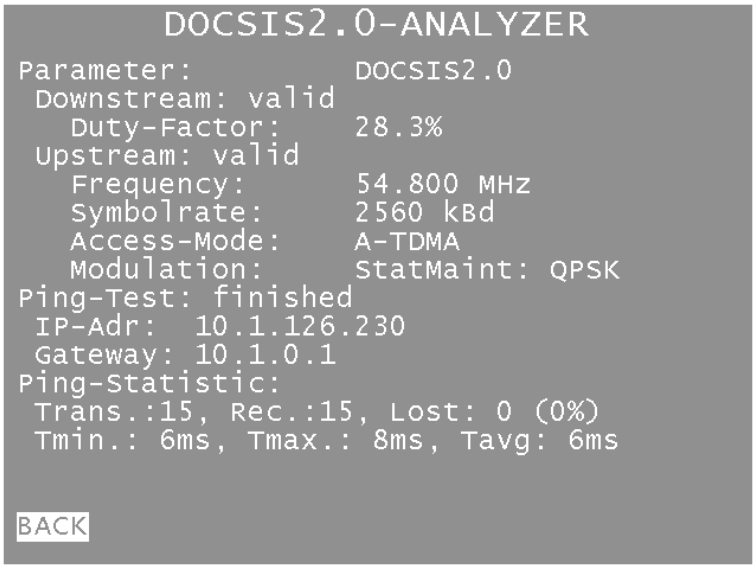
A PING test is triggered with the selection of the “PING” submenu in the DOCSIS 2.0 analyzer. Since an IP connection is required for a PING test, the user cannot access the submenu until the stack status is “DHCP Complete” or “Operational.” The PING test is configured (number and time interval of the PING packets to be sent) in instrument management (See “Instrument Management” chapter, “Configuration of the PING test of the DOCSIS 2.0 analyzer” section).

As with the above submenus, the DS data and the most important US parameters appear in the upper portion of the graphical display. The top row of the PING menu shows the status of the test (“initialised”, “running...” or “finished”).

Below this row, the IP address that the modem was assigned via DHCP and the IP address of the standard gateway on which the PING runs are displayed.

If the ping status switches to “finished”, the results are summarised 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.

During the execution time of the PING test a progress information appears in the line behind „Ping-Statistic:“.



Press **ENTER** to exit the display. This is only possible, when the PING test is ready and the statistical summary is shown.

29.5 Sequence of a measurement

After the measuring instrument is connected to a multimedia socket (or another point at which the DOCSIS connection can be tested, for example, a return channel amplifier), the measuring receiver should be tuned either by entering the channel of a known DOCSIS DS channel directly or by scanning for a valid DS channel. A summary of the US measuring parameters starts in the graphical display. The DS can be assessed qualitatively in the measured value display.

Since, in practice, a measured value update comes once every five to 20 seconds during continuous ranging, the instrument-internal beeper signals when the measured values were updated and that the CMTS sent positive feedback (“Ranging complete”) on the last data exchange. This makes the work easier, such as, when setting the return channel amplifiers. If the beeper is activated, the user knows that a correct value for the required US transmitting power is present.

If a cable network operator offers several US and DS channels, ranging may not function on the selected DS. In this case, scanning should take place after the next DOCSIS downstream, or, if known, a new DS frequency should be entered directly.

Since the DOCSIS 1.1 analyzer does not start any further registration attempts (different from the 2.0 analyzer, which establishes an IP connection with the head end), the measuring instrument with the integrated 1.1 analyzer receives no more transmission opportunities from the CMTS after a certain time (the head end assumes the modem is defective). For this reason, the analyzer is reset in this case from time to time and measuring starts again from the beginning.

As was described above, the DOCSIS 2.0 Analyzer can be used to perform further tests, in addition to pure US and DS level tests, after successful ranging.

29.6 Ingress measurement

An important measuring parameter with return channel capable systems is ingress (interference level through external stray pick-up in the coaxial cable). The measuring instrument can assess ingress with the aid of the spectrum analyzer (for this, see section Spectrum analyzer -> Ingress measurement in the return path and section RC (Return Channel) measuring range).

29.7 Notes regarding compatibility

Basically, the various DOCSIS specifications (1.0, 1.1, 2.0 and 3.0) are compatible with one another. This means that the DOCSIS analyzer functions, in general, with any head end. However, if the cable network operator, for example, were to provide only DOCSIS 2.0 modems to its customers, and there were no longer any 1.1 modems in circulation, the operator could switch off the mixed-mode and switch to pure DOCSIS 2.0 mode.

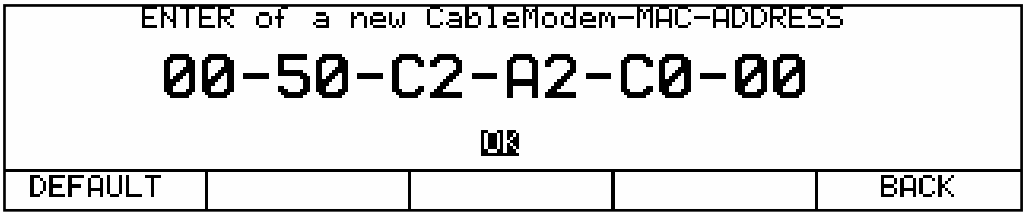
In this case, the measurement will not work with the DOCSIS 1.1 analyzer. Thus, in general, not every analyzer works with every network operator.

There are also some network operators that identify a modem based on the MAC address and assign the modem to a customer during the very first ranging. Since the DOCSIS 1.1 analyzer of the measuring receiver carries out only ranging on the physical level for its measurements and does not register further, an error message for this MAC address occurs with some cable network operators because the head end is expecting the registration and the establishment of an IP connection to start after ranging is successful. If ranging attempts fail, the head end rates the modem as defective and sends an error message.

However, the above aspects are heavily dependent on the operator.

29.8 Input of the MAC address

In the case of a measuring instrument with a DOCSIS 1.1 analyzer, a user-defined MAC address can be stored with which the modem communicates with the head end. This can be done through the menu item **MODE** -> **SETTINGS** -> **DOCSISANAL** -> **MACADR**.



You use the numeric keypad to carry out the input. After entering a position, you 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 you press the **ENTER** key a final time, causing the MAC address to be stored and used with the next activation of the DOCSIS analyzer.

You can reset the MAC address to the default setting via the menu item **DEFAULT**.

For the DOCSIS 2.0 analyzer, manipulation of the MAC address is not needed. The reason is that some head ends require the messages between the modem and CMTS to be encrypted (baseline privacy (BPI) or baseline privacy plus (BPI+)). Encryption is based on certificates that are stored permanently in the DOCSIS analyzer. These certificates are used to encrypt the messages. However, the certificates also contain the serial number and MAC address of the DOCSIS 2.0 analyzer. If the MAC address is changed, the certificates would no longer match the MAC address that must be contained in every message from the modem to the CMTS. In this case, the head end cancels the registration and data exchange with the modem and the measuring features of the DOCSIS 2.0 analyzer would be no longer available in the full extent with the head ends that request BPI(+).

For this reason, the menu item for changing the MAC address is not available if the 2.0 analyzer is installed.

29.9 Further information

Further information for measuring using the DOCSIS 2.0 analyzer can be found in application note “AN003 – DOCSIS 2.0 analyzer.” This is available from the homepage www.kws-electronic.de under “Support” – “Downloads” – “Application Notes”.

Chapter 30

SNMP Remote Control (Option)

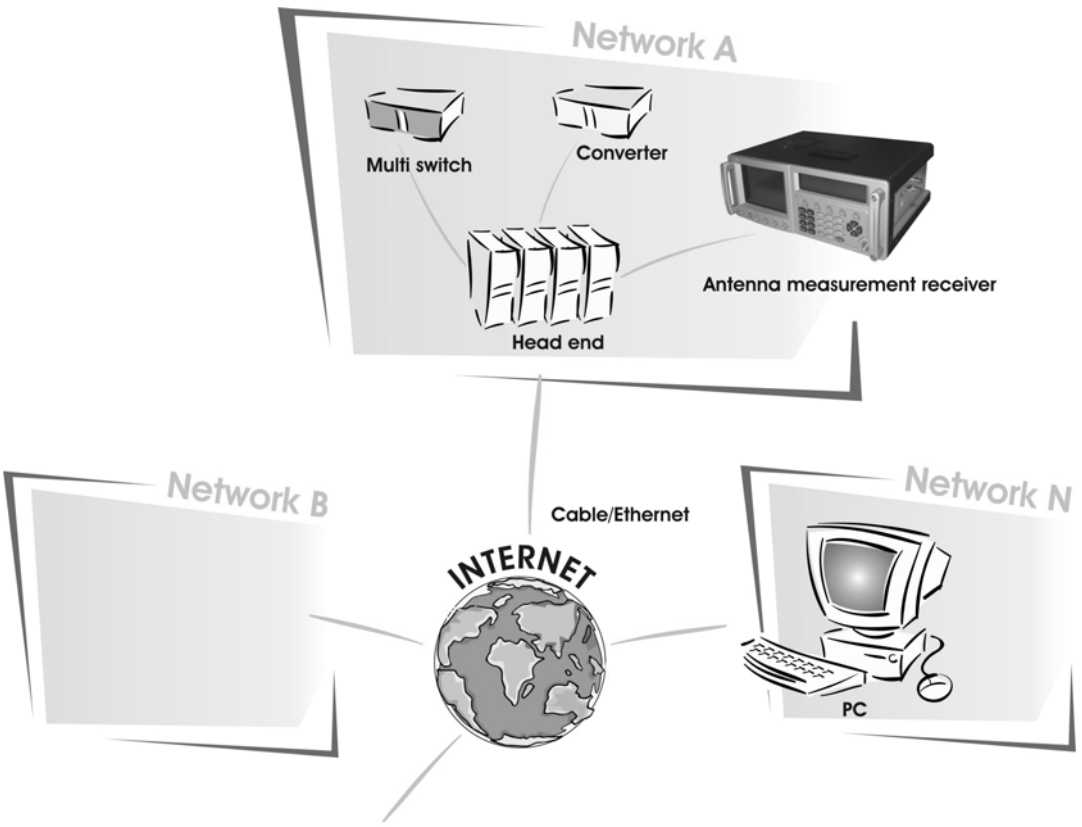
This option must be activated by entering an 8-digit key code in the measuring instrument. You can request this key code from the manufacturer. Further information on entering the key code is provided in the “Activating software options” section of the “Instrument Management” chapter.

30.1 Introduction

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 “Software” – “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.



30.2 Features and function of SNMP

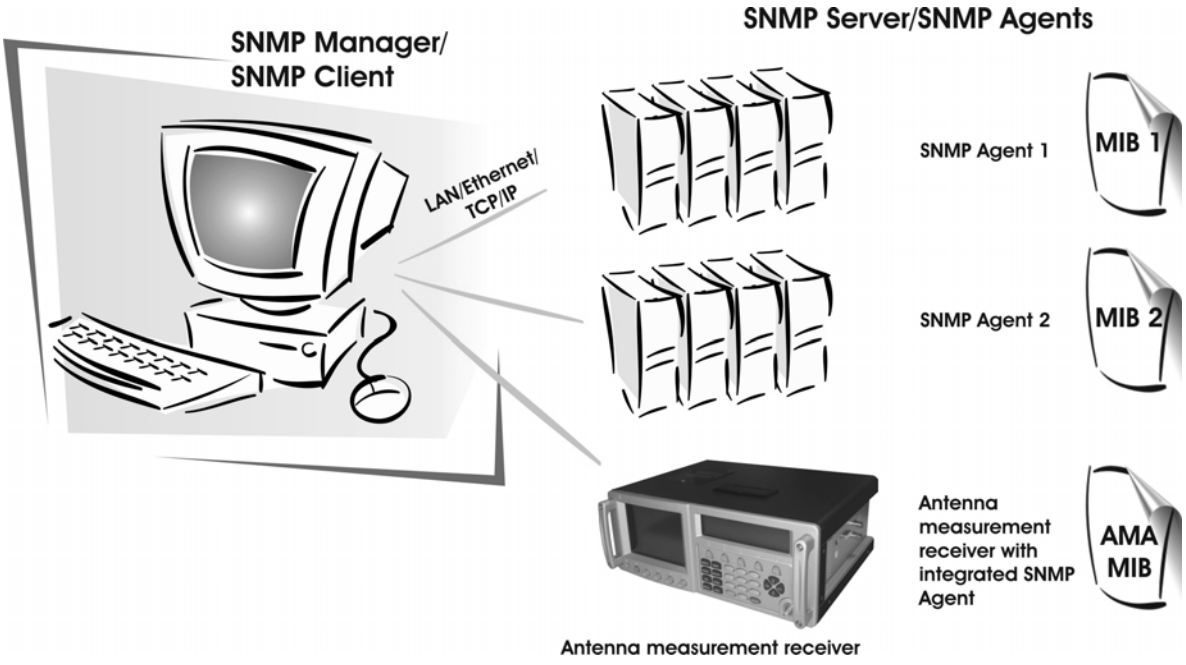
SNMP is based on the Internet Protocol (IP) and is available in three versions. The Internet standards are specified in Request for Comments documents (RFCs). Version 1 of the SNMP standard (SNMPv1), for example, is described in the documents RFC1155, RFC1156 and RFC1157. The measuring receiver's SNMP option uses SNMPv1.

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).

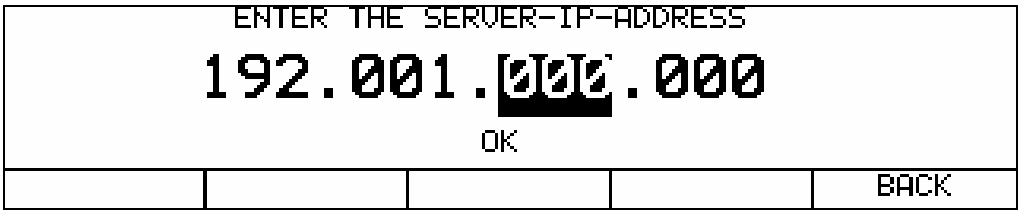
All OIDs are listed in a Management Information Base (MIB). The MIB is hierarchical (tree structure). Each node in the MIB tree has a name as well as a number and an OID holds all names and numbers up to the actual object. Certain MIB elements are standardised; however, a company may, for example, request 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.



30.3 Setting of the IP adress

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** -> **SETTINGS** -> **IP-ADR** .



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.

30.4 MIB strukture

The AMA MIB is divided into five 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.

30.5 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” – “Downloads” – “Application Notes”.

Chapter 31

Electro Magnetic Interference Measurement (optional)

31.1 Introduction

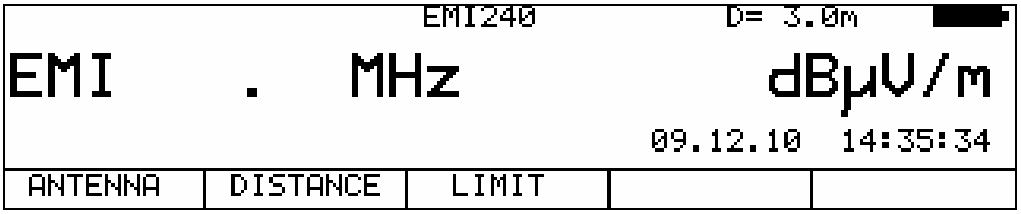
The German regulation on the protection of public telecommunication networks and transmission and receiving radio plants that are operated in the defined frequency ranges for security purposes (SchuTSEV) ["Verordnung zum Schutz von oeffentlichen Telekommunikationsnetzen und Sende- und Emfpangsfunkanalgen, die in definierten Frequenzbereichen zu Sicherheitszwecken betrieben werden"] has been in effect since May 2009. This regulation controls, for example, the switching off of analogue 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" – "Downloads" – "Application Notes".

31.2 Calling

Call measuring of electromagnetic interference (EMI) under **RANGE** -> **EMI**.



31.2 Frequency input

The numeric keypad can be used to set a frequency between 301.00 and 301.70 MHz. This is derived from the setting options for the KFG 242 frequency identification generator. Use the **ENTER** key to confirm the entry. It is important to make sure that the frequency identification generator and measuring receiver are tuned to the same frequency.

31.3 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.

31.4 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.

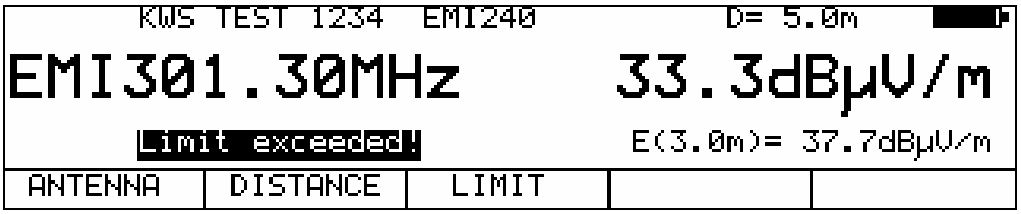
31.5 Entering the limit

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**.

31.6 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.

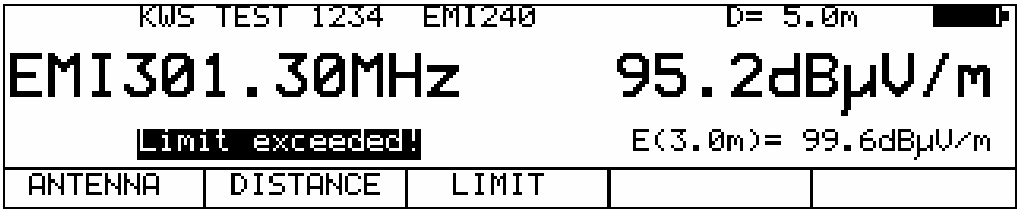
31.7 Measuring the interference field strength



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 0,1dBµV/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.

31.8 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.



31.9 Remote supply

The measuring receiver can provide a remote power supply for active receiving antennas via the RF input. Antennas EMI 240 (with the EMI 240/V pre-amplifier) and EMI 241 require a supply of 5 V.

The operator may chose 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.

31.9.1 Setting the remote supply voltage

Press **LNB** to open the selection menu. The voltages that are available (0 V, 5 V and 18 V) may be activated using function keys F1, F2 and F3.

31.9.2 Changing the fixed remote supply voltages

Two fixed voltages for the remote supply are set at the factory (5 V and 18 V).
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.
To do this, one of the two voltages must first be activated. Then press **LNB** again. The voltages can now be changed in increments of 1 V using the ↑ and ↓ keys. This setting is non-volatile.

31.9.3 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 32

Definitions and Explanations

32.1 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 (Vin/1 µV); (Vin in µV)

dBmV:

If the level is specified in **dBmV**, the reference value is the voltage 1 mV_{RMS}.

dBmV = 20 lg (Vin/1 mV); (Vin 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 (Pin/1 mW); (Pin in mW)

Conversion:

The following relationship is used for converting dBmV into dBµV:

$dB\mu V = 20 \lg (10^{-3}/10^{-6}) + dBmV$

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:

$dB\mu V = 10 \lg (Zin/10^{-9}) + dBm$ (Zin = 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

Examples: 0 dBmV = 60 dBµV = -48.75 dBm

0 dBm = 108.75 dBµV = 48.75 dBmV

80 dBµV = 20 dBmV = -28.75 dBm

Chapter 33

Channel Tables

33.1 B/G standard

Range	Channel	Video Carrier (MHz) with ATV	Centre Frequency (MHz) DVBC/DVBT
I	2	48.25	50.50
	3	55.25	57.50
	4	62.25	64.50
USB	S2	112.25	113.00
	S3	119.25	121.00
	S4	126.25	130.00
	S5	133.25	135.50
	S6	140.25	142.50
	S7	147.25	149.50
	S8	154.25	156.50
	S9	161.25	163.50
	S10	168.25	170.50
III	5	175.25	177.50
	6	182.25	184.50
	7	189.25	191.50
	8	196.25	198.50
	9	203.25	205.50
	10	210.25	212.50
	11	217.25	219.50
	12	224.25	226.50
OSB	S11	231.25	233.50
	S12	238.25	240.50
	S13	245.25	247.50
	S14	252.25	254.50
	S15	259.25	261.50
	S16	266.25	268.50
	S17	273.25	275.50
	S18	280.25	282.50
	S19	287.25	289.50
	S20	294.25	296.50
ESR	S21	303.25	306.00
	S22	311.25	314.00
	S23	319.25	322.00
	S24	327.25	330.00
	S25	335.25	338.00
	S26	343.25	346.00
	S27	351.25	354.00
	S28	359.25	362.00
	S29	367.25	370.00
	S30	375.25	378.00
	S31	383.25	386.00
	S32	391.25	394.00
	S33	399.25	402.00
	S34	407.25	410.00
	S35	415.25	418.00
	S36	423.25	426.00
	S37	431.25	434.00
	S38	439.25	442.00
	S39	447.25	450.00
	S40	455.25	458.00
	S41	463.25	466.00

Range	Channel	Video Carrier (MHz) with ATV	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	474.00
	22	479.25	482.00
	23	487.25	490.00
	24	495.25	498.00
	25	503.25	506.00
	26	511.25	514.00
	27	519.25	522.00
	28	527.25	530.00
	29	535.25	538.00
	30	543.25	546.00
	31	551.25	554.00
	32	559.25	562.00
	33	567.25	570.00
	34	575.25	578.00
	35	583.25	586.00
	36	591.25	594.00
	37	599.25	602.00
	38	607.25	610.00
	39	615.25	618.00
	40	623.25	626.00
	41	631.25	634.00
	42	639.25	642.00
	43	647.25	650.00
	44	655.25	658.00
	45	663.25	636.00
	46	671.25	674.00
	47	679.25	682.00
	48	687.25	690.00
	49	695.25	698.00
	50	703.25	706.00
	51	711.25	714.00
	52	719.25	722.00
	53	727.25	730.00
	54	735.25	738.00
	55	743.25	746.00
	56	751.25	754.00
	57	759.25	762.00
	58	767.25	770.00
	59	775.25	778.00
	60	783.25	786.00
	61	791.25	794.00
	62	799.25	802.00
	63	807.25	810.00
	64	815.25	818.00
	65	823.25	826.00
	66	831.25	834.00
	67	839.25	842.00
	68	847.25	850.00
	69	855.25	858.00

33.2 D/K standard

Range	Chan-nel	Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
I RI	=1	49.75	52.50
RII	=2	59.25	62.00
RIII	=3	77.25	80.00
II RIV	=4	85.25	88.00
RV	=5	93.25	96.00
USB	S1	111.25	114.50
	S2	119.25	122.00
	S3	127.25	130.00
	S4	135.25	138.00
	S5	143.25	146.00
	S6	151.25	154.00
	S7	159.25	162.00
	S8	167.25	170.00
III RVI	=6	175.25	178.00
RVII	=7	183.25	186.00
RVIII	=8	191.25	194.00
RIX	=9	199.25	202.00
RX	=10	207.25	210.00
RXI	=11	215.25	218.00
RXII	=12	223.25	226.00
OSB	S9	231.25	234.00
	S10	239.25	242.00
	S11	247.25	250.00
	S12	255.25	258.00
	S13	263.25	266.00
	S14	271.25	274.00
	S15	279.25	282.00
	S16	287.25	290.00
	S17	295.25	298.00
	S18	303.25	306.00
	S19	311.25	314.00
	S20	319.25	322.00
	S21	327.25	330.00
	S22	335.25	338.00
	S23	343.25	346.00
	S24	351.25	354.00
	S25	359.25	362.00
	S26	367.25	370.00
	S27	375.25	378.00
	S28	383.25	386.00
	S29	391.25	394.00
	S30	399.25	402.00
	S31	407.25	410.00
	S32	415.25	418.00
	S33	423.25	426.00
	S34	431.25	434.00
	S35	439.25	442.00
	S36	447.25	450.00
	S37	455.25	458.00
	S38	463.25	466.00

Range	Channel	Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	474.00
	22	479.25	482.00
	23	487.25	490.00
	24	495.25	498.00
	25	503.25	506.00
	26	511.25	514.00
	27	519.25	522.00
	28	527.25	530.00
	29	535.25	538.00
	30	543.25	546.00
	31	551.25	554.00
	32	559.25	562.00
	33	567.25	570.00
	34	575.25	578.00
	35	583.25	586.00
	36	591.25	594.00
	37	599.25	602.00
V	38	607.25	610.00
	39	615.25	618.00
	40	623.25	626.00
	41	631.25	634.00
	42	639.25	642.00
	43	647.25	650.00
	44	655.25	658.00
	45	663.25	666.00
	46	671.25	674.00
	47	679.25	682.00
	48	687.25	690.00
	49	695.25	698.00
	50	703.25	706.00
	51	711.25	714.00
	52	719.25	722.00
	53	727.25	730.00
	54	735.25	738.00
	55	743.25	746.00
	56	751.25	754.00
	57	759.25	762.00
	58	767.25	770.00
	59	775.25	778.00
	60	783.25	786.00
	61	791.25	794.00
	62	799.25	802.00
	63	807.25	810.00
	64	815.25	818.00
	65	823.25	826.00
	66	831.25	834.00
	67	839.25	842.00
	68	847.25	850.00
	69	855.25	858.00

33.3 M/N standard

Range	Channel			Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
I	A02	=	2	55.25	57.00
	A03		3	61.25	63.00
	A04		4	67.25	69.00
	A05		5	77.25	79.00
	A06		6	83.25	85.00
	A-5		S1	91.25	93.00
	A-4		S2	97.25	99.00
	A-3		S3	103.25	105.00
	A-2		S4	109.25	111.00
	A-1		S5	115.25	117.00
USB	A		S6	121.25	123.00
	B		S7	127.25	129.00
	C		S8	133.25	135.00
	D		S9	139.25	141.00
	E		S10	145.25	147.00
	F		S11	151.25	153.00
	G		S12	157.25	159.00
	H		S13	163.25	165.00
	I		S14	169.25	171.00
III	A07	=	7	175.25	177.00
	A08		8	181.25	183.00
	A09		9	187.25	189.00
	A10		10	193.25	195.00
	A11		11	199.25	201.00
	A12		12	205.25	207.00
	A13		13	211.25	213.00
OSB	J		S15	217.25	219.00
	K		S16	223.25	225.00
	L		S17	235.25	237.00
	M		S18	241.25	243.00
	N		S19	247.25	249.00
	O		S20	253.25	255.00
	P		S21	259.25	261.00
	Q		S22	265.25	267.00
	R		S23	271.25	273.00
	S		S24	277.25	279.00
	T		S25	283.25	285.00
	U		S26	289.25	291.00
	V		S27	295.25	297.00
	W		S28	301.25	303.00
	AA		S29	307.25	309.00
	BB		S30	313.25	315.00
	CC		S31	319.25	321.00
	DD		S32	325.25	327.00
	EE		S33	331.25	333.00
	FF		S34	337.25	339.00
	GG		S35	343.25	345.00
	HH		S36	349.25	351.00
	II		S37	355.25	357.00
	JJ		S38	361.25	363.00
	KK		S39	367.25	369.00
	LL		S40	373.25	375.00
	MM		S41	379.25	381.00
	NN		S42	385.25	387.00
	OO		S43	391.25	393.00
	PP		S44	397.25	399.00
	QQ		S45	403.25	405.00
	RR		S46	409.25	411.00
	SS		S47	415.25	417.00
	TT		S48	421.25	423.00
	UU		S49	427.25	429.00
	VV		S50	433.25	435.00
	WW		S51	439.25	441.00
	AAA		S52	445.25	447.00
	BBB		S53	451.25	453.00
	CCC		S54	457.25	459.00
	DDD		S55	463.25	465.00
	EEE		S56	469.25	471.00
IV	A14	=	14	469.25	471.00
	A15		15	475.25	477.00
	A16		16	481.25	483.00
	A17		17	487.25	489.00
	A18 (18) to A67 (67) continous Channel spacing 6 MHz				
	A68		68	799.25	801.00
	A69		69	805.25	807.00

33.4 L standard

Range	Channel	Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
I	A=91	47.75	50.50
	B=92	55.75	58.50
	C1=93	60.50	63.25
	C=94	63.75	66.50
USB	S1	120.75	123.50
	S2	128.75	131.50
	S3	136.75	139.50
	S4	144.75	147.50
	S5	152.75	155.50
	S6	160.75	163.50
	S7	168.75	171.50
	1	176.00	178.75
	2	184.00	186.75
	3	192.00	194.75
	4	200.00	202.75
	5	208.00	210.75
	6	216.00	218.75
OSB	S14	224.75	227.50
	S15	232.75	235.50
	S16	240.75	243.50
	S17	248.75	251.50
	S18	256.75	259.50
	S19	264.75	267.50
	S20	272.75	275.50
	S21	280.75	283.50
	S22	288.75	291.50
	S23	296.75	299.50
	S24	303.25	306.00
	S25	311.25	314.00
	S26	319.25	322.00
	S27	327.25	330.00
	S28	335.25	338.00
	S29	343.25	346.00
	S30	351.25	354.00
	S31	359.25	362.00
	S32	367.25	370.00
	S33	375.25	378.00
	S34	383.25	386.00
	S35	391.25	394.00
	S36	399.25	402.00
	S37	407.25	410.00
	S38	415.25	418.00
	S63	423.25	426.00
	S64	431.25	434.00
	S65	439.25	442.00
	S66	447.25	450.00
	S67	455.25	458.00
	S68	463.25	466.00

Range	Channel	Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	474.00
	22	479.25	482.00
	23	487.25	490.00
	24	495.25	498.00
	25	503.25	506.00
	26	511.25	514.00
	27	519.25	522.00
	28	527.25	530.00
	29	535.25	538.00
	30	543.25	546.00
	31	551.25	554.00
	32	559.25	562.00
	33	567.25	570.00
	34	575.25	578.00
	35	583.25	586.00
	36	591.25	594.00
	37	599.25	602.00
V	38	607.25	610.00
	39	615.25	618.00
	40	623.25	626.00
	41	631.25	634.00
	42	639.25	642.00
	43	647.25	650.00
	44	655.25	658.00
	45	663.25	666.00
	46	671.25	674.00
	47	679.25	682.00
	48	687.25	690.00
	49	695.25	698.00
	50	703.25	706.00
	51	711.25	714.00
	52	719.25	722.00
	53	727.25	730.00
	54	735.25	738.00
	55	743.25	746.00
	56	751.25	754.00
	57	759.25	762.00
	58	767.25	770.00
	59	775.25	778.00
	60	783.25	786.00
	61	791.25	794.00
	62	799.25	802.00
	63	807.25	810.00
	64	815.25	818.00
	65	823.25	826.00
	66	831.25	834.00
	67	839.25	842.00
	68	847.25	850.00
	69	855.25	858.00

33.5 I standard

Range	Channel	Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
I	IA=1	45.75	48.50
	IB=2	53.75	56.50
	IC=3	61.75	64.50
USB	S2	112.25	114.50
	S3	119.25	121.50
	S4	126.25	128.50
	S5	133.25	135.50
	S6	140.25	142.50
	S7	147.25	149.50
	S8	154.25	156.50
	S9	161.25	163.50
III	ID =4	175.25	178.00
	IE =5	183.25	186.00
	IF =6	191.25	194.00
	IG =7	199.25	202.00
	IH =8	207.25	210.00
	IJ =9	215.25	218.00
	IK =10	223.25	226.00
	IL =11	231.25	234.00
	IM =12	239.25	242.00
	IN =13	247.25	250.00
OSB	S15	259.25	261.50
	S16	266.25	268.50
	S17	273.25	275.50
	S18	280.25	282.50
	S19	287.25	289.50
	S20	294.25	296.50
ESR	S21	303.25	306.00
	S22	311.25	314.00
	S23	319.25	322.00
	S24	327.25	330.00
	S25	335.25	338.00
	S26	343.25	346.00
	S27	351.25	354.00
	S28	359.25	362.00
	S29	367.25	370.00
	S30	375.25	378.00
	S31	383.25	386.00
	S32	391.25	394.00
	S33	399.25	402.00
	S34	407.25	410.00
	S35	415.25	418.00
	S36	423.25	426.00
	S37	431.25	434.00
	S38	439.25	442.00
	S39	447.25	450.00
	S40	455.25	458.00
	S41	463.25	466.00

Range	Channel	Video Carrier in MHz with ATV	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	474.00
	22	479.25	482.00
	23	487.25	490.00
	24	495.25	498.00
	25	503.25	506.00
	26	511.25	514.00
	27	519.25	522.00
	28	527.25	530.00
	29	535.25	538.00
	30	543.25	546.00
	31	551.25	554.00
	32	559.25	562.00
	33	567.25	570.00
	34	575.25	578.00
	35	583.25	586.00
	36	591.25	594.00
	37	599.25	602.00
V	38	607.25	610.00
	39	615.25	618.00
	40	623.25	626.00
	41	631.25	634.00
	42	639.25	642.00
	43	647.25	650.00
	44	655.25	658.00
	45	663.25	666.00
	46	671.25	674.00
	47	679.25	682.00
	48	687.25	690.00
	49	695.25	698.00
	50	703.25	706.00
	51	711.25	714.00
	52	719.25	722.00
	53	727.25	730.00
	54	735.25	738.00
	55	743.25	746.00
	56	751.25	754.00
	57	759.25	762.00
	58	767.25	770.00
	59	775.25	778.00
	60	783.25	786.00
	61	791.25	794.00
	62	799.25	802.00
	63	807.25	810.00
	64	815.25	818.00
	65	823.25	826.00
	66	831.25	834.00
	67	839.25	842.00
	68	847.25	850.00
	69	855.25	858.00

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