Contents

Chapter 1

Notes on Safety and Use, Maintenance and Service

1.1 Safety notes

This instrument is built and tested according to EN 61010-1, protective measures for electronic measuring instruments with attached power cable.

Important! This instrument may only be powered with the power cable originally delivered from the factory.

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.

The instrument complies with protection class II (protective insulation)

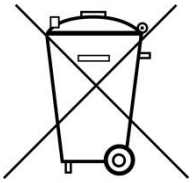
The instrument complies with IP20 protection type specified by EN60529.

The instrument may only be operated on mains voltages between 100-240V with 50-60Hz.

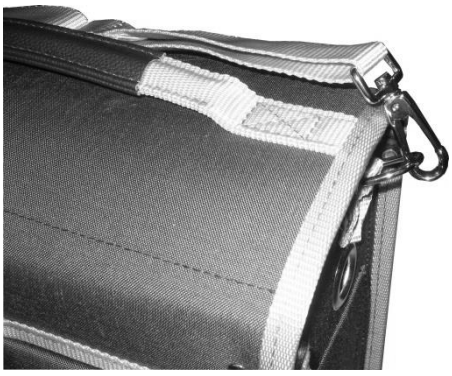
Discharging using the plug connector may damage the instrument. Protect the instrument from electrostatic discharge when handling and operating it.

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

The ventilation slots on the side of the instrument must not be covered, or there may be a reduced air circulation in the instrument. This could result in a heat build-up in the instrument and thus in an overheating of the electronical components.



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.



To be able to ensure the support safety, the carring strap´s snap hook must be attached to the case as shown on the following picture.

Opening must point outwards !

1.2 Usage Notes

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

⚠ Make sure no external voltages higher than $70V_{eff}$ ($60V_{eff}$ = Instrument delivered before January 2010) act on the RF input of the measuring receiver. Higher voltages can destroy the input circuits.
When operating the instrument with the lid open, it is important that no strong mechnical forces act on the lid, or the movable plastic parts could come off.

Sharp tools (e.g. a screwdriver) can damage the plastic glass in front of the TFT display, thus destroying the TFT.

Before closing the hinged-lid you must look out that there is no connector adapter on the RF input socket, otherwise the TFT display could be damaged.

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

The TFT display does not reach maximum brightness for a few seconds after the instrument is cold-started.
The instrument reaches full measurement accuracy after about 5 minutes of operation.

The use of wireless DECT phones and GSM phones close to the instrument can cause disturbances and faulty measurements.

1.3 Maintenance

The instrument is maintenance-free.

1.4 Cleaning

The case and the TFT display should be cleaned 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.
Any dust should be removed from the ventilation slots regularly so that the air circulation provided by the built-in ventilator is not obstructed.

1.5 Calibration

The instrument should be recalibrated at least every one to two years. It is automatically calibrated at the factory in case of upgrading, repairs or servicing.

1.6 Service

Service address: see back cover of operating manual.

Chapter 2

Specifications

Subjekt to technical change!

FREQUENCY RANGES		
SAT		910 - 2150MHz resolution 500kHz Transponder frequency or 1st IF entry
TV		44.75 - 867.25MHz resolution 50kHz
FM (VHF)		87.5 - 108.3MHz resolution 50kHz
RC (Return channel)		5 - 65MHz resolution 50kHz
DAB (Option)		170 - 250MHz resolution 50kHz
OPERATING MODES		SAT analog, DVBS, DVBS2 TV analog, DVBC, DVBT FM (VHF) RC (return channel) DAB Analyzer in all ranges
OPERATION		
Input		via keypad and rotary selector
Monitor		5" Color-TFT, VGA resolution
User Prompting		via OSD (On Screen Display) in German, English, French and Italian
Built-in speaker for audio reproduction		
RF-INPUT		IEC socket / 75 Ω (DIN 45 325)
	return loss	> 12dB (5 - 867.25MHz)
	return loss	> 10dB (910 - 2150MHz)
INPUT ATTENUATOR		0 – 60dB in 2dB-increments
LEVEL MEASUREMENT		
measuring ranges	SAT	30 – 110dBµV
	TV	25 – 110dBµV
	FM	25 – 110dBµV
	RC	25 – 110dBµV
	DAB	25 – 110dBµV
resolution		0.5dB
measuring accuracy		± 1,5dB (at 20°C) ± 2,0dB (0°C-40°C)

LEVEL MEASUREMENT			
measuring bandwidth (RB)	SAT		analog 8MHz
	SAT	DVB-S	8MHz, 4MHz or 1MHz depending on symbol rate
	TV	analog	Video carrier 200kHz Audio carrier 200kHz
		DVB-T	4MHz
		DVB-C	4MHz oder 200kHz depending on symbol rate
	FM		200kHz
	RC		1MHz
	DAB		200kHz
acoustic level trend indicator			can be switched on/off
level trend bar			with MaxHold Indicator

ANALYZER	digital analyzer	
Measuring bandwidth (RB)	SAT	8MHz, 4MHz or 1MHz dependent on span
	TV	4MHz, 1MHz or 200kHz dependent on span
	FM	200kHz
	RC	1MHz or 200kHz dependent on span
	DAB	1MHz or 200kHz dependent on span
Span (frequency segment)	SAT	total range, 150MHz or 38MHz
	TV	total range, 76MHz or 15MHz
	FM	total range, 15MHz
	RC	total range, 15MHz
	DAB	total range, 15MHz
Switch directly between analyzer and receiver modes		

SAT analog		
Video features	video bandwidth	5MHz
	deemphasis	per CCIR 405-1
	inversion	for C-band reception
Audio features	audio subcarrier	5.00 – 9.75MHz
Searching function		

DVBS		
QPSK demodulator		(per ETS 300421)
Symbol rates		2 – 45 MSym/s
Measuring parameters		(per ETR 290)
	VBER	10^{-2} to 10^{-8} (bit error rate per Viterbi)
	CBER	10^{-2} to 10^{-8} (bit error rate before Viterbi)
	MER	2 – 20dB resolution 0.1dB
Searching function		

DVBS2		
QPSK/8PSK demodulator		(per ETS 302307)
16APSK, 32APSK		not supported
FEC 1/4, 1/3, 2/5		not supported
Symbol rates		2 – 45 MSym/s
Measuring parameters		(per ETR 290)
	LBER	10^{-1} to 10^{-8} (bit error rate per LDPC)
	CBER	10^{-2} to 10^{-8} (bit error rate before LDPC)
	MER	1 – 20dB resolution 0.1dB
Automatic detection of DVBS/DVBS2		
Searching function		

TV analog

Television standards		B/G, D/K, L, I, M/N
Colour standards		PAL, NTSC
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 0.5dB
Searching function		

DVBC

QAM demodulator		(per ETS 300429)
Symbol rates		0.5 – 7.2 MSym/s (2 – 7,2 MSym/s with option DVBT2 or DAB)
Modulation scheme		16, 32, 64, 128, 256 QAM
Measuring parameters		(per ETR 290)
	BER	10^{-2} bis 10^{-8}
	MER	10 - 35dB (38dB with option DVBT2) resolution 0.1dB
Searching function		

DVBT

COFDM demodulator		(per ETS 300744)
FFT		2k, 8k
Modulation scheme		QPSK, 16QAM, 64QAM
Guard interval		1/4, 1/8, 1/16, 1/32
Measuring parameters		(per ETR 290)
	VBER	10^{-2} bis 10^{-8} (bit error rate per Viterbi)
	CBER	10^{-2} bis 10^{-6} (bit error rate before Viterbi)
	MER	3 – 24dB (32dB with option DVBT2) resolution 0.1dB
	Impulse response	attenuation relative to the primary impulse 0-30dB (0-40dB with option DVBT2) delay relative to the primary impulse in µs or km
Searching function		

DVBT2 (option)

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

DAB/DAB+ (Option)		
COFDM demodulator		(per ETSI EN 300401)
FFT		2k
MODE		1
Modulation scheme		DQPSK
Guard Intervall		1/4
Measuring parameters		
	CBER (before Viterbi)	$1{,}00 \cdot 10^{-6}$
	MER	to 25dB
	Resolution	0.1dB
	Measuring accuracy	± 1.5dB
DAB+ frame decoding		per ETS TS 102563
Scan function		
TII evaluation		

FM (VHF)	
Mono/Stereo indicator	
Searching function	

MPEG2-Decoder	NIT evaluation Direct tuning of the receiver from the NIT Display of MPEG2 video parameters Video bit rate measurement in Mbit/s
Video decoding	MPEG-2 (ISO/IEC 13818-2)
Audio decoding	MPEG-2 (ISO/IEC 13818-3), Dolby Digital AC-3, Dolby Digital Plus, MPEG-2 AAC (ISO/IEC 13818-7), MPEG-4 AAC (ISO/IEC 14496-3)

MPEG4 decoder	In addition to MPEG2:
Video decoding	H.264/AVC Level 4.1 HP (ISO/IEC 14496-10)

CI (Common Interface)	1 CI slot Presentation of card menu

Data logger	Stores measurements automatically in the form of an XML file on a USB stick

INTERFACE	
SCART	CCVS input, impedance 75 Ohm CCVS output, output impedance 75 Ohm, 1 V_{pp} at 75 Ohm audio input (left channel only), impedance 600 Ohm audio output (left channel only), Output impedance 600 Ohm 1 V_{pp} at 600 Ohm
DVI	Digital video output for connecting a TV device with a DVI/HDMI input Output impedance 100 Ohm Difference output level typ. 1 V_{pp}
USB-A	USB-A socket for data logger and software update USB 2.0

TUNING MEMORY	99 Memory locations memory protection function

REMOTE SUPPLY		
SAT		
	maximum power	500 mA (short circuit-proof)
	voltages	14V / 18V
	22kHz modulation	U_{SS} = 0.8 V_{SS}
	DiSEqC	version V1.0, V1.1, V1.2, V2.0
	UNICABLE	
	current measuring	
	measuring range	0 – 500 mA
	resolution	1 mA
	measuring accuracy	± 5% of final value
TV/FM/RC/DAB	maximum power	100 mA for 5V, otherweise 500 mA (short circuit-proof)
	voltages	5V, 14V, 18V
	current measuring	
	measuring range	0 – 100 mA for 5V, otherweise 500 mA
	resolution	1 mA
	measuring accuracy	± 5% of final value

POWER SUPPLY		
Line	integrated power supply	
	mains voltage	100 – 120V AC, 200 - 240V AC; 50 – 60 Hz
	power consumption	max. 40W
External 12V		11 – 15V DC max. 3A through extra-low voltage jack per DIN 45323
Storage battery		NI-MH battery package 12V / 4.5Ah
	operating time	approx. 2 hours (dependant upon the LNB load) automatic cutout as protection against exhaustive discharge
	charging time	approx. 4 hours
		Delivery later serial number 60001 Li-Ion battery package 7.2V / 6.6Ah
	operating time	approx. 2 hours (dependant upon the LNB load) automatic cutout as protection against exhaustive discharge
	charging time	approx. 3 hours
	battery management	Battery can be charged using mains and 12 V external supply

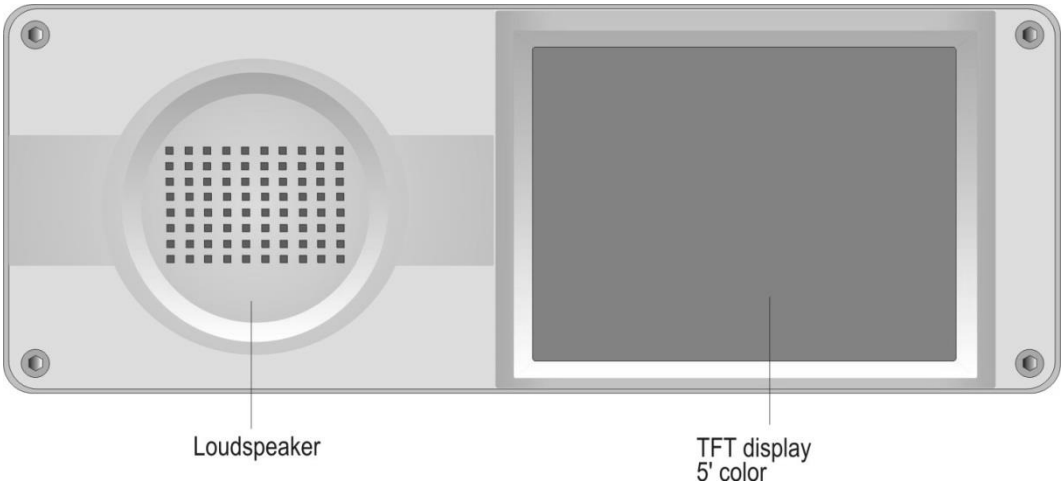
ELECTROMAGNETIC COMPATIBILITY	according to EN 61000-6-2 and EN 61000-6-3
PROTECTION	according to EN 61010-1
DIMENSIONS (W x H x D)	252mm x 135 x 272mm
WEIGHT	approx. 4.8 kg with battery pack and bag **Delivery later serial number 60001** approx. 4.4 kg with battery pack and bag

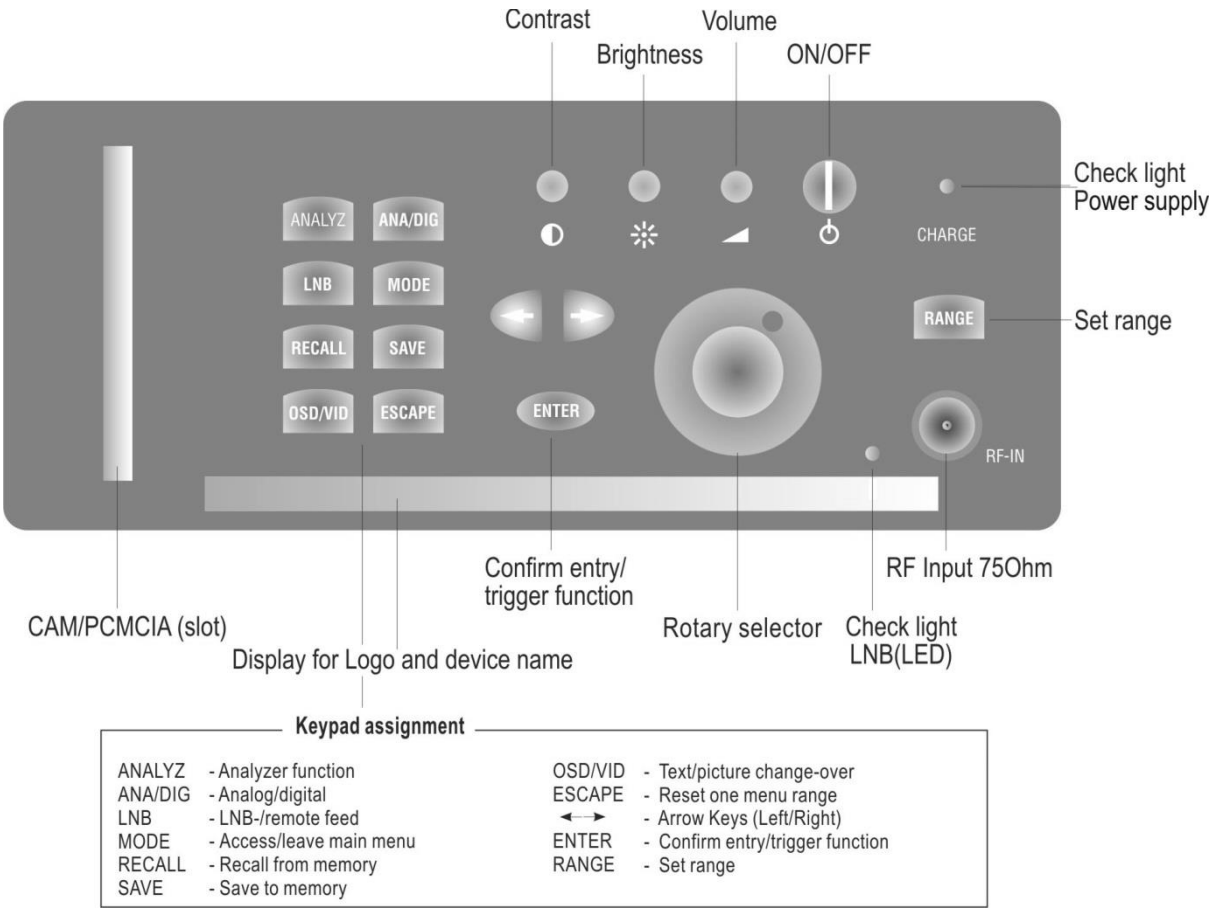
QUANTITY OF DELIVERY	
Included in the delivery	bag (CANVAS) with straps power cord adaptor cable for cigarette lighter with 12V external IEC measuring cable manual

Chapter 3

Control and connection elements, pin configurations

3.1 Front Panel

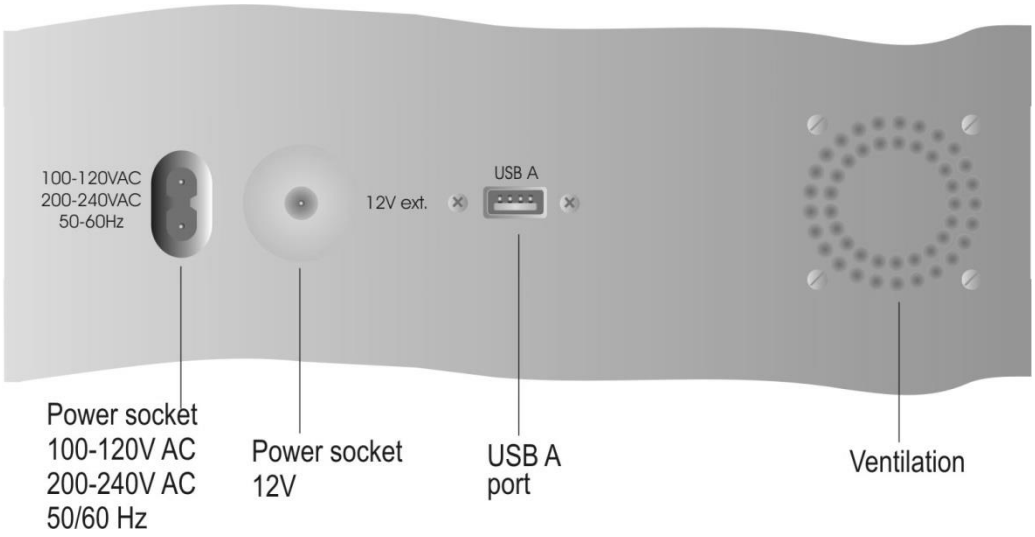




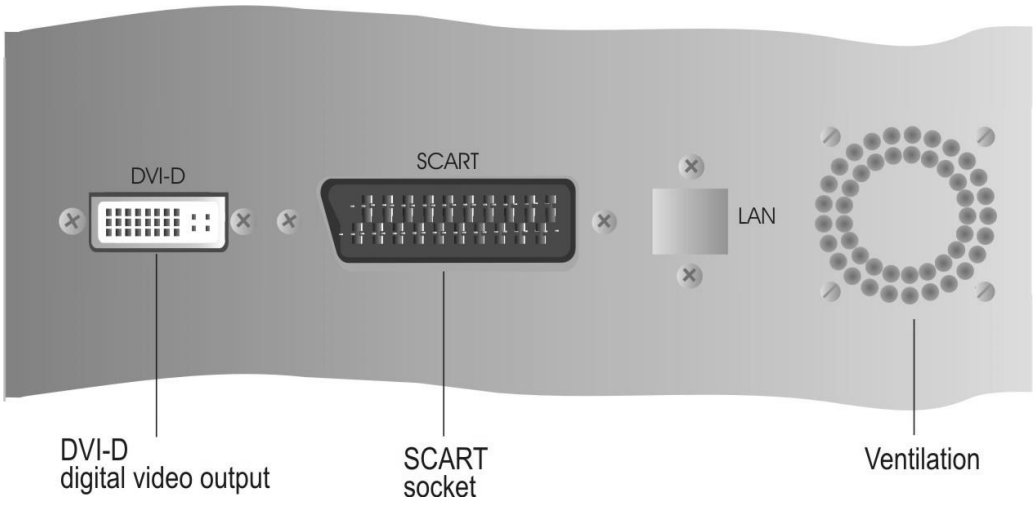
Keypad assignment

ANALYZ	- Analyzer function	OSD/VID	- Text/picture change-over
ANA/DIG	- Analog/digital	ESCAPE	- Reset one menu range
LNB	- LNB-/remote feed	◄–►	- Arrow Keys (Left/Right)
MODE	- Access/leave main menu	ENTER	- Confirm entry/trigger function
RECALL	- Recall from memory	RANGE	- Set range
SAVE	- Save to memory		

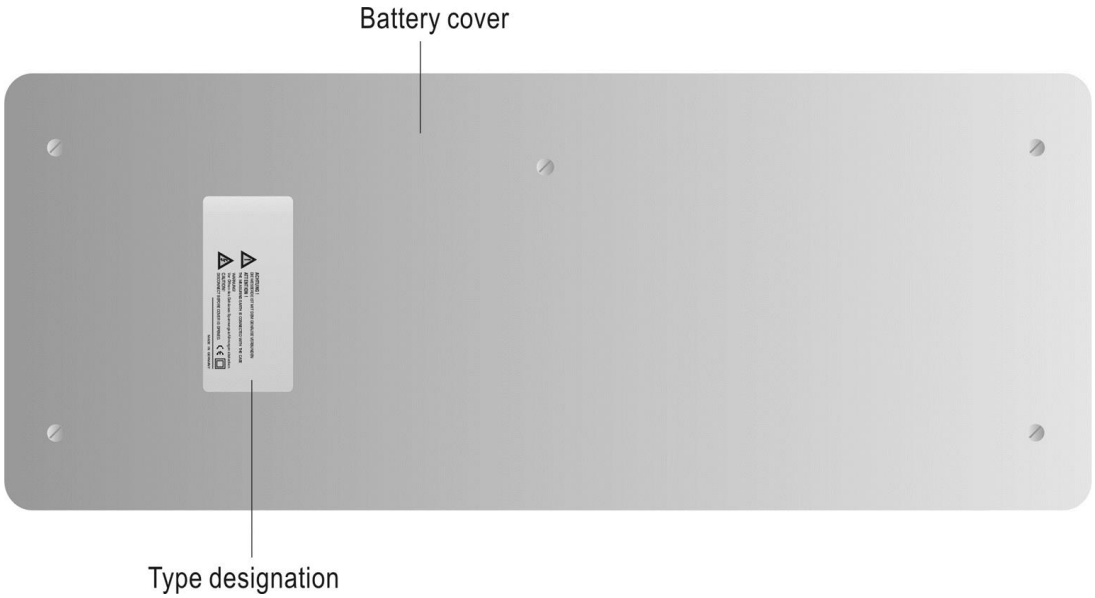
3.2 Left side view



3.3 Right side view

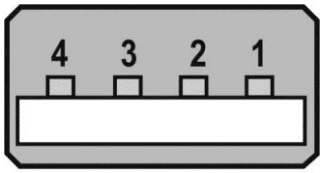


3.4 Rear panel



3.5 USB-A socket

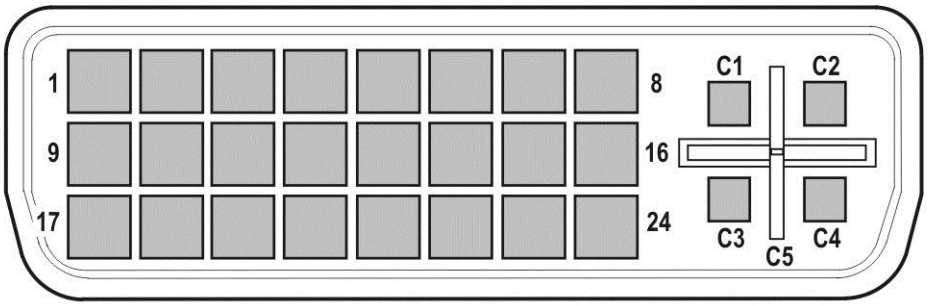
Pin 1 = V_{CC} (+5 V)
Pin 2 = Data D -
Pin 3 = Data D +
Pin 4 = GND



Socket A

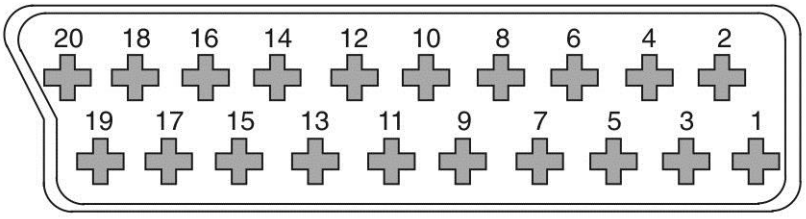
3.6 DVI output

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.

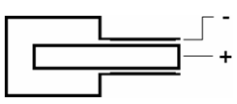
3.7 SCART socket



1 = not used	8 = not used	15 = not used
2 = not used	9 = not used	16 = not used
3 = Audio output left	10 = not used	17 = Video ground
4 = Audio ground	11 = not used	18 = Video ground
5 = not used	12 = not used	19 = Video output
6 = Audio input left	13 = not used	20 = Video input
7 = not used	14 = not used	Screen = Chassis ground

3.8 12V power supply

Extra-low voltage jack per DIN 45 323



Chapter 4

Startup

4.1 Mains operation

The power socket is on the left side of the instrument. The instrument is operated through a two-pin power cable (included in the delivery) connected. The LED (**CHARGE**) on the front panel of the instrument lights up to indicate that power is available. The instrument complies with protection type II (protective insulation).

Important! ⚠ *Always disconnect the instrument from the power supply when disassembling the instrument (e.g. replacing batteries).*

4.2 Battery operation

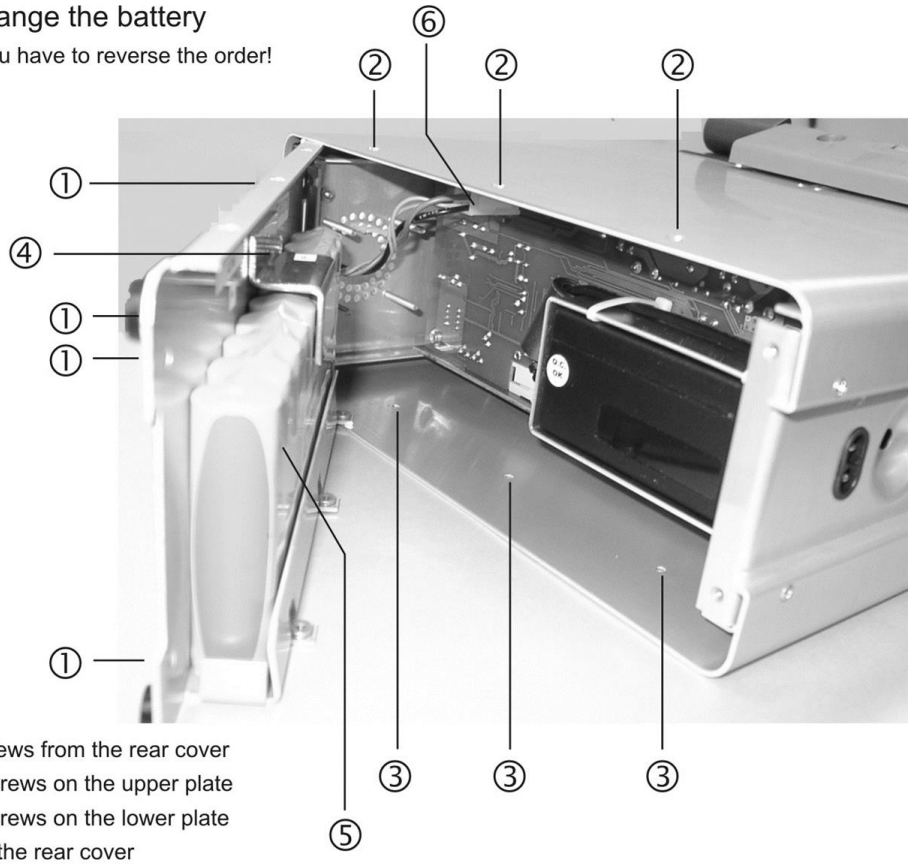
4.2.1 Replacing battery package

4.2.1.1 NI-MH battery package 12V/4.5Ah

The internal battery may be exchanged by the customer. We strongly recommend that only OEM batteries be used. To change the battery, loosen the four screws located on the rear side and the six mounting screws from the upper and lower plate, then remove the rear cover of the instrument. After lossening the mounting screws from the battery bracket you can now take out the old battery and then unplug the battery connector. Follow a similar procedure to install the new battery and reinstall the rear cover.

Procedure to exchange the battery

To build in the battery you have to reverse the order!



① Remove the four screws from the rear cover
② Remove the three screws on the upper plate
③ Remove the three screws on the lower plate
After ①②③ remove the rear cover
④ Remove the attachement screw from the battery bracket
⑤ Take out the battery pack
⑥ Disconnect the battery plug

After the battery is changed, the battery charge management must be recalibrated. First, discharge the battery completely, then recharge it.

4.2.1.2 Li-Ion battery package 7.2V/6.6Ah (Delivery later serial number 60001)

The internal battery may be exchanged by the customer. We strongly recommend that only OEM batteries be used. To change the battery, loosen the four screws located on the rear side and the six mounting screws from the upper and lower plate, then remove the rear cover of the instrument. After lossening the mounting screws from the battery bracket you can now take out the old battery and then unplug the battery connector. Follow a similar procedure to install the new battery and reinstall the rear cover.

Note! The exchange is conducted just as with NI-MH battery package (see illustration).

4.2.2 Battery management

4.2.2.1 NI-MH battery package 12V/4.5Ah

The instrument contains an internal battery management which ensures an optimum recharge and discharge of the battery. The battery is recharged when the instrument is connected to the power supply or to an external voltage. A quick recharge is performed when the instrument is out of operation, a standard recharge is done during operation. A red CHARGE Led indicates that the battery is being recharged. When the battery is fully charged, the battery management switches to floating charge, CHARGE Led shows a green light. The instrument contains also a charge status display. A charge status bar in the frequency window continually shows the current charge state of the battery. A red LOW behind the bar indicates that the charge is critical. Any measurement in progress can still be completed. Immediately recharge the battery afterwards. The instrument switches off automatically to avoid total discharge of the battery.

Storing the battery at temperatures under 10°C:
Because the chemical reactions in an installed battery change at low temperatures, battery packs that have been stored at temperatures lower than 10°C are no longer able to perform to their full capacity. The minimum voltage required for the operation of the instrument will fall below the specified value sooner, this will also affect the battery calibration (the battery may need to be callibrated again).
After storage at less than 10°C, it is recommended that the instrument is initially connected to a power supply for approx. 20-30 minutes, so that the battery can be refreshed.
This is particularly important with high LNB current and by digital operation.

4.2.2.2 Li-Ion battery package 7.2V/6.6Ah (delivery later serial number 60001)

The instrument has internal battery management, which optimises the charging and discharging of the battery. The battery begins to charge as soon as the instrument is connected to the mains or an external voltage supply. The instrument starts in charging mode if it is not being used; during this time only the OSD window on the top left is shown with the text “Charging BATT” and the battery symbol. The display screen turns off after a minute. Pressing any button turns the display back on. If the instrument is operated in measuring mode, the charging current may be reduced somewhat depending on the operating status, causing the charging process to take longer. When the battery is being charged, the “charge” LED lights up red. Once the battery is fully charged, the internal battery management switches to maintenance charging and the “charge” LED turns green. The instrument also has a charge status indicator. A status bar in the frequency window indicates the remaining charge of the battery at all times. If the battery charge becomes critical, the word “low” appears in red next to the bar. You can still complete the current measurement, but the battery should then be recharged as soon as possible. The instrument shuts down automatically to prevent total discharge.

Storing the battery and operating the device at low temperatures
Because of the chemical reactions inside the battery the performance of the built in battery is somewhat reduced at low temperatures. It is not possible to charge the battery when the temperature is below 0°C.

4.2.3 Calibration of the battery management

Make sure to fully discharge and then recharge the battery at regular intervals; this ensures that the charge status display shows the correct value. It will also increase the durability of the battery. The battery is fully discharged when the instrument switches off automatically.

In devices with Li-Ion battery package (delivery later serial number 60001) the calibration of the battery management is not necessary.

4.3 External power supply

In addition to mains and battery supply the instrument can also be operated by an external DC current through a power socket on the left side of the instrument. The external power supply must be between 11V and 15V. A maximum 3A may be supplied. The measuring receiver can be fed through a mains adaptor plug or the cigarette lighter of a vehicle. This has the advantage that the internal battery can be recharged through an external power supply, which enables the user to make the instrument work again, e.g. by recharging it in their car. An adaptor cable with a cigarette lighter plug is included for this purpose.

4.4 Ventilation control

An integrated mini ventilator provides sufficient ventilation of the electronical components. This ventilator is controlled by a temperature sensor via a microprocessor.

4.5 Switching on

The processor in the device requires approx. 3 seconds to boot up. During this time the charge display LED flashes yellow. Afterwards, a display will appear on the screen.

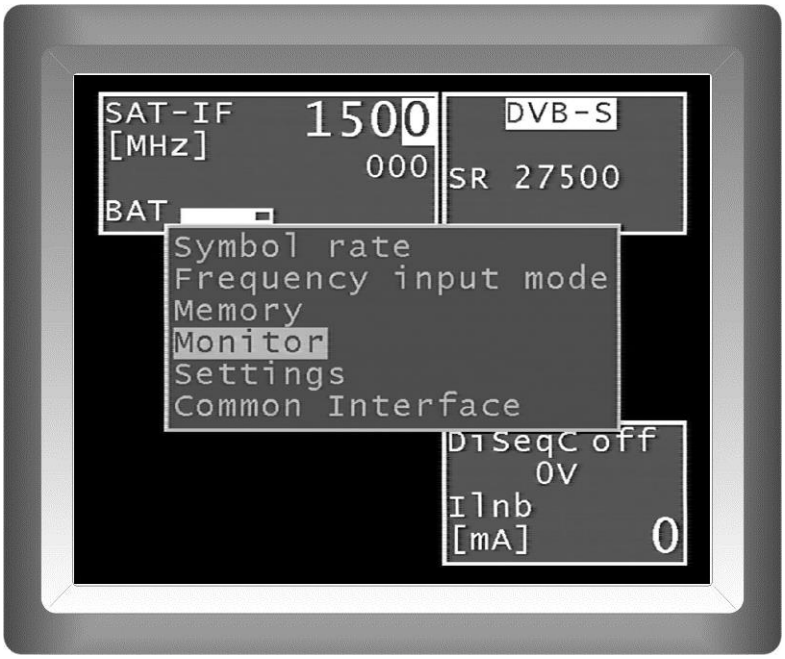
Chapter 5

Menu structure

Most functions of the instrument can be selected in a clear menu structure.

The main menu of the instrument is adjusted to the currently set operating mode respectively. This ensures that functions can only be selected where needed.

- Selecting main menu: Press **MODE** key
- Leaving the menu: Press **MODE** key
- Selecting a menu point: Use **rotary selector** to chose desired menu point, then press **ENTER** key
- Back to previous menu level: Press **ESCAPE** key



The illustration shows the menu in the DVBS range. Menus in other ranges contain correspondingly differing menu options.

Chapter 6

SAT measuring range

Press the **RANGE** button repeatedly until “SAT” is shown in the frequency window

6.1 Frequency input

The frequency is displayed in the frequency window. The smaller font indicates the part after the comma in kHz as a 3-digit value. The integral value of the frequency is entered in MHz or GHz (see below). Use the rotary selector and the **<** or **>** keys to set the desired frequency. The decimal place of the current cursor position can be changed from 0-9 by turning the rotary pulse encoder. Use the **<-** and **->** keys to move the cursor to the left and to the right. Press **ENTER** key to confirm.
The receiver is then tuned and the respective measuring values are displayed.

Press **ESCAPE**, **< >** keys or use the rotary selector to stop the measuring process; a new frequency can be set as described above.

6.1.1 IF input

Press **MODE** > **frequency input mode** > **IF** key to switch the instrument to IF input. Display in frequency window **SAT IF [MHz]**. As described above the frequency can be set between 910MHz and 2150MH.

6.1.2 RF input

Switching the instrument to RF input **MODE-> frequency input mode -> RF(GHz)**. Display in frequency window **SAT RF [GHz]**. This function serves to incorporate frequency implementation in an LNB from the transponder frequency (RF) to the first SAT IF. In RF mode, the device adds the oscillator frequency of an LNB in the frequency display.

For Cu band LNBs: IF = RF – LO (LO = LNB oscillator frequency)
The instrument calculates: RF = IF + LO.

For C band LNBs: IF = LO – RF
The instrument calculates: RF = LO – IF.

6.1.2.1 Cu band

The device incorporates 2 user defined LNB oscillator frequencies for RF inputs in the Cu band. They can be changed under **MODE -> Settings -> LNB frequencies -> Cu low band (Cu high band)** between 9,000 and 11,000 GHz. The factory presettings are 9,750 GHz (LOW band) or 10,600 GHz (HIGH band).
The device also provides three ways of using these two oscillator frequencies. **MODE** -> **Settings** -> **LO** assignment allows the user to switch between "Cu standard" (coupled to the LNB setting), “Cu LOLow” (the low band oscillator is always incorporated regardless of the LNB setting) and “Cu LOHigh” (corresponds to the high band oscillator).

6.1.2.2 C band

The device incorporates one user-defined LNB oscillator frequency for RF inputs in the C band. It can be changed under **MODE -> Settings -> LNB frequencies -> C band** between 4,000 and 6,000 GHz. 5,150 GHz is the factory presetting. To use the LNB oscillator frequency, select the “C band” menu item via **MODE -> Settings -> LO assignment**.

If the device operates using RF input, the respective LO used is shown in the frequency window using the abbreviations “CuL” (LO for Cu low band), “CuH” (LO for Cu high band) or “_C_” (LO for C band).

6.2 Selecting the operating mode

In the SAT measuring range the operating modes ANALOG (FM) and DVB-S (QPSK) are available for the instrument.

Press **ANA/DIG** key to set the desired operating mode. The parameter window displays the **ANALOG** or **DVB-S** message to indicate the current operating mode.

6.2.1 Analog mode

Frequency-modulated (FM) television signals can be received and measured here.

6.2.1.1 Setting the sound carrier

The audio signals are transmitted on sound carriers. Set the respective sound carrier frequency on the instrument for reception. Three pre-set sound carrier frequencies are available for a quick input. **MODE** > **sound carrier** allows you to select between the three pre-set frequencies. Use the rotary selector to select the desired frequency. Press **ENTER** to set the new sound carrier frequency. Press -> to change the pre-set frequency between 5.00 and 9.75MHz. The factory has set the frequencies 6.50, 7.02 and 7.20MHz.

6.2.1.2 Video polarity

The factory has set negative video modulation. Set the video polarity to inverse in order to receive television signals with positive video modulation. Press **MODE** > **Video polarity** > **inverse (normal)** for this. When **UNICABLE control** is active, the device automatically switches to **inverse** video polarity**.**

6.2.1.3 Searching

This function enables you to search the complete SAT frequency range (910-2150MHz) for analogue television signals. Start searching by first tuning the measuring receiver to a frequency (see Frequency input) from where you want to start the search function. Press **ENTER** to start the process (the **SCAN** message will appear in the frequency window). The searching ends when the instrument has found a transponder, then the measuring receiver measures on the frequency found. The user can also stop the searching by operating the rotary selector or the **ESCAPE** key.

> ***Note!***
> In the UNICABLE and JESS operating mode the scan function is deactivated.

6.2.1.4 Picture control

First tune the measuring receiver to the desired frequency (see Frequency input). Then press the **OSD/VID** key to switch to the corresponding television picture. Press the same key again to switch back to the OSD (On Screen Display) and thus to the measuring values.

6.2.2 DVBS mode

Here you can receive and measure QPSK-modulated DVBS signals.

6.2.2.1 Symbol rate input

The corresponding symbol rate must be set before a DVBS signal can be received. The device offers the operator 10 preset symbol rates for rapid input. **MODE** -> **Symbol rate** opens the selection area for the 10 preset symbol rates. Use the **rotary pulse encoder** to select the required symbol rate. The new symbol rate is set when you press **ENTER**. Press -> to change the preset symbol rate between 2000 and 45000 kBd (2,000-45,000MSym/s) MHz. The default preset symbol rates are 27500, 22000, 5632kBd, 4000kBd, 2400kBd and more. At tuning the device tries out every symbol rate of this list until it is locked. To shorten this procedure you can use only the first five of the list or all ten. You can choose between these options via the menu **Used SRs.** This setting is store in the non-volatile memory.

6.2.2.2 Searching

This function enables you to search the complete SAT frequency range (910-2150MHz) for DVBS signals whose symbol rate corresponds to the symbol rate currently set in the instrument. Start a search by first tuning the measuring receiver to a frequency (see frequency input) from which you want to start the search function. Press **ENTER** to start the process, which is displayed by the **SCAN** message in the frequency window. When the instrument has found a transponder, the search ends and the measuring receiver measures on the frequency it has found. The search can be stopped by using the rotary selector or the **ESCAPE** key.

> ***Note!***
> The search function in the operating mode of UNICABLE has been deactivated.

6.2.2.3 DVBS parameters

The parameters are displayed in the parameter window. When the measuring receiver is tuned to a frequency (see frequency input), the DVBS channel decoder tries to synchronize to the present signal; this is shown by the **SCAN** message in the parameter window.
If a DVBS signal with the set symbol rate is present, the channel decoder interlocks and the instrument responds with **LOCKED** in the parameter window. Otherwise the **UNLOCKED** message appears, which can have the following reasons. The symbol rate does not fit, the receive level is too small, the signal is interfered, or no DVBS signal is present on this frequency.

When the DVBS channel decoder has received a signal, the instrument shows the code rate of the signal in the parameter window. At the same time the bit error rate measuring and the MER measuring start.
The values measured are displayed in the BER window or MER window. In addition to that, the MPEG window appears; in this window the search for PSI information in the transport stream can be followed. This will be explained in more detail in the chapter MPEG decoder.

6.2.2.4 BER measurement (bit error rate measurement)

As mentioned in the previous paragraph the result of the BER measurement is indicated in the BER window. The measuring receiver is able to measure the bit error rate before Viterbi (CBER) and the bit error rate after Viterbi (VBER) at the same time. The VBER is shown in small font in the top line in the BER window. Below that there is the CBER in larger font.

6.2.2.5 MER measurement

The MER ratio of the signal in the baseband (after the demodulator) is indicated in the MER window indB. The measuring range is between 2.0 and 20.0dB. The resolution is 0.1dB.

6.2.2.6 Packet error measurement

Short interruptions in the DVB-S/S2 signal usually cannot be detected using MER or BER measurements. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can cause the picture to freeze temporarily or the sound to crackle. The extent of this depends largely on the receiver hardware.

In the **MODE** menu, a function can be activated which sums up all corrupt transport stream packets starting from the time of activation or when a new frequency is entered. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed in the BER window instead of the VBER or LBER. This function can be deactivated again in the above menu or by performing a restart.

6.2.3 DVBS2 mode

Here you can receive and measure QPSK/8PSK-moduled DVBS2 signals.

DVB-S2 is a further development of DVB-S. Alongside QPSK, another, higher-quality modulation scheme (8PSK) was introduced. As an option, pilots can be transmitted to help the receiver to synchronise in bad reception conditions. In addition to this, more efficient error protection (LDPC/BCH) increases the bandwidth effectiveness (bit rate/bandwidth for the same MER).

6.2.3.1 Symbol rate input

The corresponding symbol rate must be set before a DVBS2 signal can be received. The device offers the operator 10 preset symbol rates for rapid input. **MODE** -> **Symbol rate** opens the selection area for the 10 preset symbol rates. Use the **rotary pulse encoder** to select the required symbol rate. The new symbol rate is set when you press **ENTER**. Press -> to change the preset symbol rate between 2000 and 45000 kBd (2,000-45,000MSym/s) MHz. The default preset symbol rates are 27500, 22000, 5632kBd, 4000kBd and 2400kBd. At tuning the device tries out every symbol rate of this list until it is locked. To shorten this procedure you can use only the first five of the list or all ten. You can choose between these options via the menu **Used SRs.** This setting is store in the non-volatile memory.

6.2.3.2 Searching

This function enables you to search the complete SAT frequency range (910-2150MHz) for DVBS signals whose symbol rate corresponds to the symbol rate currently set in the instrument. Start a search by first tuning the measuring receiver to a frequency (see frequency input) from which you want to start the search function. Press **ENTER** to start the process, which is displayed by the **SCAN** message in the frequency window.
When the instrument has found a transponder, the search ends and the measuring receiver measures on the frequency it has found. The search can be stopped by using the rotary selector or the **ESCAPE** key.

During the search, the instrument also detects DVBS and DVBS2 signals and adjusts the measuring receiver to the relevant operating mode.

Note!
In the UNICABLE and JESS operating mode the scan function is deactivated.

6.2.3.3 DVBS2 parameters

The parameters are displayed in the parameter window. When the measuring receiver is tuned to a frequency (see frequency input), the DVBS2 channel decoder tries to synchronize to the present signal; this is shown by the **SCAN** message in the parameter window.
The receiver first attempts to synchronise to the DVBS2 signal that is present using the set symbol rate. If this is not successful, all of the preset symbol rates are set one after another. In addition, the instrument also automatically detects the DVB-S/DVB-S2 operating modes.
If a QPSK/8PSK signal that has the set symbol rate is present, the channel decoder locks and **LOCKED** is displayed in the instrument's parameter window. Otherwise, the **UNLOCKED** message is shown This may be caused by the following: none of the set symbol rates fit, the receive level is too low, there is too much noise in the signal, or there is no DVBS2 signal at this frequency. When the DVBS2 channel decoder receives a signal, the instrument shows the code rate and the modulation scheme of the signal in the parameter window. At the same time, measurement of the bit error rate and the MER is triggered. The measured values are shown in the BER window and the MER window respectively. The MPEG window is also displayed; you can follow the search for PSI (program service information) in the transport stream here. Further information about this is found in the MPEG decoder section.

6.2.3.4 BER measurement (bit error rate measurement)

As mentioned in the previous paragraph the result of the BER measurement is indicated in the BER window. The measuring receiver is able to measure the bit error rate before LDPC (CBER) and after (LBER) at the same time. The PER is shown in small font in the top line in the BER window. Below that there is the CBER in larger font.

Note:
The internal error protection is called LDPC (Low Density Parity Check) in the DVBS2 standard, and the external error protection is called BCH (Bose Chaudhuri Hocquenghem). In particular, the performance of the LDPC error protection is significantly better than that of the DVBS (Viterbi) internal error protection.

6.2.3.5 MER measurement

The MER ratio of the signal in the baseband (after the demodulator) is indicated in the MER window in dB. The measuring range is 20.0dB. The resolution is 0.1dB.

6.3 Level measurement

As soon as the instrument is set to a frequency (see frequency input), the level measurement starts and the value measured is indicated in dBµV in the level window.
The measuring range is between 30 and 110dBµV with a resolution of 0.5dB. The measuring bandwidth is automatically adjusted to the measured channel bandwidth accordingly. The measuring rate for the numeric level value is about 3Hz.

6.3.1 MAX Hold function

A yellow level trend bar graph is displayed in the level window as well as the numeric level value. The length of this level trend bar graph changes in proportion to the level value. The maximum modulation of the level trend bar graph since the last tuning process is continually indicated by a red vertical line. The repetition rate of the level bar graph is 10Hz. This function helps to adjust a satellite dish.

6.3.2 Acoustic level trend indicator

Another auxiliary for adjusting a satellite dish is the acoustic level trend signal. A signal tone, whose frequency changes in proportion to the measured level value, is set for the loudspeaker. The higher the level value, the higher the frequency of the signal tone.
Press **MODE** > **level acoustic** > **on (off)** to turn the function on or off at any time.

6.4 LNB supply

The measuring receiver controls a connected LNB or a multi-switch via the conventional 14/18V-22kHz control (max. 4 SAT-IF ranges) or via DiSEqC control.
This supply is short circuit-proof and provides a maximum 500 mA current. The instrument switches off the LNB supply if a short-circuit is found or the current is too high. If an external LNB supply which is higher than that which is set is present, the supply will also be switched off.
The red LED on the RF input lights up as soon as the LNB supply is activated.

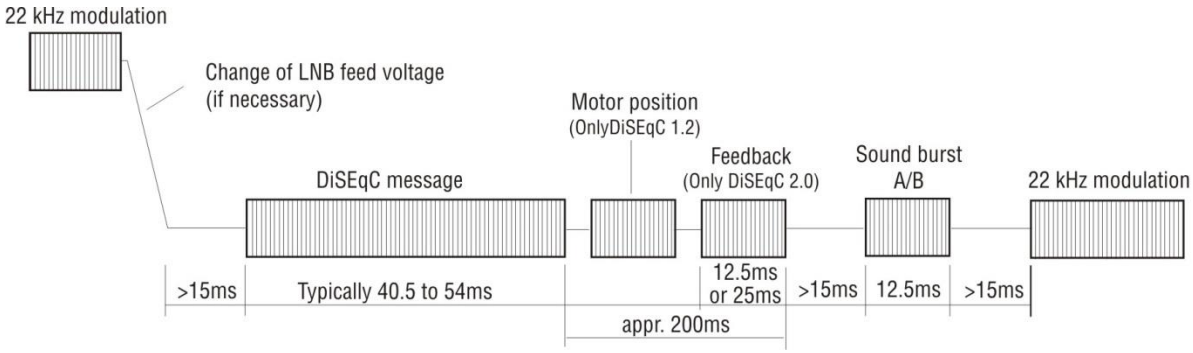
6.4.1 14/18V – 22kHz control

The 14/18V – 22kHz control (or DiSEqC off) is activated by: **LNB > DiSEqC > off**. The LNB supply is then set on 0V. Use **LNB** > **range** > **14V, 18V, 14V/22kHz, 18V/22kHz** to set the desired SAT-IF range.

6.4.2 DiSEqC

DiSEqC defines a standard which transfers the control commands from the master (e.g. receiver) to the slave (e.g. multiswitch, positioner) via FSK (frequency search for 22kHz) 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.

6.4.2.1 DiSEqC V1.0 control

When **LNB -> DiSEqC -> V1.0** is set, the device runs on the DiSEqC Standard V1.0. This allows up to 5 satellite positions with up to 4 SAT IF levels each to be controlled.

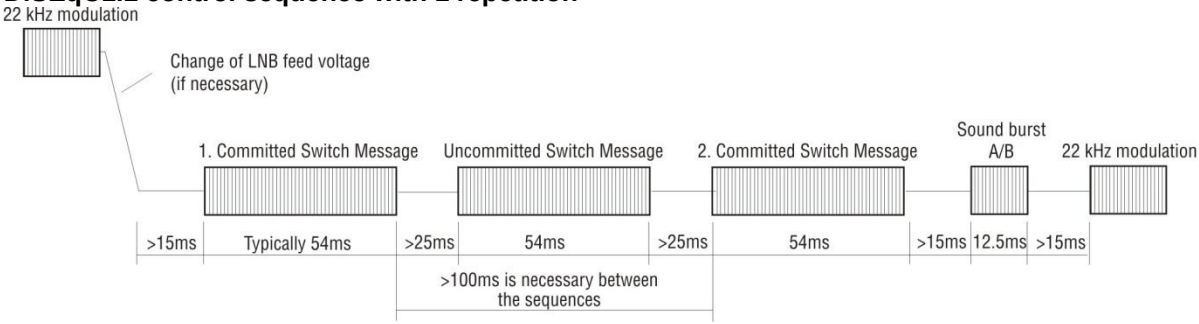
A SAT IF level is set using **LNB > SAT IF level > V/Lo, H/Lo, V/Hi, H/Hi**.
A satellite position can be set using **LNB > Satellite > P1 – P4**. P1 can be used for ASTRA and P2 for EUTELSAT, for example.

6.4.2.2 DiSEqC V1.1 control

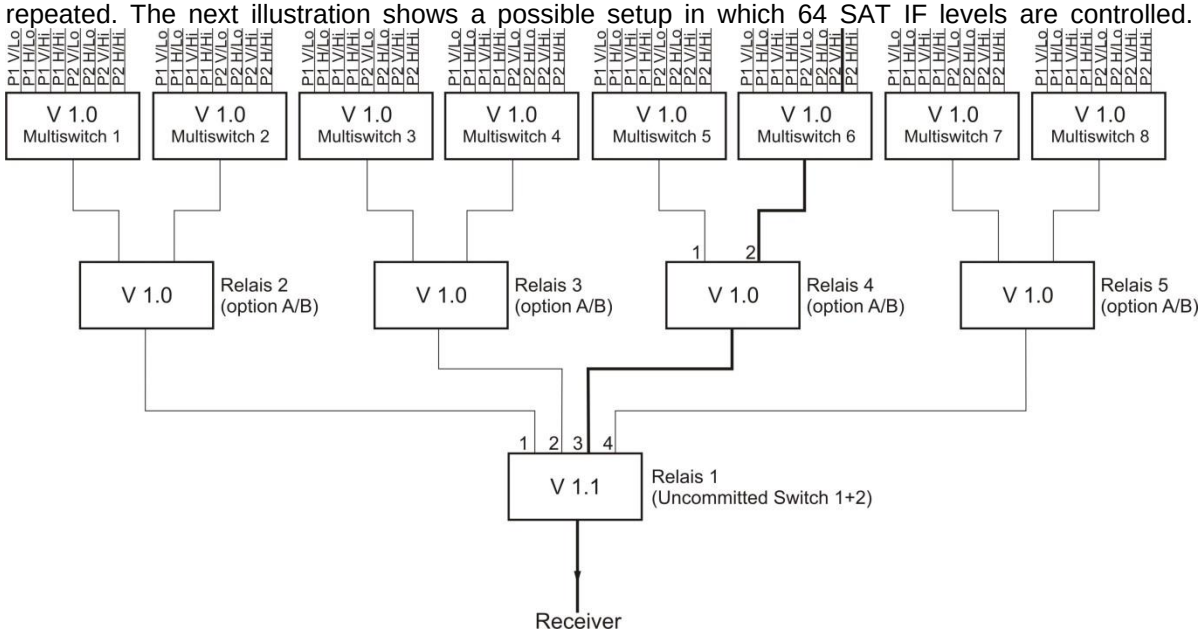
LNB -> DiSEqC -> V1.1 activates the DiSEqC V1.1 menu. V1.1 allows a total of up to 256 SAT IF levels to be controlled. V1.1 also incorporates DiSEqC component cascading. I.e. corresponding multiswitches or switching relays can be connected in series. This requires multiple repetition of the DiSEqC command(s). See the following chapter for further information.

The settings for the SAT IF level 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 -> Uncommitted switch**. 'Uncommitted switches' allow the 16 SAT IF levels possible with V1.0 to be split in another 16 branches thanks to the cascading option, using 4 additional switches (uncommitted switches). This allows a total of up to 256 SAT IF levels to be controlled.
The 'uncommitted switches' are controlled in binary format here. The rotary pulse encoder allows one of the 16 possible combinations of the 4 'uncommitted switches' to be selected using a hexadecimal number ('0' hex - 'F' hex). Press **ENTER** to accept the setting.
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, which slows the control. **LNB -> Repetitions** allows you to select between 0, 1, (default), 2 and 3 repetitions. Press **ENTER** to accept the setting.

DiSEqC1.1 control sequence with 1 repetition



As mentioned above, DiSEqC1.1 is cascade-capable. Therefore, 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 illustration shows a possible setup in which 64 SAT IF levels are controlled.



The structure incorporates 3 hierarchy levels, therefore 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, which corresponds to ‘2 hex’ in hexadecimals.

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.
Multiswitch 6 switches 8 SAT-IF levels. The selected path can be reached with P2V/Hi. However, as relay 4 requires the option bit to be set, the ‘committed switches’ setting must be P4V/Hi.
Therefore, settings must be made in all 4 DiSEqC1.1 submenus for the marked SAT-IF route:

- Set SAT-IF level to V/Hi
- Set satellite position to P4
- Set ‘uncommitted switches’ to ‘2 hex’
- Set repetitions to 2

Afterwards, the display should show ‘P42V/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.

6.4.2.3 DiSEqC V1.2 control

LNB -> DiSEqC -> V1.2 activates the DiSEqC V1.2 menu. V1.2 can be used to control positioners with DiSEqC rotors. The menu includes selection of the 4LNB levels (identical to that for V1.0) and control of a DiSEqC positioner.
The display of the position after ‘P’ in the LNB window does not refer to the position of the position bit as in DiSEqC1.0, but corresponds with the position number most recently called from the position memory of the DiSEqC rotor. If you switch to DiSEqC1.2, position number 1 of the DiSEqC rotor is automatically accessed.
Open the corresponding menu using **LNB > Motor**.

Positioning:
This allows the positioner to be moved to the east and west.
The cursor is at STOP when the menu is opened. You can move the cursor to the “East” or “West" menu item using the arrow keys. The motor then moves immediately to the east or west. You do not have to press the **ENTER** key first. The positioner stops immediately when the Stop menu item is set.
East limit:
This enables an eastern limit to be set for the positioner which it cannot pass. To do so, proceed as follows: First use the “Turn” function to move the positioner to the position to be set as the eastern limit. Then, open the “East limit” function. The limit is saved in the positioner when you press **ENTER** to confirm.
West limit:
This enables an western limit to be set for the positioner which it cannot pass. To do so, proceed as follows: First use the “Turn” function to move the positioner to the position to be set as the western limit. Then, open the “West limit” function. The limit is saved in the positioner when you press **ENTER** to confirm.
Limits off:
This function allows you to cancel the eastern and western limits of the positioner. The motor can then travel to its mechanical limits again.
Saving:
This function allows you to save a position reached using the “Turn” function in one of the position memory spaces 0-99.
Position 0 is reserved for reference position 0 degrees. When called up, as special function (e.g. Enable limits) is performed for some motors.
Recall:
The “Recall” function allows you to open positioner positions previously stored using the “Save” function. The motor then turns to the saved position. Position 0 corresponds to reference position 0 degrees. The last position accessed is displayed in the LNB window after ‘P’, e.g. ‘P03’. This position is incorporated in the tuning memory. It allows various orbital positions to be recalled from the tuning memory. There is no need to open this indirectly via the **Motor -> Recall** menu.

6.4.2.4 DiSEqC V2.0 control

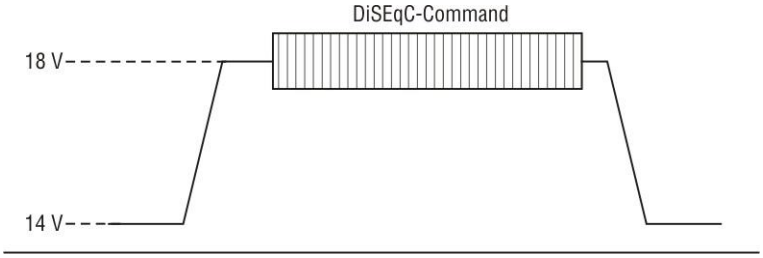
LNB > **DiSEqC** > **V2.0** activates the DiSEqC V2.0 control. The difference to V1.0 is the additional feedback query of a controlled DiSEqC component. When the device controls a multiswitch with DiSEqC V2.0, it sends an answer back to the device.

The instrument evaluates this feedback and reports “DiSEqC answer OK” if successful, or “DiSEqC answer incorrect” if there is an error.

6.4.3 UNICABLE

The UNICABLE version (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 co-ordinating transponders and UB slots is transmitted via the special DiSEqC command to the UNICABLE unit. 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, horizontal and vertical polarisation, low or high band, and the transponder frequency to be set.



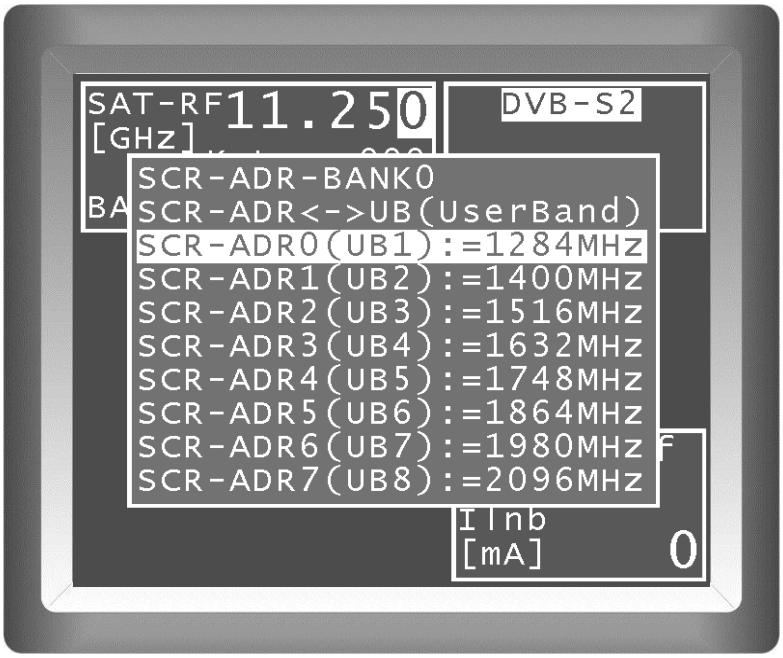
The following control routine is used in this device:

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.

6.4.3.1 Activation and Configuration

The UNICABLE control is activated via **LNB** -> **DiSEqC** -> **UNIC**.
The first menu that appears allows users to choose between setting the SCR-ADR-BANK and setting the SCR-ADR (satellite channel router address).
In the SCR-ADR menu, users can select the user band (UB) bandpass slot for the measuring receiver to use and edit the corresponding centre frequency. These parameters can be obtained from the data sheet of the UNICABLE unit being used.

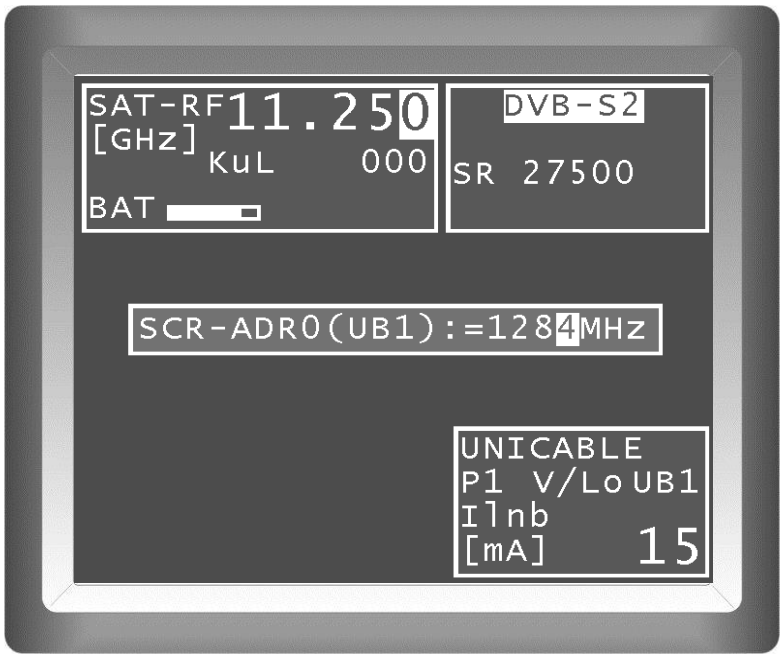


This figure shows the default settings with the following relationships:

SCR-ADR0:= 1284MHz	SCR-ADR1:= 1400MHz
SCR-ADR2:= 1516MHz	SCR-ADR3:= 1632MHz
SCR-ADR4:= 1748MHz	SCR-ADR5:= 1864MHz
SCR-ADR6:= 1980MHz	SCR-ADR7:= 2096MHz

Note:
Manufacturers have different methods for numbering the UBs. They are numbered either from 0 to 7 or from 1 to 8. The physical address always goes from 0 to 7. For example, the lowest slot, which could also be marked as UB0 on the converter unit, can be activated by selecting SCR-ADR0 (UB1).

To change the settings displayed here, proceed as follows:
Use the rotary pulse encoder to select the required SCR address. Then press the **->** key to access the following menu:



The UB centre frequency corresponding to the selected SCR address can be set here. This is the frequency that a connected receiver needs to tune to. You can use the rotary pulse encoder and the **<-** and **->** buttons to set the UB centre frequencies to between 950MHz and 2150MHz.

Press **ENTER** to save your entry and return to the menu with the SCR addresses. Press the **ENTER** button again to complete configuration of the UNICABLE control in the measuring receiver.
All entries are stored in non-volatile memory, and the device will operate using these settings when it is next switched on.

-SCR-ADR-Bank
Some UNICABLE units operate with eight receivers per cable and others with four receivers. Such units generally operate with differing UB centre frequencies.
To simplify the procedure for the user, the instrument offers a feature that enables switching between four SCR-ADR banks. That means that the device has three banks of SCR addresses for UNICABLE units that operate with 8 receivers and a different bank of SCR addresses for UNICABLE units that operate with 4 receivers. The UB centre frequencies can also be changed within the banks as described above. That means that the next time the device is switched on, it will operate again with these SCR-ADR <-> UB centre frequency settings. In addition, the bank setting is stored in the tuning memory. This makes it possible for you to combine memory locations with Bank 0 and Bank 1 as desired.

- Entering a name for the bank
You can select a bank in the SCR-ADR-Bank menu. Press the -> key to open a menu where you can assign a name to the bank, for example the name of the manufacturer of the UNICABLE components.

Using the **<-** or **->** arrow keys, you can move the cursor to the desired position in the label.
You can edit the label with alphanumeric characters using the arrows or the number keys. The name can be up to 20 spaces in length.

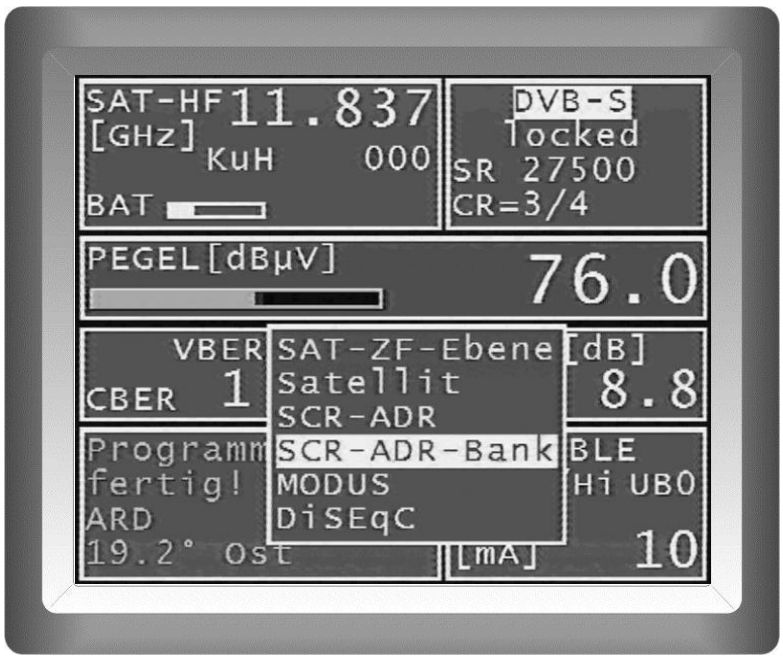
- Confirming and saving the entry
Pressing the **ENTER** key closes the input menu and stores the values in the non-volatile memory.

-WIDEBAND RF mode
Some UNICABLE units (LNB) work on a single oscillator frequency only. That means that the low band and the high band are combined into a single band. This special mode can be set in the measuring device via **LNB** -> **MODE** -> **WIDEBAND RF**. The UNICABLE control is switched back into standard mode with 2 oscillator frequencies via **LNB** -> **MODE** -> **STANDARD RF**. This is also the instrument's default setting. This setting is non-volatile, and 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) work on a single oscillator frequency only. 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-Frequency**. The setting is also non-volatile. This position is also incorporated in the tuning memory. The default setting is 10,200 GHz.

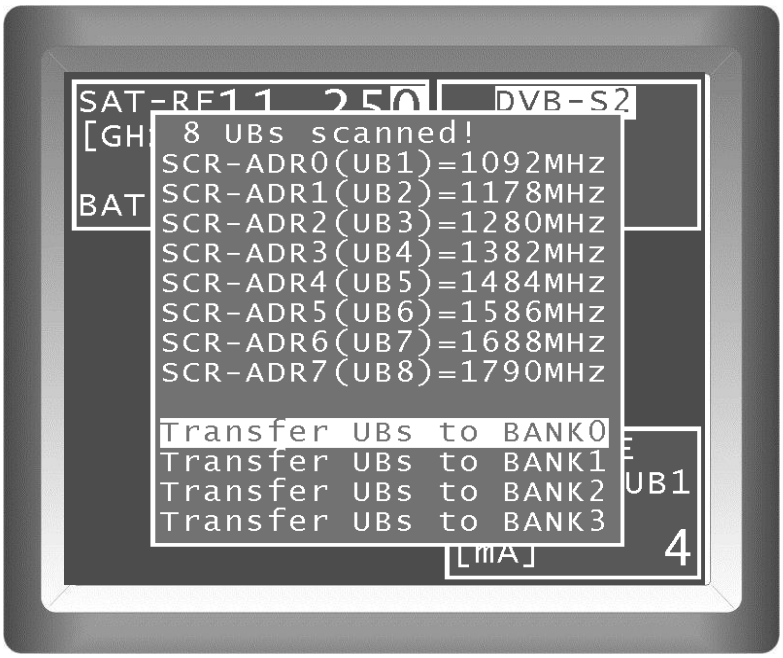
6.4.3.2 Operation

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 via the SCR address.
These UNICABLE control parameters are set via **LNB** -> **SAT-IF-Layer** -> **Satellite** and -> **SCR-ADR.**
The measuring receiver is tuned as described in the "Frequency input" chapter.
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 as a UNICABLE command and then tune itself to the correct UB slot centre frequency.
Whenever there is a new tuning process, the entire UNICABLE control command is sent to the UNICABLE unit. Because UNICABLE enables the use of up to 8 receivers connected to one cable, collisions may occur between the connected receivers during control. If this situation arises when using the measuring receiver, send the control command again by pressing the **ESC** and **ENTER** key combination.
The following figure shows the instrument in UNICABLE mode with the LNB menu open.



-WIDEBAND RF mode
As described above, these UNICABLE units work on a single oscillator frequency only. That means that the low band and the high band are combined into a single band. This reduces the number of SAT-IF layers to 2 (vertical and horizontal). If the instrument is in this mode, the vertical (V) or horizontal (H) polarisation can be set via **LNB** -> **SAT-IF-Layer**. This also switches the measuring receiver to RF frequency input mode. A transponder frequency of between 10,700 GHz and 12,750 GHz can be entered.

- SCR-ADR ermitteln
Dieses Menü wird nur eingeblendet wenn das Gerät nicht abgestimmt ist (Grundzustand). Beim Aufruf dieses Menüs wird die Anzahl der verfügbaren UB-Scheiben (SCR-ADR) des angeschlossenen Umsetzers und deren Mittenfrequenzen gesucht und angezeigt. Dies kann einige Sekunden dauern.



Selecting one of the **Transfer UBs to BANKx!** menu items saves the displayed frequencies in the non-volatile memory of the bank selected and overwrites the existing frequencies.

Note!
Switched-in antenna wall outlets or poor signal conditions could impede the SCR-ADR scan.
The search function in the operating mode of UNICABLE and JESS has been deactivated.

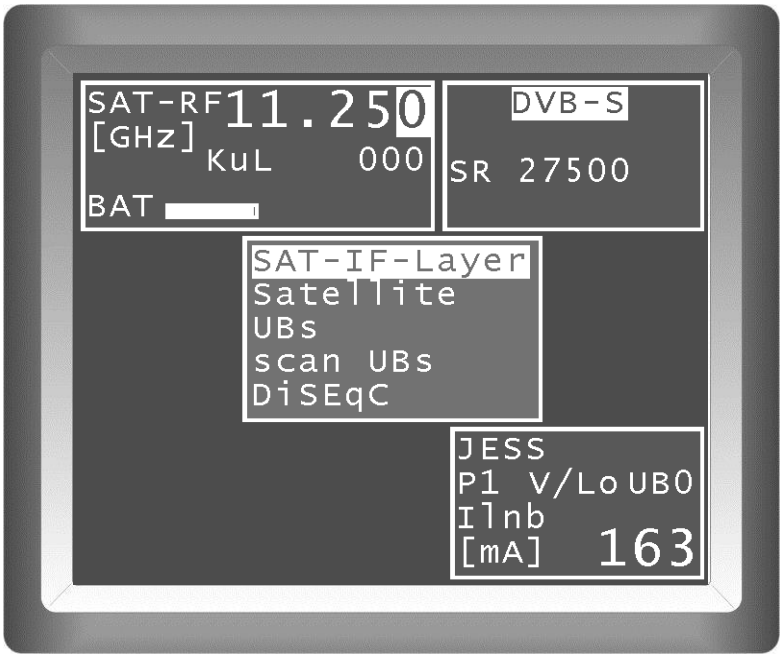
6.4.4 JESS (optional)

JESS (Jultec Enhanced Stacking System) is an expansion on UNICABLE Standard with a larger range of functions. Among other functions, it supports 16 UB slots and allows the frequency of the individual slots to be read directly from the converter unit. The transmission of the commands occurs exactly as described above for UNICABLE and in accordance with the DIN EN 50494 standard.

6.4.4.1 Activation and Configuration

The JESS control is activated by selecting **LNB** -> **DiSEqC** -> **JESS**.
Afterwards, a menu appears, allowing users to select the user band (UB) bandpass slot for the measuring receiver to use and edit the corresponding centre frequency. These parameters can be obtained from the data sheet of the converter unit being used. 16 UB slots are available in one bank. Individual UB frequencies can be edited as described above for UNICABLE.

The following figure shows the instrument in JESS mode with the LNB menu open.

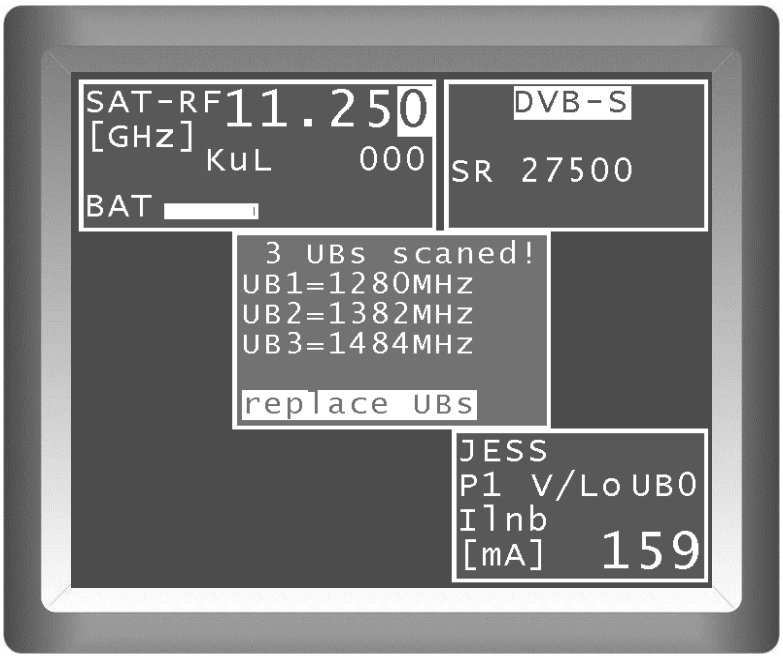


6.4.4.2 Operation

The JESS control can be used to convert 16 SAT-IF layers in a maximum of 16 UB slots. These are further divided into 4 satellite positions with 4 SAT-IF layers each. Each connected receiver (maximum of 16) operates using a dedicated UB slot. This is defined via the UB number.
These JESS control parameters are set via **LNB** -> **SAT-IF-Layer** -> **Satellite** and -> **UBs**.

The measuring receiver is tuned as described in the “Frequency input” chapter.
The difference when using the JESS control is that the desired transponder frequency is converted to the centre frequency of a UB slot in the converter unit.
That means that the measuring receiver must send the transponder frequency to the converter unit as a JESS command and then tune itself to the correct UB slot centre frequency.
Whenever there is a new tuning process, the entire JESS control command is sent to the converter unit again.
Because JESS enables the use of up to 16 receivers connected to one cable, clashes may occur between the connected receivers during control.
If this situation arises when using the measuring receiver, send the control command again by pressing the **ESC** and **ENTER** key combination.

- Scan UBs
When this menu is opened, the number of available UB slots on the connected converter is determined, and they are displayed along with their centre frequencies.

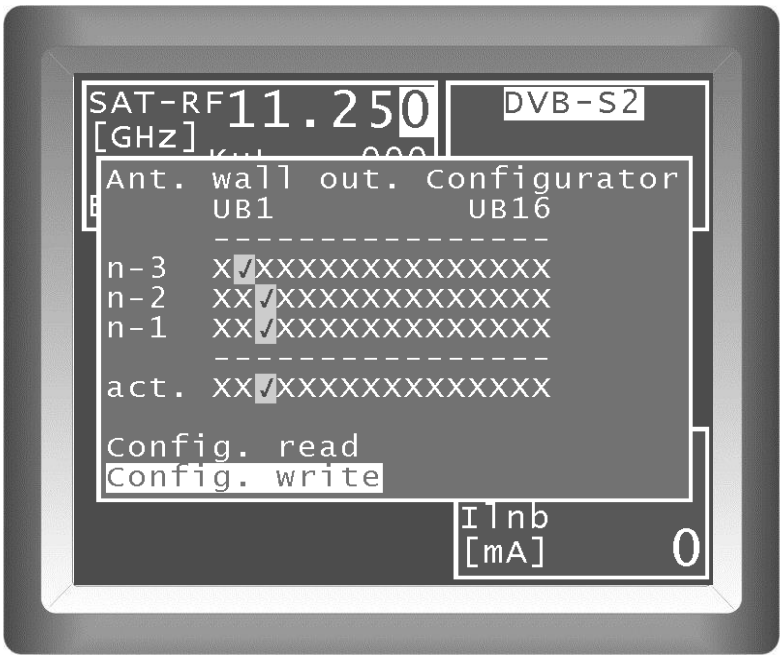


Selecting the **replace UBs** menu item saves these frequencies in non-volatile memory and overwrites the existing frequencies.

Note:
Switched-in antenna wall outlets or poor signal conditions could impede the SCR-ADR scan.
In the JESS operating mode the scan function is deactivated.

6.4.5 *Programming antenna wall outlets*

For single-cable systems, there is a possibility that participants sharing a cable will cause each other interference by using the same UB slots. To prevent this, programmable antenna wall outlets are available which accept only UNICABLE or JESS commands for the programmed UB slots (e.g., the SSD6 series of wall outlets from Axing or the JAP series from Jultec, etc.).
Selecting **LNB** -> **DiSEqC** -> **Prog. ADo.** opens a “Configurator” which can be used to analyse and program an antenna wall outlet connected to the measuring instrument. The figure below shows the measuring instrument in the antenna wall outlet configuration mode.



An X represents a locked user band (UB) bandpass slot and a green check mark indicates an unlocked UB slot. The current configuration is displayed in the “act.” line. This configuration can be determined by selecting “**Config. read**” or edited by selecting “**Config. write**”. The “n-1” line displays the last successfully programmed configuration, “n-2” displays the configuration previous to this, etc.
To change the current configuration, proceed as follows:
Select the “**Config. write**” menu using the **up** and **down** keys. Then press the **->** key to access the following menu.

The desired configuration can be set using the up and down keys as well as the **<-** and **->** keys. Pressing **ENTER** programs this configuration and returns you to the original menu.
If the programming was successful, this configuration is shown in the lines “n-1” and “akt.”, the previous contents of line “n-1” is now in line “n-2”, etc. If the programming was not successful, the message “**DiSEqC answer incorrect**” appears briefly and the lines n-1 to n-3 remain unchanged (the configuration is transmitted using DiSEqC commands).

Note:
The search function in the operating mode of JESS has been deactivated.

6.4.6 LNB current measurement

The measuring receiver measures the power of the direct current that comes from the RF input (e.g. for a LNB supply) and indicates it in mA in the LNB window. The measuring range is between 0 and 500mA, the resolution is 1mA.

Chapter 7

TV measuring range

Press the **RANGE** button repeatedly until “TV” is shown in the frequency window.

7.1 Choosing channel or frequency input

The instrument can be tuned by entering the channel centre frequency (DVBC and DVBT), the video carrier frequency (ATV) or by entering the channel. You can switch between the modes by using **MODE > Frequency input mode.**

7.1.1 Frequency input

Frequencies are displayed in the frequency window. Use the rotary pulse encoder and the **<-** or **->** buttons to set the required frequency (in MHz). The decimal place of the current cursor position can be changed from 0-9 by turning the rotary pulse encoder. The left-right position of the cursor can be moved by using the **<-** and **->** buttons. Confirm the entry using the **ENTER** button.
After that, the receiver is tuned and the actual measured values are displayed. Use the **ESCAPE, <-** or **-> buttons** or the rotary pulse encoder to end the measurement procedure. A new frequency can be set as described above

7.1.2 Channel input

In the channel input mode, use the rotary selector to enter the desired channel.
Switch between the S (special channels) and the E channels by using **<-** or **->.**
Use the **ENTER** button to complete the entry. The channel table appendix contains a list of channels and their corresponding channel centre frequency (DVBC and DVBT) or video carrier frequency (ATV).

7.1.3 Frequency offset

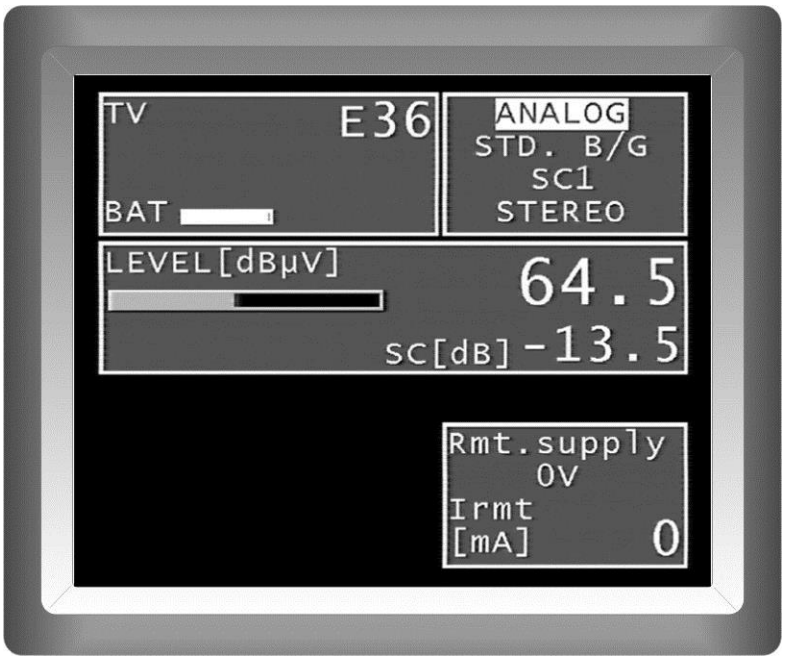
The function is only available in the channel input mode for DVBT.
This function can be used to add a systematic frequency offset (offset) to the stored channel table. The factory setting of the frequency offset is 0kHz. Using **MODE-**>**Frequency offset** allows you to select the following offsets: 0kHz, +500kHz, +333kHz, +167kHz, -167kHz, -333kHz and -500kHz. The frequency offset is shown in smaller font directly under the channel number (e.g. +167kHz). This frequency offset performs as if the frequency offset was added to all of the centre frequencies of the channel table.

Example:

The instrument functions with a frequency offset of 167kHz. If the channel is set to E22 (482.000MHz), the receiver actually tunes to 482.167MHz.

7.2 Selecting the operating mode

In the TV measuring range the operating modes ANALOG TV (ATV) and DVBC and DVBT and DVBT2 (option) are available for the instrument.
Press **ANA/DIG** key to set the desired operating mode. The parameter window shows the operating mode that is set.



7.2.1 Analog mode (ATV)

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 and NTSC colour standards. It switches between colour standards automatically.

7.2.1.1 Choosing the TV standard

The **MODE > TV-Norm** button can be used to set one of the TV standards mentioned above.
A corresponding message is then shown in the parameter window.
The channel table is also changed when the instrument is switched to another TV standard. Further information about this is found in the Channel table appendix.

7.2.1.2 Sound carrier

Audio signals are transmitted on modulated sound carriers. Each TV standard has a differing difference in frequency between the two sound carriers and the video carrier.
The sound information can transmit mono, stereo or “dual sound” (bilingual).
The instrument can demodulate both sound carriers. The type of source signal transmission (mono, stereo, dual sound) is displayed in the parameter window. The instrument has only one channel for sound reproduction (loudspeaker, SCART). The sound carrier (sound carrier 1, sound carrier 2) that is to be listened to and whose level is to be measured is selected using **MODE > Sound carrier**.

7.2.1.3 Searching

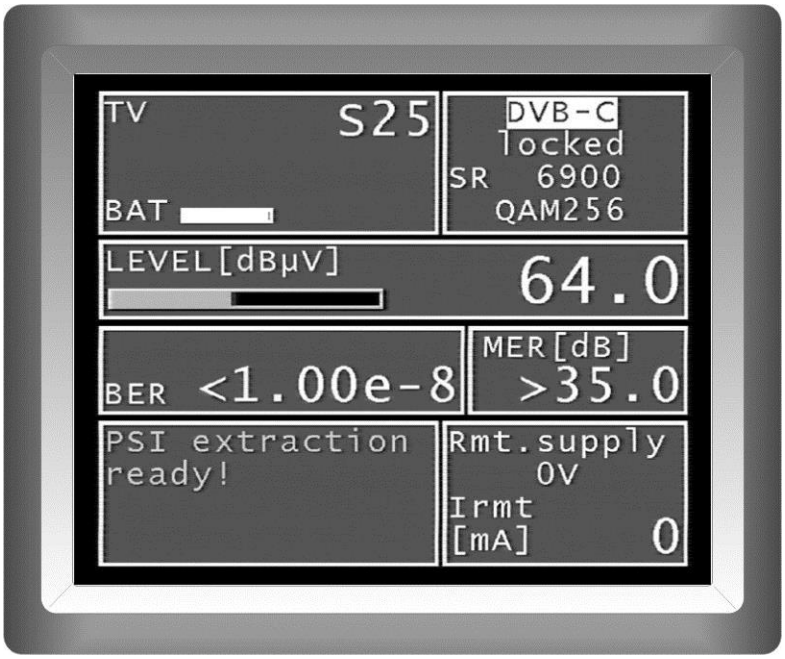
This function enables you to search the complete TV range for analog television signals. However, the instrument must only be operated in the channel input mode to do this.
The search is then started by tuning the measuring receiver to a frequency (channel) at which the search should begin (see Frequency/Channel input). Begin the procedure with **ENTER**. **SCAN** is displayed in the frequency window while the search takes place. When the instrument detects an ATV signal, the search is stopped and the receiver measures this frequency.
The user can also stop the searching by operating the rotary selector or the **ESCAPE** key.

7.2.1.4 Picture control

First tune the measuring receiver to the desired frequency/channel. Then press the **OSD/VID** key to switch to the corresponding television picture. Then press the **OSD/VID** key to switch to the corresponding television picture. Press the same key again to switch back to the OSD (On Screen Display) and thus to the measuring values.

7.2.2 DVBC mode

Here you can receive and measure digital cable signals. The instrument supports the 16QAM, 32QAM, 64QAM, 128QAM and 256QAM modulation schemes.



7.2.2.1 Selecting the modulation scheme

MODE > Modulation is used to select one of the modulation schemes. A corresponding message is then shown in the parameter window.

7.2.2.2 Symbol rate input

The corresponding symbol rate must be set before a DVBC (QAM) signal can be received. The device offers the operator 3 preset symbol rates for rapid input. **MODE** -> **Symbol rate** opens the selection area for the preset symbol rates. Mit dem Drehimpulsgeber wird die gewünschte Symbolrate angewählt. The new symbol rate is set when you press **ENTER**. Press **->** to change the preset symbol rate between 2000 and 7200kBd (2 - 7.2Msym/s). The default preset symbol rates are 6900, 6875 und 6111kBd.

7.2.2.3 Searching

This function is used to search the entire TV range for DVBC signals. The instrument must be set to channel input to do this. Within the search function, the current DVBC parameter and then the preset symbol rates, with the QAM64 and QAM256 modulation schemes, are then set for each channel in alternation.
The search is then started by tuning the measuring receiver to a channel at which the search should begin. Begin the procedure with **ENTER**. “SCAN” is displayed in the frequency window while the search takes place. When the instrument detects a DVBC signal, the search is stopped and the instrument measures the frequency that was detected. You can stoped the search using the rotary pulse encoder or the **ESCAPE** button.

7.2.2.4 DVBC parameters

The parameters (modulation scheme, symbol rate) are shown in the parameter window. If the receiver is tuned to a frequency/channel, the DVBC channel decoder attempts to synchronise with the signal that is present; this can be followed through the SCAN message in the parameter window.
The instrument then attempts to synchronise to the DVBC signal that is present using the DVBC parameters that are set. If this is not successful, all of the preset symbol rates are tuned one after another using the QAM64, QAM256 and QAM128 modulation schemes.
If the parameters match, the channel decoder locks and LOCKED is displayed in the parameter window. If this is not successful, UNLOCKED appears.

That may be caused by the following: the symbol rate and/or the modulation scheme do not correspond, the receive level is too low, there is too much noise in the signal or there is no DVBC signal at this frequency. When the DVBC channel decoder receives a signal, it begins to measure the MER (modulation error rate) and the BER (bit error rate). The measured values are shown in the BER window or the MER window. The MPEG window also is displayed; you can follow the search for PSI (program service information) in the transport stream here. Further information about this is found in the MPEG decoder section.

7.2.2.5 BER measurement

As mentioned above, the result of the BER measurement is shown in the BER window. The bit error rate is measured here by the Reed Solomon decoder.

7.2.2.6 MER measurement

The MER is a measurement of the deviation of the individual constellation points of a signal from their ideal values. The channel decoder measures this. The measuring range extends to 35.0dB; the resolution is 0.1dB. The measured value is displayed in the MER window.

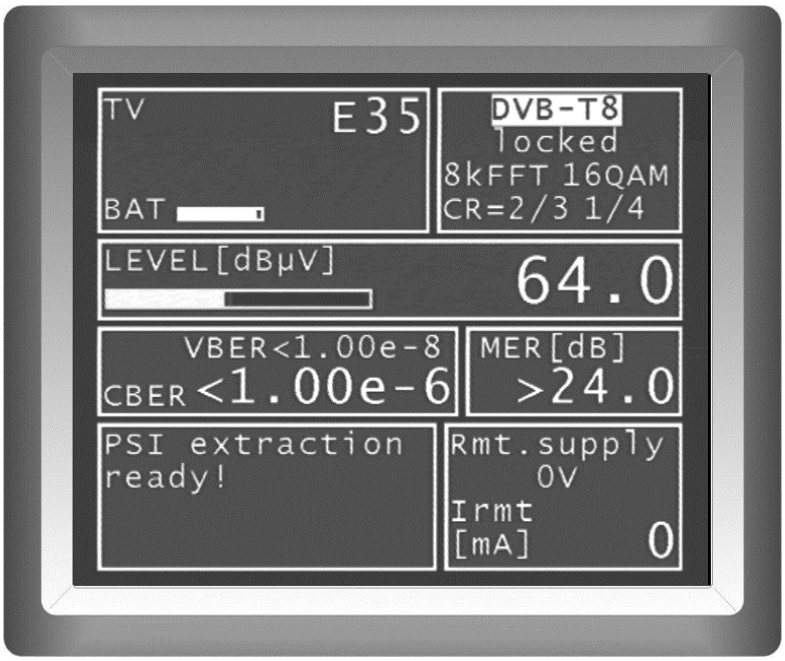
7.2.2.7 Packet error measurement

Short interruptions in the DVB-C signal usually cannot be detected using MER or BER measurements; however they can make entire packets in the transport stream unusable. This can cause the picture to freeze temporarily or the sound to crackle. The extent of this depends largely on the receiver hardware.

In the **MODE** menu, a function can be activated which sums up all corrupt transport stream packets starting from the time of activation or when a new frequency is entered. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed in the BER window. This function can be deactivated again in the above menu or by performing a restart.

7.2.3 DVBT mode

Digital TV signals that are terrestrially broadcast in the DVBT standard are received and measured here. The instrument supports the 8kFFT and 2kFFT formats.



7.2.3.1 Selecting the COFDM bandwidth

The DVBT standard is designed for a transmission in 7 or 8MHz channels. The user can set the COFDM demodulator to both transmission formats with **MODE ->** COFDM bandwidth. This setting is stored in the tuning memory, which means 7 and 8MHz channels can be saved one after the other.
During the tuning process the instrument automatically sets the channel bandwidth according to the list of channels. It can then be changed manually as described above, though. The display in the parameter window shows the bandwidth that is set (e.g. DVBT(8)).

7.2.3.2 Searching

This function enables you to search the complete TV range for DVB-T signals. The instrument must be operated in the channel input mode to do this.
The search is then started by tuning the measuring receiver to a channel at which the search should begin. Begin the procedure with **ENTER**. “SCAN” is displayed in the frequency window while the search takes place. When the instrument detects a DVBT signal, the search is stopped and the instrument measures the frequency that was detected. You can stop the search using the rotary pulse encoder or the **ESCAPE** button.

7.2.3.3 DVBT parameters

The parameters are displayed in the parameter window. If the measuring receiver is tuned to a frequency (see frequency input), the DVBT channel decoder attempts to synchronise with the signal that is present; this can be followed through the SCAN message in the parameter window. If a DVBT signal that has the bandwidth that is set is present, the channel decoder locks and LOCKED is displayed in the parameter window. Otherwise, the UNLOCKED message is shown This may be caused by the following: the bandwidth that is set does not fit, the receive level is too low, there is too much noise in the signal, or there is no DVBT signal at this frequency. As soon as the DVBT channel decoder receives a signal, the instrument shows the modulation parameter in the parameter window. These are:

FFT: The standard is designed for a transmission with 1705 single carriers (2k FFT) and 6817 single carriers (8k FFT).

Modulation: According to standard, the single carriers in COFDM can be modulated with 3 different modulation schemes: QPSK, 16QAM and 64QAM.

Coderate (FEC): The code rate indicates the relation of effective data rate to transmission data rate.

At the same time the bit error rate measuring and the MER measuring start. The values measured are displayed in the BER window or MER window. In addition to that, the MPEG window appears; in this window the search for PSI information in the transport stream can be followed. This will be explained in more detail in the chapter MPEG decoder.

7.2.3.4 BER measurement

As mentioned in the previous paragraph the result of the BER measurement is indicated in the BER window. The measuring receiver is able to measure the bit error rate before Viterbi (CBER) and the bit error rate after Viterbi (VBER) at the same time. The VBER is shown in small font in the top line in the BER window. Below that there is the CBER in larger font.

7.2.3.5 MER measurement

The MER ratio of the signal in the baseband (after the demodulator) is indicated in the MER window in dB. The measuring range extends to 24.0dB; the resolution is 0.1dB.

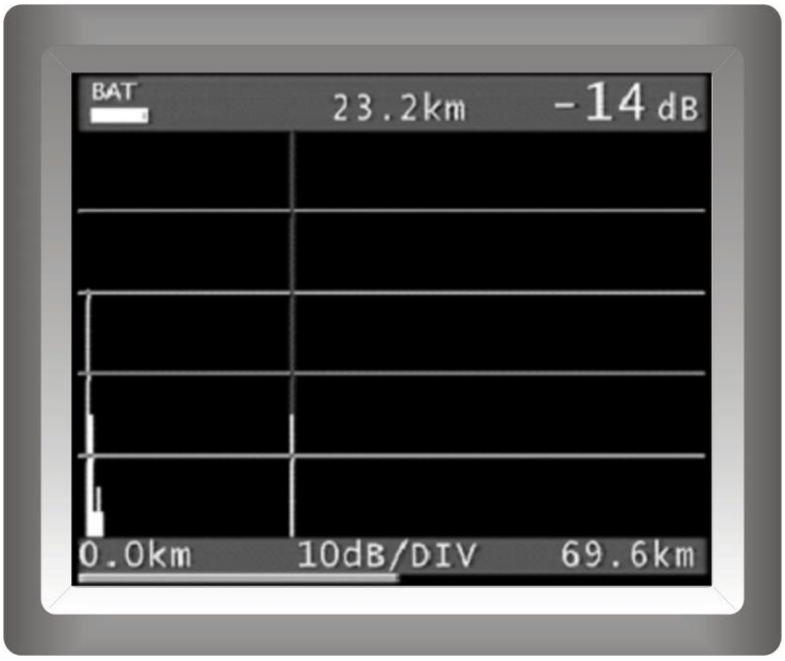
7.2.3.6 Packet error measurement (only option DVB-T2)

Short interruptions in the DVB signal usually cannot be detected using MER or BER measurements. They can make entire packets in the transport stream unusable for the MPEG decoder, however. This can cause the picture to freeze temporarily or the sound to crackle. The extent of this depends largely on the receiver hardware.

In the MODE menu, you activate a function which sums up all corrupt transport stream packets starting from the time of activation or when a new frequency is entered. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed in the BER window instead of the VBER or LBER. This function can be deactivated again in the above menu or by performing a restart.

7.2.3.7 Impulse response

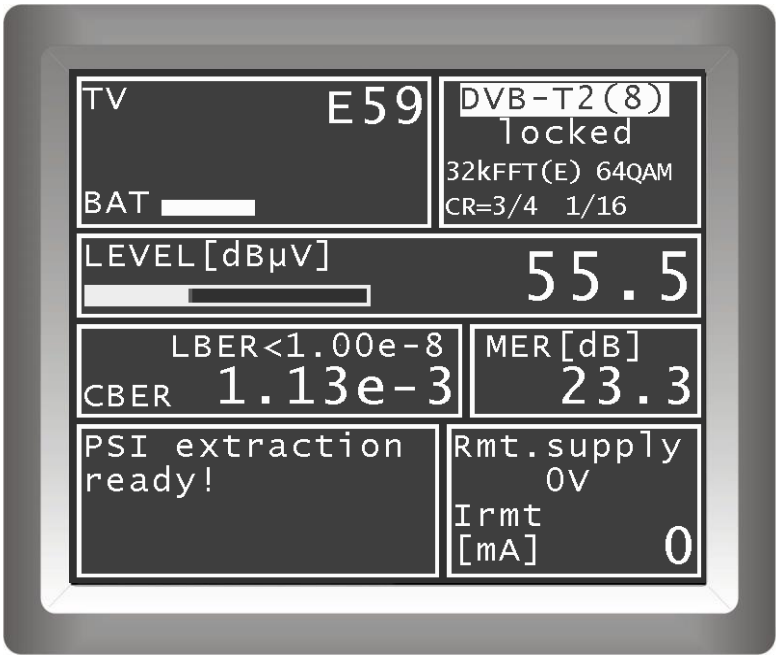
Is it helpful to measure the impulse response for DVBT when erecting a receiving antenna - especially in situations where reception is difficult. Keyword multipath reception (fading). If a receiving antenna receives the DVBT signal from multiple directions with differing transit times and differing field strengths, the individual signals superimpose upon each other to form a sum signal.
Because DVBT is made up of several narrow-band single carriers (COFDM), single carriers may occasionally be notably attenuated through superimposition. Because information is divided among all carriers with respect to time, the DVBT 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 DVBT channel decoder acquires this through the pilot carriers that are transmitted with DVBT. Through calculating the IFFT, you can obtain the impulse response from the channel transmission function.
The measuring receiver must receive a DVBT signal in order to display the impulse response. The instrument should be tuned to an appropriate channel to do this.
This mode is activated using **MODE -> Impulse response**; pressing the **ESCAPE** button exits this mode.



The above illustration shows a sample impulse response. A primary impulse (primary reception direction) is shown on the left edge of the display. Additional smaller impulses can be seen to the right, in an interval with respect to time. You can move the cursor (vertical red line) to a secondary impulse using the rotary pulse encoder. The level of the secondary impulse relative to the primary impulse as well as its time delay in [µs] is shown on the upper edge of the display.
The time delay can also be converted to distance using **MODE** -> **km.** This is based on the fact that the signal travels at the speed of light.

7.2.4 DVB-T2 (option)

You can access the DVB-T2 operating mode of the TV measuring range using the **ANA/DIG** button (see also the section "Selecting the operating mode").



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.
DVB-T2 is a very flexible standard for terrestrial transmission of digital TV. COFDM transmission parameters can be optimally adapted to the topographic conditions. The main improvement over DVB-T is the considerably more efficient FEC (LDPC and BCH), with which the transmission capacity can be increased by up to 30% at the same channel quality.

7.2.4.1 Selecting the COFDM bandwidth

The DVB-T2 standard provides for transmission in 1.7, 5, 6, 7 or 8MHz channels.
The device only supports the following bandwidths: 6MHz, 7MHz and 8MHz.

The user can set the COFDM demodulator to these three transmission formats via **MODE** -> **COFDM bandwidth**. This setting is incorporated in the tuning memory and allows you to store 6, 7 and 8 MHz channels consecutively. The device automatically sets the channel bandwidth during the tuning process based on the channel table. This can be changed manually later as described above. The display includes a note displaying the set bandwidth in the parameter window (e.g. DVBT(8)).

7.2.4.2 Searching

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

The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Begin the procedure with ENTER. “SCAN” is displayed in the frequency window while the search takes place. When the instrument detects a DVB-T2 signal, the search is stopped and the instrument measures the frequency that was detected. You can stop the search using the rotary pulse encoder or the ESCAPE button.

7.2.4.3 DVB-T2 parameters

The parameters are shown in the parameter window. If the measuring receiver is tuned to a frequency (see frequency input), the DVB-T2 channel decoder attempts to synchronise with the signal that is present; this can be followed using the SCAN message in the parameter window. If a DVB-T2 signal that has the bandwidth that is set is present, the channel decoder locks and LOCKED is displayed in the parameter window. Otherwise, the UNLOCKED message is shown This may be caused by the following: the bandwidth that is set does not fit, the receive level is too low, there is too much noise in the signal, or there is no DVB-T2 signal at this frequency. As soon as the DVB-T2 channel decoder receives a signal, the instrument shows the most important modulation parameters in the parameter window.
At the same time, measurement of the bit error rate and MER measurement are triggered. The measured values are shown in the BER window and the MER window respectively. The MPEG window is also displayed; you can follow the search for PSI (program service information) in the transport stream here. Further information about this is found in the MPEG decoder section.

In the figure, the equipment receives a DVB-T2-signal with the following parameters:
FFT order: 32k(E). (E) means “Extended Carrier Mode”, i.e. bandwidth utilisation is higher in this mode as additional OFDM single carriers are used.
Modulation scheme: 64QAM, FEC: 3/4 and Guard Intervall (GI): 1/16.

The **MODE -> DVBT2 parameters** can be used to displayed a window in which additional DVB-T2 parameters are listed.

Explanations:
Pilot pattern = PP4
PAPR = TR ("**P**eak to **A**verage **P**ower **R**eduction = **T**one **R**eservation") – Crest factor reduction on
LDPC-Frame = NORMAL
ROT = ON (Constellation rotation on)
Cell_ID = 1
System = SISO (**S**ingle **I**n **S**ingle **O**ut) – A transmission antenna and a receiving antenna, as opposed to MISO which has two transmission antennas and a receiving antenna.

7.2.4.4 BER measurement

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. LDPC (Low Density Parity Check) is used for internal error protection, BCH (Bose Chaudhuri Hocquenghem) is used for external error protection.

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

7.2.4.5 MER measurement

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 32dB with a resolution of 0.1dB.

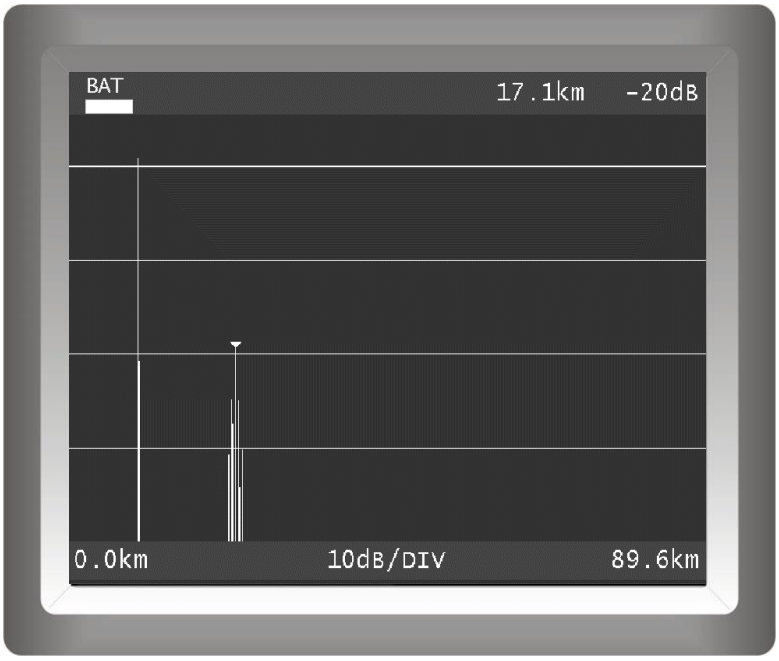
7.2.4.6 Impulse response

As with DVB-T, DVB-T2 is intended for operation in a single frequency network. This means several transmitters transmit on the same frequency. The transmitters involved must operate synchronously on the same frequency. The maximum transmitter distance depends on the Guard Interval used.

At the receiving location, the signals from individual transmitters superimpose on each other to form a sum signal.
The result can be constructive or destructive depending on the transit time difference and the received field strength. The impulse response graphically represents attenuation and transit time difference of the individual signals.
In order to calculate the channel impulse response, the DVB-T2 receiver requires information on the channel transmission function. The demodulator obtains this information by evaluating the pilot carrier in the OFDM signal.

The measuring receiver must receive a DVB-T2 signal in order to measure the impulse response. The instrument should be tuned to an appropriate channel to do this.
This mode is activated using **MODE** -> **Impulse response**; pressing the **ESCAPE** button exits this mode.

You can expand the impulse response horizontally with the **<-** and **->** buttons. You can define the unit of the x-axis with **MODE** -> **µs** or **km**. Time and length are related via the speed of light, c:=3•10^8m/s.



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 (vertical red line) to a secondary impulse using the rotary pulse encoder. At the top right edge of the picture, the transit time difference and attenuation in relation to the primary impulse is displayed at the cursor position.

7.2.4.7 PE measurement

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.
In the **MODE** menu, a function can be activated which sums up all corrupt transport stream packets starting from the time of activation or when a new frequency is entered. The number of packet errors (PE = Packet Error) and the amount of time that has passed since the last tuning process is displayed in the BER window instead of the LBER. This function can be deactivated again in the above menu or by performing a restart.

7.2.4.8 Picture and sound check

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

7.3 Level measurement

As soon as the instrument is set to a frequency (see Frequency/channel input), the level measurement starts and the value measured is indicated in dBµV in the level window. The measuring range is between 25 and 110dBµV with a resolution of 0.5dB.
The measuring bandwidth is automatically adjusted to the measured channel bandwidth accordingly. The measuring rate for the numeric level value is about 3Hz.

7.3.1 MAX Hold function

A yellow level trend bar graph is displayed in the level window as well as the numeric level value. The length of this level trend bar graph changes in proportion to the level value. The maximum modulation of the level trend bar graph since the last tuning process is continually indicated by a red vertical line. The repetition rate of the level bar graph is 10Hz.

7.3.2 Acoustic level trend indicator

A pure (sine) tone, whose frequency changes in proportion to the level that is measured, is emitted from the loudspeaker. The higher the level value, the higher the frequency of the signal tone. Press **MODE** > **level acoustic** > **on (off)** to turn the function on or off at any time.

7.3.3 Level measurement at DVBC and DVBT

The spectra of the signals in DVBC and DVBT have characteristics similar to noise.
The spectrum 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 result using the bandwidth formula to the channel bandwidth.
The measuring bandwidth is adjusted to the current channel bandwidth.

7.3.4 Level measurement at AnalogTV (ATV)

The peak value of the video carrier is measured in ATV. 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. –13.0dB).

7.4 Remote supply

The measuring receiver can provide a remote power supply via the RF input; for example, this may provide power for an active receiving antenna. You may choose between 5 V, 14 V, 18 V and no remote supply. The supply is short circuit proof and provides a maximum of 100 mA current. In the event of a short circuit, if the current is too high, or if an external voltage is too high, the device switches off the remote supply automatically. The red LED on the RF input lights up as soon as the remote supply is active.
Caution! Always check the compatibility of the system that is connected with the remote supply that is selected before switching on a 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. The voltages that are available (0V, 5V, 14V and 18V) may be selected using the rotary pulse encoder. The **ENTER** button activates the remote supply.

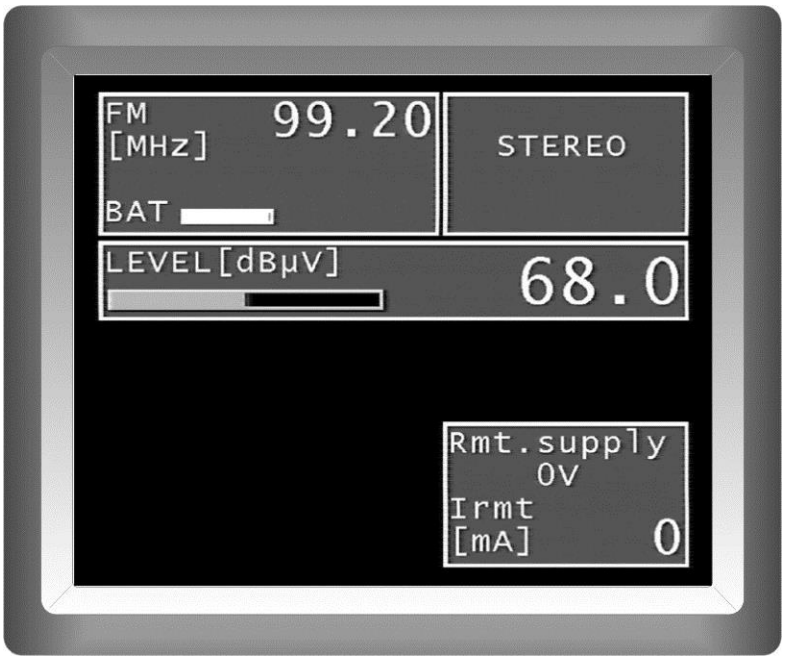
7.4.2 Measuring the remote supply current

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 in the LNB window in [mA]. The measuring range extends from 0-100 mA with a resolution of 1 mA.

Chapter 8

FM (VHF) measuring range

Press the **RANGE** button repeatedly until “FM” is shown in the frequency window.



8.1 Frequency input

The frequency is displayed in the frequency window. Use the rotary pulse selector and the **<-** and **->** buttons to set the required frequency (in MHZ) in the 87.5 – 108.3MHz range. The decimal place of the current cursor position can be changed from 0-9 by turning the rotary selector. Use the <- and -> keys to move the cursor to the left and to the right. Press **ENTER** key to confirm the input.
The receiver is then tuned and the respective measuring values are displayed. Press **ESCAPE**, **<** or **>** keys or use the rotary selector to stop the measuring process; a new frequency can be set as described above.

8.2 Sound reproduction

The measuring instrument’s VHF stereo receiver demodulates a VHF signal that is received and reproduces the audio signal using the built-in loudspeaker. Because the instrument has only one channel for sound reproduction, only the left channel of stereo broadcasts is heard on the loudspeaker.

8.3 Stereo indicator

As soon as the receiver detects a stereo pilot tone, **STEREO** appears in the parameter window. Otherwise, the instrument displays **MONO**.

8.4 Searching

This function is used to search the entire VHF range (87.5MHz – 108.3MHz) for VHF signals. Start the searching by first tuning the measuring receiver to a frequency from where you want to start the search function. Press **ENTER** to start the process. **SCAN** is displayed in the frequency window while the search takes place. When the instrument detects a VHF signal, the search is stopped and the receiver measures this frequency.

The user can stop the searching by operating the rotary selector or the **ESCAPE** key.

8.5 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 in the level window. The measuring range extends from 25 to 110dBµV with a resolution of 0.5dB.
The measuring rate for the numerical level value is approx. 3 Hz.

8.5.1 MAX Hold function

A yellow level trend bar graph is displayed in the level window as well as the numeric level value. The length of this level trend bar graph changes in proportion to the level value. The maximum modulation of the level trend bar graph since the last tuning process is continually indicated by a red vertical line. The repetition rate of the level bar graph is 10Hz.

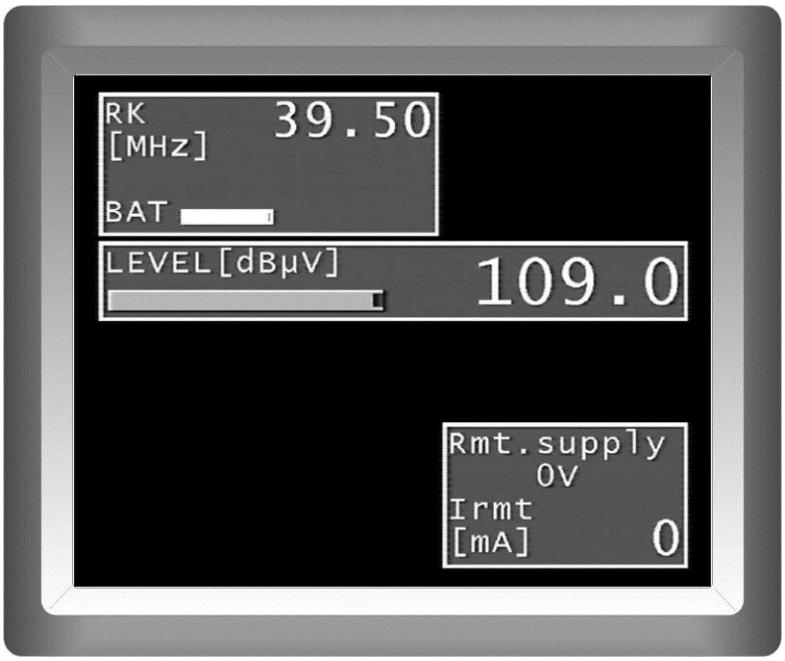
8.5.2 Acoustic level trend indicator

A pure (sine) tone, whose frequency changes in proportion to the level that is measured, is emitted from the loudspeaker. The frequency of the signal tone rises as the level increases.
Press **MODE** > **level acoustic** > **on (off)** to turn the function on or off at any time.

Chapter 9

RC (return channel) measuring range

Press the **RANGE** button repeatedly until **RC** is shown in the frequency window.



9.1 Frequency input

Frequencies are displayed in the frequency window. Use the rotary pulse encoder and the **<-** and **->** buttons to set the required frequency (in MHz) in the 5 – 65 MHZ range. The decimal place of the current cursor position can be changed from 0-9 by turning the **rotary pulse encoder**. The left-right position of the cursor can be moved by using the **<-** and **->** buttons. Confirm the entry using the **ENTER** button.
After that, the receiver is tuned and the actual measured values are displayed. Use the **ESCAPE, <-** or **-> buttons** or the **rotary pulse encoder** to end the measurement procedure. A new frequency can be set as described above.

9.2 Level measurement

As soon as the instrument is set to a frequency, the level measurement starts and the value measured is indicated in dBµV in the level window. The measuring range is between 25 and 110dBµV with a resolution of 0.5dB.
The measuring rate for the numeric level value is about 3Hz.

9.2.1 MAX Hold function

A yellow level trend bar graph is displayed in the level window as well as the numeric level value. The length of this level trend bar graph changes in proportion to the level value. The maximum modulation of the level trend bar graph since the last tuning process is continually indicated by a red vertical line. The repetition rate of the level bar graph is 10Hz.

9.2.2 Acoustic level trend indicator

A pure (sine) tone, whose frequency changes in proportion to the level that is measured, is emitted from the loudspeaker. The frequency of the signal tone rises as the level increases.
Press **MODE** > **level acoustic** > **on (off)** to turn the function on or off at any time.

Chapter 10

DAB measuring range (Option)

DAB stands for “Digital Audio Broadcasting”. The measuring receiver can demodulate both DAB and DAB+ modulated signals and decode the FIC (Fast Information Channel) and MSC (Main Service Channel) information contained within.
You can access the DAB range by pressing the **RANGE** button until “DAB” appears in the frequency window. The frequency range for DAB extends from 170.00 to 250.00 MHz.

10.1 Switching between frequency and channel input

The instrument can be tuned by entering the channel centre frequency or by entering the channel. You can switch between the modes using **MODE > Frequency input mode**.

10.1.1 Frequency input

Frequencies are displayed in the frequency window. Use the rotary pulse encoder and the **<-** or **->** buttons to set the required frequency (in MHz). The decimal place of the current cursor position can be changed from 0-9 by turning the rotary pulse encoder. The cursor can be moved to the left or right using the **<-** and **->** buttons. Confirm the entry using the **ENTER** button.
After that, the receiver is tuned and the actual measured values are displayed. Use the **ESCAPE, <-** or **->** keys or the rotary pulse encoder to end the measurement procedure. A new frequency can be set as described above.

10.1.2 Channel input

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

Use the rotary pulse encoder to select the appropriate channel and access it using the **ENTER** key.

10.2 Scan

You can use this function to scan the entire range for DAB/DAB+ signals. For this, you must switch the instrument to channel input mode.

The scan is then started by first tuning the measuring receiver to a channel at which the scan should begin. Press the **ENTER** key to start the scan in the positive direction. When the band limit is reached, the scan continues at the other end of the range. “SCAN” is shown on the display while the scan takes place. You can exit the search function at any time by pressing the **ESCAPE** key or using the rotary pulse encoder.

10.3 Level measurement

After the measuring receiver is tuned, the automatic attenuation control and level measurement starts. The spectra of the signals for DAB have characteristics similar to noise.
The signal energy is spread over the entire channel bandwidth. The measuring receiver uses its measuring bandwidth to measure the level in the channel centre and extrapolates the channel bandwidth using the bandwidth formula.
The level measured is indicated on the right side of the display in dBµV with 0.5 dB resolution.
The measuring range extends from 25 to 110 dBµV. The measuring bandwidth is adjusted to the channel bandwidth of the signal measured. The measurement repetition rate is approx. 3 Hz.

10.3.1 Acoustic level trend

When no line of sight to the measuring instrument exists while lining up an antenna, an acoustic level trend signal can be switched on. In this case, an acoustic signal is emitted from the speaker. Its frequency changes in proportion to the measured level. When the level increases, the frequency goes up and vice versa. The measurement repetition rate is approx. 3 Hz. The acoustic signal can be switched on and off via the menu item.
When the acoustic signal is switched on, the menu item is displayed inverted.

10.4 DAB parameters

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

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

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

Station ID: A station ID is also transmitted in DAB. This TII (Transmitter Identification Information) is transmitted in the first DAB symbol (zero symbol).

Each DAB station transmits its own unique Main ID and Sub ID. These numbers allow a station to be uniquely identified in a single-frequency network. This is unlike in DVB-T, where each station in a cluster transmits the same station ID.

10.5 BER measurement (Bit Error Rate)

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

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

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

The depth of measurement is $1 \cdot 10^6$ bits.

10.6 MER measurement (Modulation Error Rate)

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

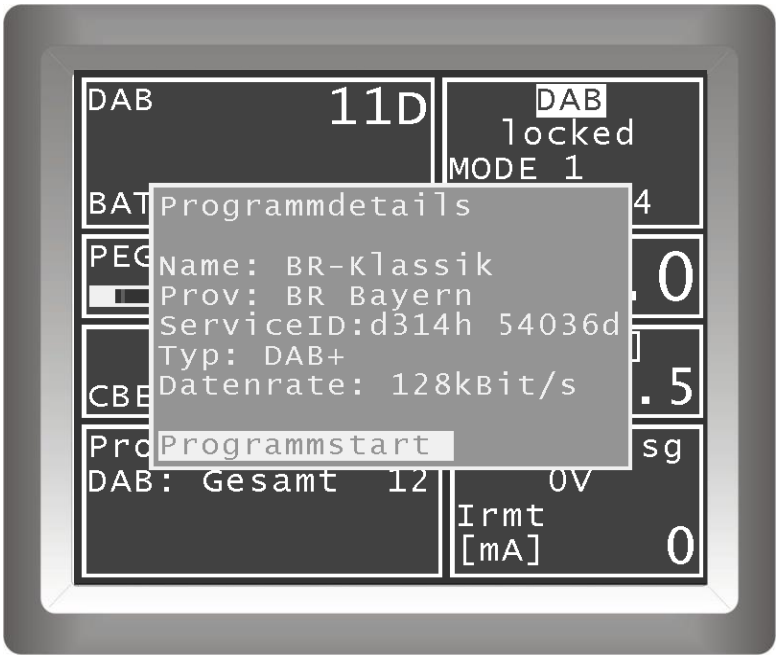
10.7 FIC decoding

Once the measuring receiver has locked in on a DAB signal, the DAB frame is analysed. The data of the FIC (Fast Information Channel) are then analysed. This contains information on the composition of the ensemble. For DVB, this corresponds to evaluation of PAT, PMT and SDT.
If the decoder has completed the program lists, the MPEG window will display: “Program search complete”, “DAB: total xx”. Afterwards, you can press the OSD/VID key to view the program list (see figure below). This is performed in a similar manner as for DVB. See the “MPEG decoder” section).

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

10.8 MSC decoding and audio playback

You can play a program from the list by moving the cursor onto the appropriate program name using the rotary selector.
When **ENTER** is pressed once, the decoder lists the corresponding program details.



This includes the program name, program provider, service ID, DAB type and the audio data rate of the particular program. The example above is for a DAB+ program with 128 kbit/s.
Press **ESCAPE** to view the previous program list again so you can select another program. You can use **OSD/VID** to go straight back to the normal measuring mode.

Note:
During audio playback, the processor is working to full capacity. Pressing keys or the rotary pulse encoder may cause brief interruptions or frame errors.

10.9 Remote supply

The measuring receiver can provide a remote power supply via the RF input; for example, this may provide power for an active receiving antenna. You may choose between 5 V, 14 V, 18 V and no remote supply.
The supply is short circuit-proof and provides a maximum current of 100 mA at 5 V or 500 mA. The instrument automatically switches off the remote supply if there is a short circuit or if the current is too high. The red LED on the RF input lights up as soon as the remote supply is active.

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

10.9.1 Setting the remote supply

Press LNB to open the selection menu. The available voltages (0 V, 5 V, 14 V and 18 V) can be selected using the rotary pulse encoder. The **ENTER** key activates the remote supply.

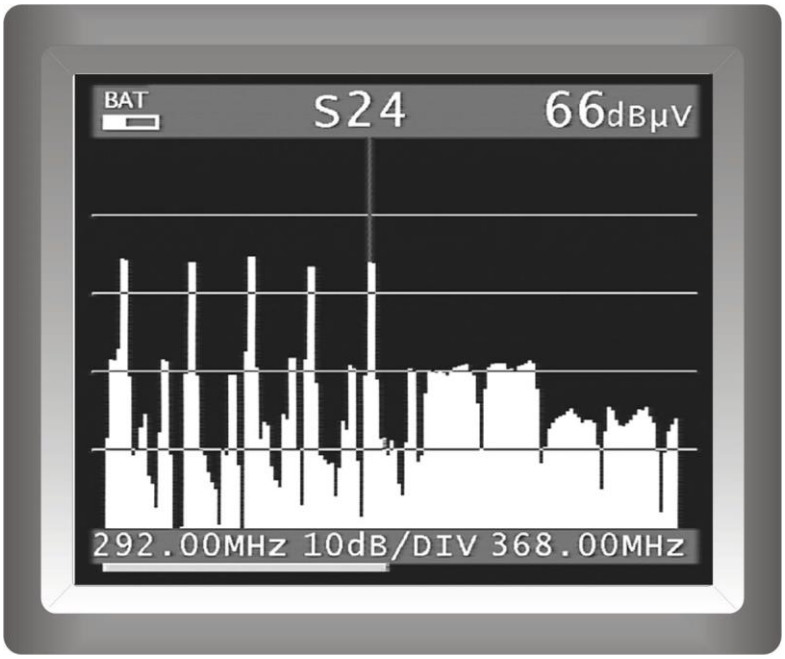
10.9.2 Measuring the remote supply current

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 in the LNB window in [mA]. The measuring range extends from 0-500 mA with a resolution of 1 mA.

Chapter 11

Analyzer

The instrument includes a spectrum analyzer for all measuring ranges.
The illustration below shows an analyzer screen in the cable range.



The level grid includes 10dB/DIV. The start and stop frequencies are shown on the lower edge of the screen. The level display on the upper right edge of the screen and the channel display in the centre of the upper edge of the screen relate to the cursor position.

11.1 Accessing the analyzer

First set the required measuring range in the measuring receiver mode using the **RANGE** button. Press **ANALYZ** to initiate the analyzer. The status of the measuring receiver is now important. If the receiver is not tuned to a channel (e.g. previously pressing **ESCAPE**), the analyzer "sweeps" over the entire measuring range (FULLSPAN). But if the instrument is in the tuned mode (measuring mode), the analyzer shows a smaller section of the frequency spectrum (SPAN1) above and below the measuring frequency. When the UNICABLE control is active, the analyzer displays the frequency spectrum above and below the centre frequency of the last UB slot that was activated.

11.2 Frequency segment (SPAN)

The "SPAN" frequency segment can be changed in all ranges.
In the "FULLSPAN" mode, the frequency segment spans the entire measuring range. The frequency segment (SPAN) can be changed using the **<** or **>** arrow buttons.
The table below provides an overview of the frequency segments that may be set in each measuring range.

Measuring range	Total (FULLSPAN)	SPAN1	SPAN2	SPAN3
SAT	910 - 2150MHz	150MHz	38MHz	Not available
TV	45 - 867MHz	152MHz	76MHz	15MHz
FM (VHF)	87.5 - 108.3MHz	15MHz	Not available	Not available
RC (Return channel)	5 - 65MHz	15MHz	Not available	Not available
DAB	170 - 250MHz	15MHz	Not available	Not available

11.3 Cursor

The cursor appears as a vertical red line on the screen. You can use the rotary pulse encoder to move the cursor within the frequency segment. The current cursor frequency (or channel number) is shown in the upper centre of the screen.

11.3.1 Automatically positioning the cursor on video carrier or channel centre with TV analyzer.

If the analyzer is in the TV measuring range, if SPAN1 or SPAN2 is set, and if the channel input mode is active, the cursor moves in the channel grid. Based on the spectrum, the instrument detects whether the process involves an analog (ATV) or digital (DVBC or DVBT) TV channel. With analog channels, the cursor jumps to the video carrier frequency; with digital channels, the cursor expands to a window that corresponds to the channel bandwidth. The channel bandwidth is assigned based on the channel table.

11.4 Switching between frequency and channel mode

You can only do this in the TV range and DAB range. You can switch between the two modes using the **menu items MODE -> Channel** and **MODE -> Frequency**.

11.5 Level measurement

During each search, the level of the cursor frequency is measured and displayed in the upper right edge of the screen in dBµV. Level measurement in analyzer mode is comparable to a pure spectrum analyzer. The power within the measuring bandwidth (RB) is measured and converted into dBµV as a level. On the other hand, the level measurement in measuring receiver mode always measures the power (level) in the channel.

11.6 Corrected level display with TV analyzer and DAB analyzer

If the analyzer is in the TV measuring range and DAB measuring range, if SPAN1, SPAN2 or SPAN3 is set and if the channel input mode is active, the level display is identical to measuring receiver mode. The correction of the level display that is required for digital channels is carried out automatically (also see sec. “Automatically positioning the cursor on video carrier or channel centre with TV analyzer”). The correction must be made because the measuring bandwidth (RB) in analyzer mode is narrower than the channel bandwidth. The analyzer display itself is not affected by this correction.

11.6.1 Switching between absolute and differential level display (only TV range)

Switch to SPAN1 or SPAN2 with the right arrow key in the analyzer.

Use **MODE**-> **Absolute level** or **MODE** -> **Level differential** to switch the level display between displaying the absolute level (as in measuring receiver mode) or the level differential to the next lower channel. The setting is non-volatile.

11.6.2 Level differential measurement

When level differential measurement is set, a second cursor (green) appears on the analyzer screen. This always indicates the next lower channel, in relationship to the red primary cursor. Thus, the two cursors are joined together in a fixed relationship.
The amount of the level differential between the channels that are marked by the two cursors is shown. This includes all corrections.
This feature is helpful in setting the levels of neighbouring analog and digital channels, for example.

11.7 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”.

11.8 Switching to measuring receiver mode

You can change between analyzer mode directly into measuring receiver mode while in all measuring ranges. The instrument uses the current cursor frequency to tune the measuring receiver. However, frequency segment SPAN1 must be set.

Press **ENTER** to begin the process.

SAT range:

If the cursor is located at the transponder centre frequency, the instrument detects, based on the spectrum, whether it is an analog or digital transponder.
Thus, the measuring receiver then switches automatically to the related receive mode. However, this feature only works when the digital transponder operates with a symbol rate higher than about 20 Msym/s. When the UNICABLE control is active, the frequency display always refers to the spectrum that was converted by the UNICABLE unit.

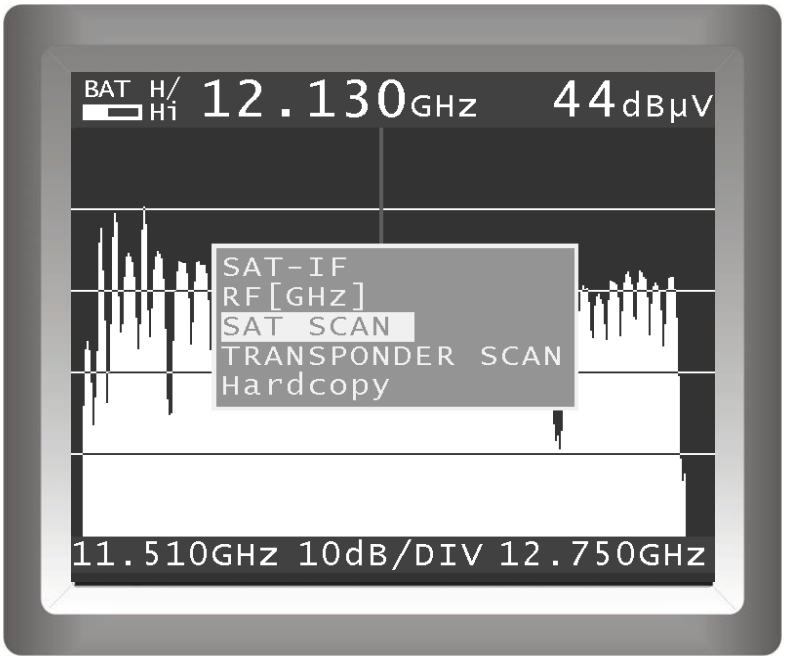
TV range:

As already mentioned in the “Cursor” section, the instrument can distinguish between analog and digital channels based on the spectrum. The 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 (DVBT or DVBC).

If the **ANALYZ** button is then pressed again, the instrument returns to analyzer mode.

11.8.1 Special functions SCAN and Transponder SCAN in SAT range

Pressing the **MODE** key opens a menu which includes the selections SAT SCAN and TRANSPONDER SCAN, among others. These functions can be accessed by selecting **SCAN -> ENTER** (descriptions of these functions are found in the following chapter).



Transponder SCAN:

When **Transponder SCAN** is selected, the following additional functions are carried out depending on the current SPAN.

FULLSPAN: Starting from the current cursor position, the next maximum is found and the centre frequency of this transponder is determined. The analyzer then switches to SPAN1 with the determined frequency as the cursor position.

SPAN1: As with FULLSPAN, the centre frequency of the next transponder is found and the instrument is tuned to this. In addition to the 5 set symbol rates, the entire range of symbol rates from 2-45 Msym/s is searched.

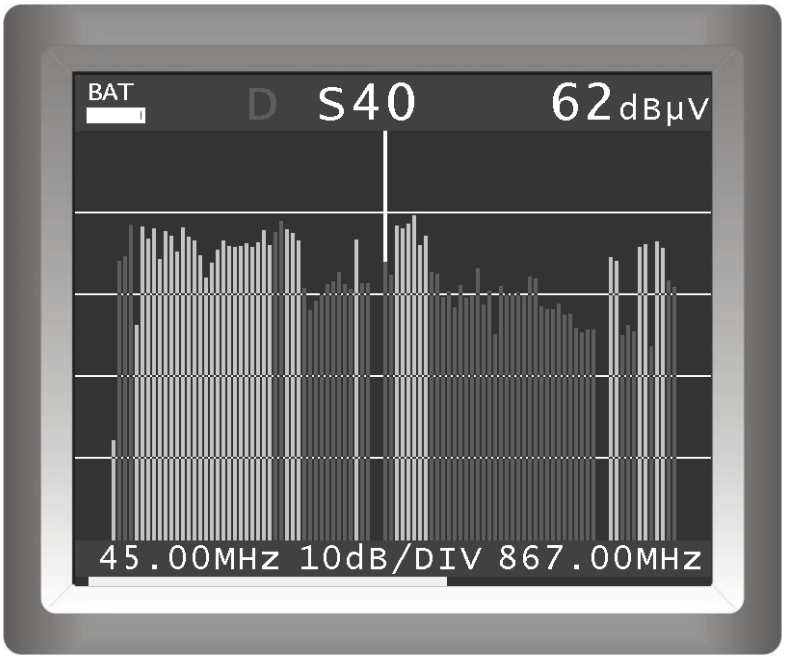
SPAN2: For fine-tuning, the instrument is tuned directly to the frequency of the cursor position. In addition to the 5 set symbol rates, the entire range of symbol rates from 2-45 Msym/s is searched.

11.9 Activating the remote supply

The remote power supply options available in each respective measuring range (e.g. LNB supply) may be activated while in analyzer mode in the same way as was discussed in previous sections. Thus, use the **LNB** button to access the corresponding menu.

11.10 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 among the levels in a broadband cable system independent of the modulation (ATV or DVB-C) of the individual channels.



During the process, the instrument measures the levels of every individual channel and displays them in the diagram as a green or red bar. The green bars are analog and the red bars are digital channels. The cursor is marked with an “A” or “D”.

In this diagram, tilted levels or abnormal drops in levels can be immediately detected with digital channels.

Chapter 12

SCAN support for finding satellites

The SCAN function comprises several functions which make finding and recognising satellite positions significantly easier. First the device must be located in the SAT measuring range and must be set to digital (DVB-S/DVBS2) operating mode, then press the **RANGE** button multiple times until "SAT" appears in the frequency window. You can select the operating mode using the **ANA/DIG** button. Selecting **MODE -> SAT List** opens a submenu with the following items: SAT SCAN; SAT List, Import Satlist and Erase favourites.

12.1 SAT SCAN

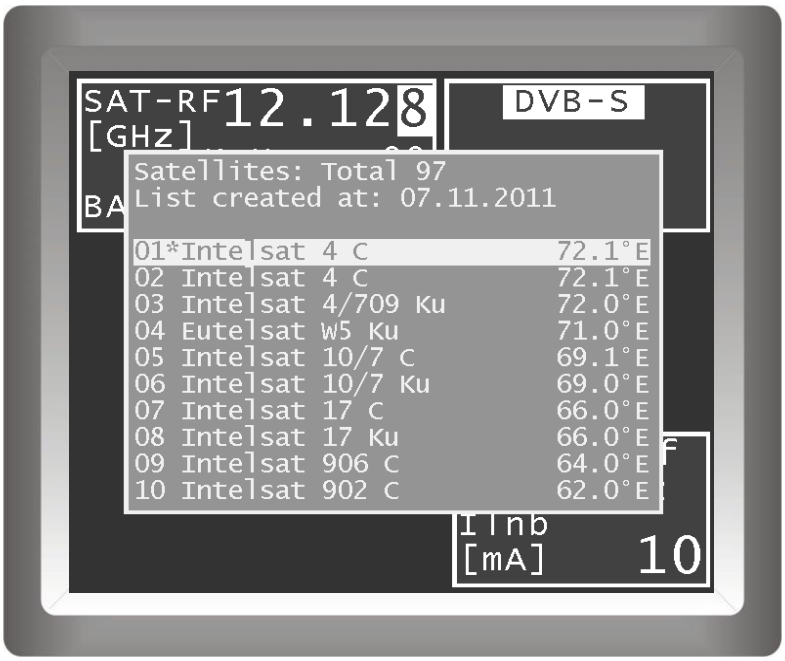
This function can be accessed from the selection menu shown above using the **ENTER** key. A search loop can now be started whereby the instrument is tuned to transponders of the most important satellites in order from east to west. The position currently being checked is shown on the screen in a clearly visible red window and the message “Search position” appears in the MPEG window. If the satellite system was successfully identified within the data stream, the set position appears in the MPEG window with the location in degrees (see figure). The search process can be continued using **MODE -> SAT SCAN** or stopped using **ESC.** You can also switch to analyzer mode using **ANALYZ** or to the normal measuring mode using **ENTER**.

Note:
If Quattro LNBs are used, the various SAT identifications are not sent on all levels.
The LNB should be connected to the connectors for the horizontal high or vertical low levels since only these levels are searched.
The relevant data can be found in the document which accompanies the SAT list.

The scan parameters (satellite, transponder frequency, etc.) are a fixed part of the SAT list. Therefore, you should keep the SAT list updated (see chapter “Import SAT list”).

12.2 SAT List

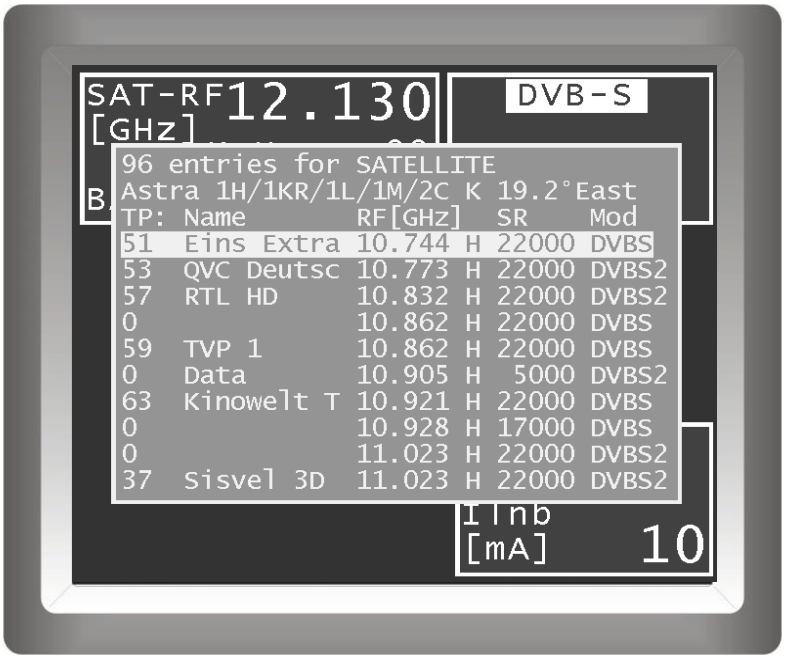
Selecting the **SAT List** menu opens the SAT list. You can scroll through the list one page at a time using the **<-** and **->** arrow keys. Individual satellites can be selected using the up and down keys. Pressing **ENTER** again displays the transponder list for the selected satellite.



The SAT list is provided by the manufacturer of the instrument and is regularly updated. You should therefore check that you are using an updated list (see the date listed in the 2nd row of the list). Updating the list is described in the chapter “Import SAT list”.

12.3 Transponder list

The transponder list includes not only reception parameters such as frequency, modulation, etc., but also transponder numbers and names, if these are known. The process of selecting an element is the same as for the other lists. Tuning is performed by pressing the **ENTER** key.
You can return to the previous list by pressing **ESCAPE**.



12.4 Favourites list

To allow the user to find the most frequently required satellites more quickly, these can be saved in a favourites list. To do so, select the desired satellite from the SAT list. Pressing the **SAVE** key opens the following menu.

You can now select its position in the favourites list. Pressing **SAVE** again saves it as a favourite and returns to the SAT list. The favourites now appear as the first entries in the SAT list and are labelled with a *. A favourite can be overwritten by another favourite at any time. All favourites can be deleted using **MODE** -> **SAT List** -> **Delete favourites list**.

12.5 Import SAT list

An up-to-date SAT list can be found at: www.kws-electronic.de. To import this list, it must first be transferred to a USB data carrier and then this must be connected to the instrument.
The device must be located in the SAT measuring range and must be set to digital (DVB-S/DVBS2) operating mode. You can select the measuring range using the **RANGE** button and the operating mode with the **ANA/DIG** button.
Select the “Import Satlist” menu item from the **SAT list** menu. All files on the data carrier with the ending “sat” are now listed. Select the desired list and import it using **ENTER**. Any lists already present on the instrument will be overwritten.

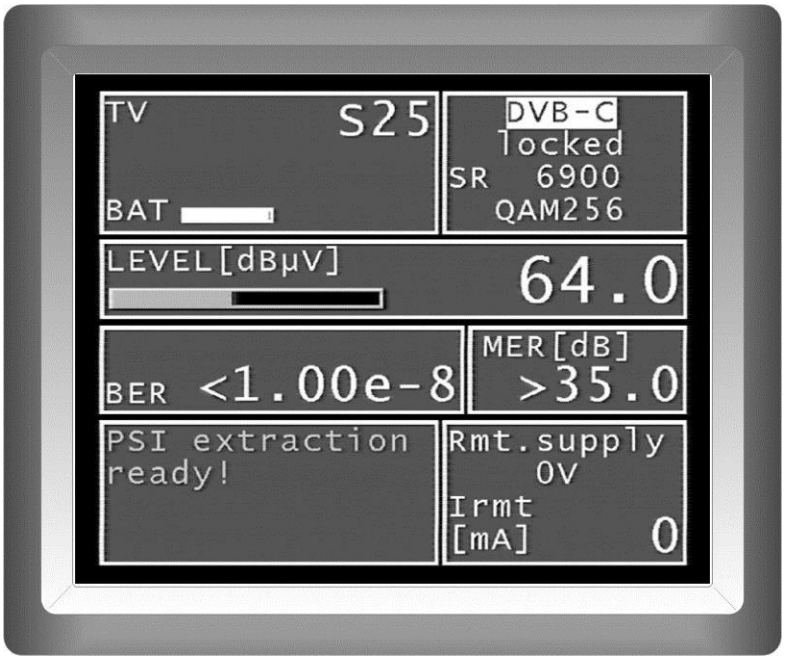
Chapter 13

MPEG decoder

An MPEG2 decoder is included in the delivery of this instrument. It functions as the Back-End of a DVB receiver. It evaluates the Program Service Information (PSI) and decodes the digital audio and video data.

13.1 Program Service Information (PSI)

In digital television (DVB) data are transmitted byte-serially in a transport stream (TS).
The TS generally contains more than one video and audio program, but also data streams and extra information about the programs which are transmitted in time-division multiplex. Special tables, which are transmitted in the TS, provide information about the transmitted programs or data services. The receiver first has to evaluate these PSI tables to be able to give the user an overview in the form of program lists. This process may take a few seconds, depending on the number of programs contained, and can be followed in the MPEG window.

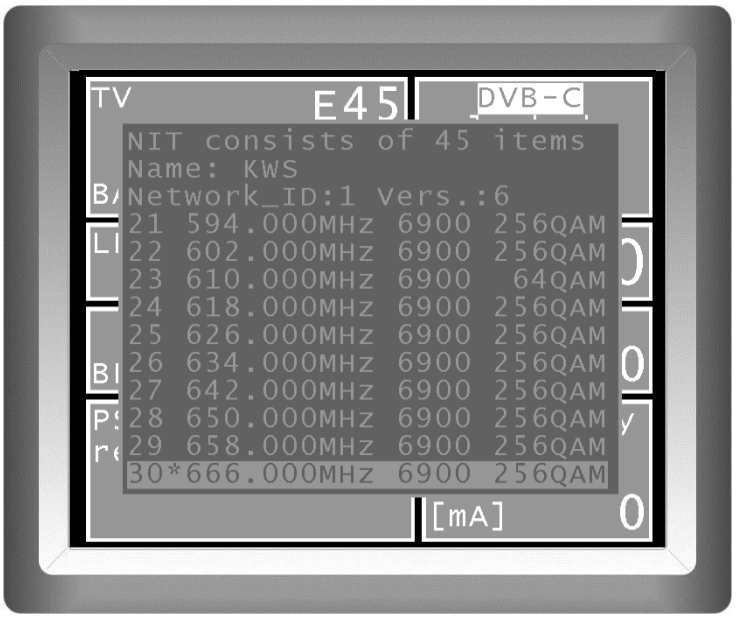


The MPEG window is seen in the lower left edge of the screen. This example shows a new program search in a DVBC channel.

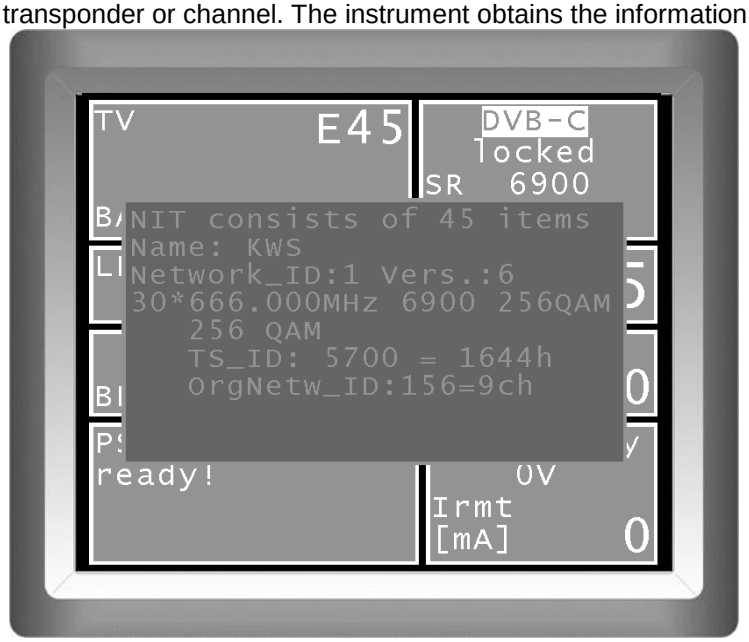
For a quick overview of the present transponder the provider name and its orbital position are displayed in the MPEG window.

13.2 Network Information Table (NIT)

The NIT (Network Information Table) is a special table which contains information about other transponders within the network (e.g. satellite). Information from the NIT can be used for navigation (program search).
First the measuring receiver must receive a digital transponder. Press **MODE** > **NIT** to start the NIT search. If an NIT is found the decoder displays the entries of the NIT in a list.



The transponder or channel to which the receiver is currently tuned is marked with a **,*'** in the NIT. Now a different entry can be selected by using the rotary selector. By pressing the **ENTER** key you get a menu displaying more details about the chosen channel including the transport stream-ID, the Original-Network-ID and the NIT-Version. Press **ENTER** again to tune the receiver to the new transponder or channel. The instrument obtains the information from the NIT entry selected before.



The SAT NIT can list transponders which are emitted by different satellites. Here only those transponders can be requested directly from the NIT which are on the same satellite that provided the NIT.

It is possible to occupy the tuning memory directly from the NIT. Use the rotary selector to select the entry from the NIT list accordingly. Then, as discribed in chapter Memory management – point 1 (Saving), a memory location can be selected and the NIT can be stored. Press **SAVE** to access the SAVE menu.

If there are more than 10 entries in the NIT, the keys <- und -> can be used to move between the individual pages of the list.

13.3 Picture and sound control

As described in chapter **Program Service Information**, more than one video and audio program are transmitted in the same multiplex (TS). As soon as the MPEG2 decoder finds a TS, the PSI are analysed and program lists made. This process can be followed in the MPEG window. When the decoder has finished the program lists, the message **Program search finished** appears in the MPEG window. The program list cannot be displayed before this message appears. Press the **OSD/VID** key before. The illustration below shows a video program list.

The list of video programs always appears first. Press **MODE** > **AUDIO list** to display the list of audio programs. Press **MODE** > **VIDEO list** to get back. All programs marked with *' are encrypted.
You can move the cursor within the program list to the required program by using the rotary pulse encoder. You can use the **<** or **>** buttons to move between the pages of the program list.
Then press the **ENTER** key to receive further detailed information about this program. This includes program name, provider, Service-ID, Transportstream-ID, OriginalNetwork-ID and PIDs (Packet Identify) of the text streams involved.
Many programs are broadcast with multiple audio streams (e.g. several languages). From the program details menu, you can use the "Select audio stream" menu item to choose the required audio channel.

Press **ENTER** one more time to start the program. The video program only can be seen on the screen now. At the same time the sound can be controlled by the loudspeaker.

Note!
In digital transmission, the quality of picture and sound do not give any clue about the receive quality. Picture and sound are always perfect as long as there is a certain level of transmission quality, whereas nothing works below this level. Within a small transition range the characteristic small bricks (Brick Wall Effect) appear in the picture, whereas there are constant interruptions of the sound. The broadcast quality can only be determined based on the measurements (BER, MER).

Press **ESCAPE** to see the previous program list, another program can be selected. Press **OSD/VID** to get back to the normal measuring mode immediately.

13.4 Display of MPEG2 video parameters

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

Profile and level: e.g. MP @ ML
Chroma format: e.g. 4:2:0
Video resolution: e.g. 720*576
LetterBoxFormat: 4:3 or 16:9

The parameter window can be displayed or hidden at any time using the **<** or **>** arrow keys.

13.5 Video bit rate measurement

The MPEG2 decoder measures the current bit rate of the video stream being broadcast while a live picture is shown. It is shown in the unit [Mbit/s] in the window described in the following section. The measuring time is 1 second.

13.6 MPEG4 H.264/AVC video and Dolby Digital (Plus, AC-3) audio

If the MPEG4 is not present, **MPEG4 H.264/AVC programs cannot** be decoded. However, these programs appear in the list of video programs. The corresponding message (H.264) is in the program details.
Likewise **no DD+/AC-3 audio streams** can be decoded. However, the user is still provided with relevant information in the program details.

-Neotion Pocket CAM
This module can convert SD (single density) coded MPEG4(H.264) video streams into MPEG2 video streams. Some countries broadcast DVB-T in H.264. This means that in order to reduce the data rate, SD programs are broadcast in the more efficient MPEG4(H.264) coding scheme. The measuring instrument supports the Neotion Pocket CAM. This makes it possible to play these programs on the built-in MPEG2 decoder.

13.7 Dynamic program switching

Some program providers divide their programming into regional content at specific times. This means that, for example, 4 programs may appear in the MPEG program list which have the same content at certain times and different content at other times. The program map table (PMT) in the data stream therefore changes over time. In this way, the station can prompt the receiver to use different packet identities (PIDs).

In the standard setting, the MPEG decoder of the instrument uses the PMT that was sent at the time of the last program search. In other words a static PMT.
The dynamic PMT update function can be activated using **MODE -> Settings -> Dyn_program_switching**. If you start the program now, the decoder continually searches for a new PMT version. If the device detects a change in the PMT, the current program is stopped, the message “Dynam. program switching” appears and then the program is restarted with the updated PIDs. These settings are saved in the non-volatile memory and remain active until they are deactivated in the above menu.

Chapter 14

Memory management

The instrument has a tuning memory with 99 program locations. The implemented memory preview can help the user to get an overview of the tuning memory without accessing all memory locations first or making notes while saving. The memory preview is activated while saving, while accessing, and at some memory functions. Use the **ROTARY SELECTOR** and, alternatively, the **<-** and **->** keys to move around the whole tuning memory.

14.1 Saving

First tune the receiver. Press **SAVE** to get to the **SAVE** menu. The instrument searches the tuning memory for the first available location and suggests the user to save this memory location number. It is also possible to select any other memory location between 0-99 by using the ROTARY SELECTOR (alternatively press the **<-** u. **->** keys). The content of the memory location is indicated behind each memory number. Press **SAVE** or **ENTER** to start the saving process. If the desired memory location is occupied, the instrument displays a warning. Press **ENTER** or **SAVE** again to overwrite the memory location anyway.

14.2 Accessing

Press the **RECALL** key to get to the **RECALL** menu. When first accessing memory after switching on the instrument the instrument suggests memory location 1. After each memory accessing the memory location is increased by 1, so next time the instrument suggests memory location 2. It is also possible to select any other memory location by using the ROTARY SELECTOR (alternatively press the **<-** u. **->** keys). Press the **RECALL** or **ENTER** keys to start accessing the memory, and the measuring receiver accepts the settings from the memory. If the respective memory location is empty, the old settings remain unchanged.

14.3 Memory functions

The memory functions can only be operated if the measuring receiver is not tuned.

14.3.1 Erasing the memory

Press **MODE** > **memory** > **erase memory** to erase the whole tuning memory. A warning is given before, however. The instrument erases its tuning memory only if **ENTER** is pressed to confirm. This may take a few seconds. A message is displayed when this process is finished.

14.3.2 Erasing a memory location

With this function a memory group or an individual memory location within the tuning memory can be erased. Press **MODE** > **memory** > **erase memory location** to access this function. First the instrument asks for the first location to be erased. After confirming with **ENTER** the instrument asks for the last location. If the first and last memory location are identical, only one single memory location is erased. Here as well a warning is given before erasing. Press **ENTER** to confirm the warning and to start the erasing process. A message is displayed when this process is finished.

14.3.3 Sorting the memory

With this function the whole tuning memory can be sorted by various criteria.

Sorting by A/D mode:
Here the memory is sorted by analog and digital memory locations. Access with **MODE** > **memory** > **sort memory** > **by mode**.

Sorting by frequency:
Here the memory is sorted by increasing frequency. Access with **MODE** > **memory** > **sort memory** > **by Frequenz**.

Sorting by range:
Here the memory is sorted by SAT (beginning), TV, FM and RC range. Access with **MODE** > **memory** > **sort memory** > **by range**.

Sorting by satellite:
Here the memory is sorted by satellite positions.
This function is only available for SAT memories with DiSEqC. Access with **MODE** > **memory** > **sort memory** > **by position**.

Sorting the memory can take a few seconds. During this period the instrument is blocked, a message is displayed when the process is finished.

14.3.4 Memory protection

With this function a memory protection can be put on the whole tuning memory, memory groups or individual memory locations. It prevents an accidental overwriting of a memory location by the user.
Access with **MODE** > **memory** > **memory protection**. Similar to chapter **Erasing a memory location**, the instrument asks for the first and last memory location to be provided with a memory protection. Press **ENTER** to start the process, the instrument then displays a message accordingly.
The next section explains how to disable memory protection.
Memory locations marked with **,*'** have an activated memory location.

14.3.5 Disable memory protection

This function is used to disable an existing memory protection.
Access with **MODE** > **memory** > **disable memory protection**. This is done in the same way as memory protection is activated. The instrument then responds with a corresponding message.

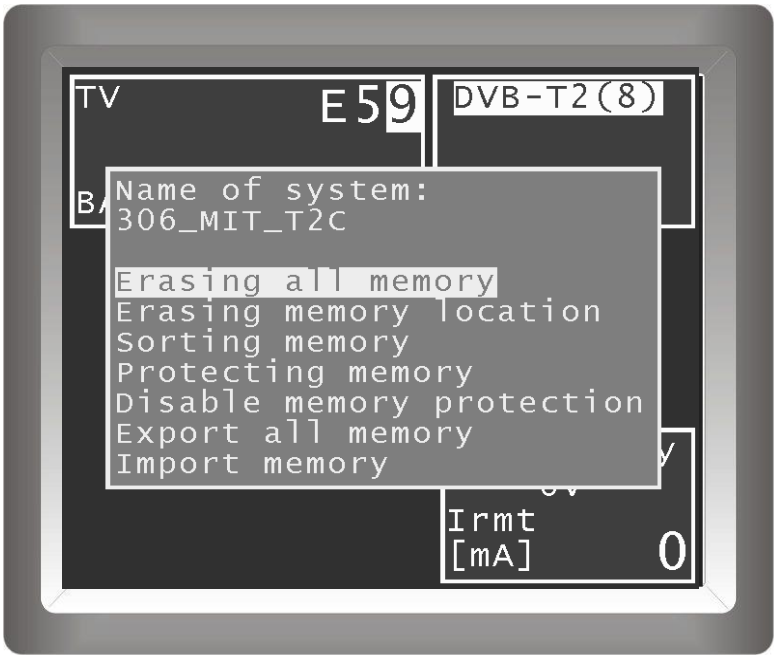
14.3.6 Memory export

The complete tuning memory can be copied as a data in the format "MEM" on to a USB-data-carrier with this function. .
Select with **MODE** > **memory** > **memory export**.
The instrument will suggest a name for the data, for example the site (measuring point). This can be adjusted alphanumerically with the arrow key and the rotary pulse. You complete the adjustment with the **ENTER** key.

The entered name is identical to the data name of the MEM-data. If a data with the same name exists already, a warning will appear. A different name can be entered with **ESCAPE**, or the existing data can be corrected with **ENTER**. How to input the tuning memory will be described in the next chapter.

14.3.7 Memory import

With this function an existing MEM-data tuning memory can be imported from a USB-data-carrier. Select with **MODE** > **memory** > **memory import**. Now a complete selection of stored MEM-data will be shown. Adjust the cursor to the desired data with the rotary encoder. By pressing the **ENTER** key the MEM-data will be transported to the tuning memory. The name of the selected MEM file is saved in the instrument as a system name and is displayed in the header of the memory menu.
This name is suggested as a file name during the next measurement.



Note:
Any other general settings by the user, such as LNB oscillator frequencies for RF inputs or the UB centre frequency for UNICABLE or JESS, are not transferred with the memory. These may have to be adjusted manually.

Chapter 15

USB-A interface

The instrument includes a USB-A interface. The corresponding socket can be found on the left side of the instrument. The interface works in high-speed mode according to specification 2.0. The measuring instrument supports only the MASS STORAGE DEVICE class (USB stick).

The software in the measuring receiver can read and write files from and to the USB stick via the integrated FAT32 file system. Using a USB stick, the user can carry out a firmware update or record measurement data (DataLogger).

We recommend that an original KWS USB stick is used.

Chapter 16

Common Interface

The instrument is equipped with a CI interface. CI consists of a PCMCIA slot, which can be accessed from a lid on the front of the instrument. The PCMCIA slot holds all common CAMs (Conditional Access Modules). The instrument also supports the CAMs of PREMIERE. All DVB programs can be decoded if you have an appropriate CA module with an activated Smartcard. Data is not decoded in the MPEG decoder, but only in the CAMs.

16.1 Replacing the CA module

As mentioned above the PCMCIA slot can be accessed from the lid on the front of the instrument.
The instrument has to be switched off before replacing a CA module.
A new module can be inserted in the slot under the lid.
It is important that the module fits into the guideway of the installed PCMCIA header. The polarity of the module has to be considered during insertion. The coloured imprint of the CAM normally has to point to the right. There must not be any major resistance during insertion under any circumstances. Otherwise the polarity of the module has be checked again. An inserted module can be lifted with the eject lever protruding on the top, it can then be taken out of the instrument manually.

16.2 Operation

An inserted module is initialised every time the instrument is cold started. Use the menu Common Interface to query the inserted CA module. Press **MODE** > **Common Interface** to open the menu. The name of the CA module is displayed as menu title.
Under the first menu point (“CA system IDs“) the CA systems supported by the module can be queried. The second menu point (“card menu“) is dealt with in the following chapter.
For picture and sound control of decoded programs, refer to chapter **MPEG Decoder**.

16.3 Card menu

This menu point allows you to access the module-specific menu. Various information and services can be queried for each module. For example smartcard information, software version, software update, PIN code entry for protection of children and young people etc.
The menu interface is structured in the same way as all the other operation of the instrument. All texts and menu points, however, come from the CAM. Also the language is set by the module here.

The illustration below shows the card menu of an AlphaCrypt CAM.

Chapter 17

Management of the instrument

These functions can only be accessed when the instrument is not tuned.

17.1 Language of the user guidance

It is possible to change the language of the user guidance between German, English, French and Italian. Press **MODE** > **settings** > **German (English, French, Italian),** to select the desired language.

17.2 Software version

This function allows the user to query the software (firmware) version of the instrument.
Press **MODE** > **settings** > **info**.

17.3 Software update

The user can download a new firmware release onto the device at any time.
The software is saved in a file with the ending .bin. This file can be ordered from the manufacturer and saved onto the USB stick **included** via PC.
When doing so, it should be noted that for safety the instrument should be plugged in to the mains. While the update is running, the instrument must not be switched off.
Insert the USB stick into the instrument and select the menu item MODE > Settings > Software > Update. A selection appears with all saved BIN files. Move the cursor to the desired file using the rotary encoder. Press the ENTER button to begin the software update. The instrument first deletes the old version from the memory and then writes the new software to the internal flash drive.
This takes approximately 1 minute.

17.4 Serial number

The serial number can be found on the type designation on the rear of the instrument. Also it is possible to access the serial number in the instrument by pressing **MODE** > **settings** > **serial number**.

17.5 Default setting

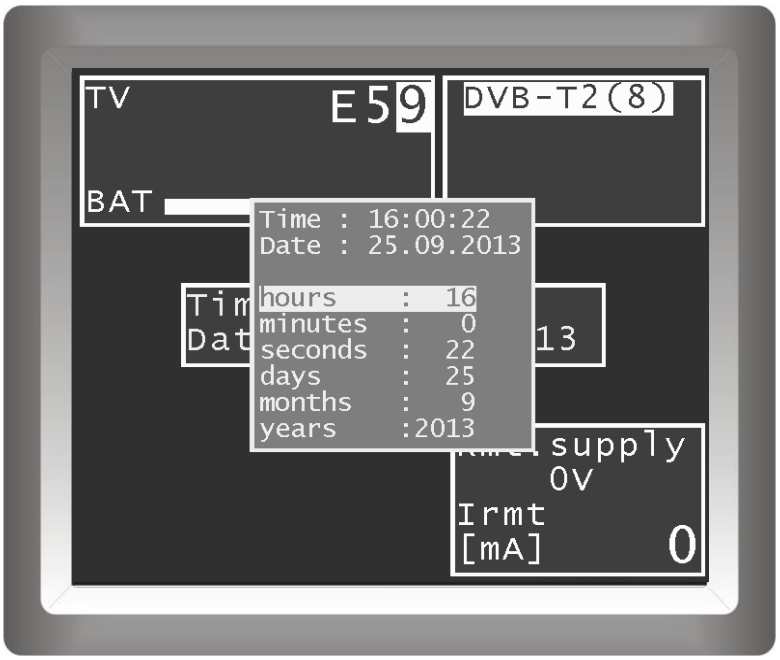
This **PRESET** function allows the user to reset the instrument to its default settings, but not the content of the tuning memory, which remains unchanged by **PRESET**.

17.6 Hardcopy

For documentation purposes, the contents of the screen can be saved on a USB stick, provided the instrument is in tuned mode or analyzer mode. By selecting **MODE** -> **Hardcopy**, you can access a menu where you can choose between **New hardcopy** and **Directory**. In the Directory menu, you can delete existing files which have the ending “BMP”. In the **New hardcopy** menu, you can enter a name for the new file and create it with **ENTER**.

17.7 Clock (only Li-Ion battery pack) – Delivery later serial number 60001

The instrument has a real time clock that is powered by the internal battery.
Set the date and time using the **Clock** menu. To do this, select the corresponding menu item and open it with **ENTER**. You can now set the time and date. Press **ENTER** to accept the value and return to the previous menu.



Chapter 18

AV input and output (SCART)

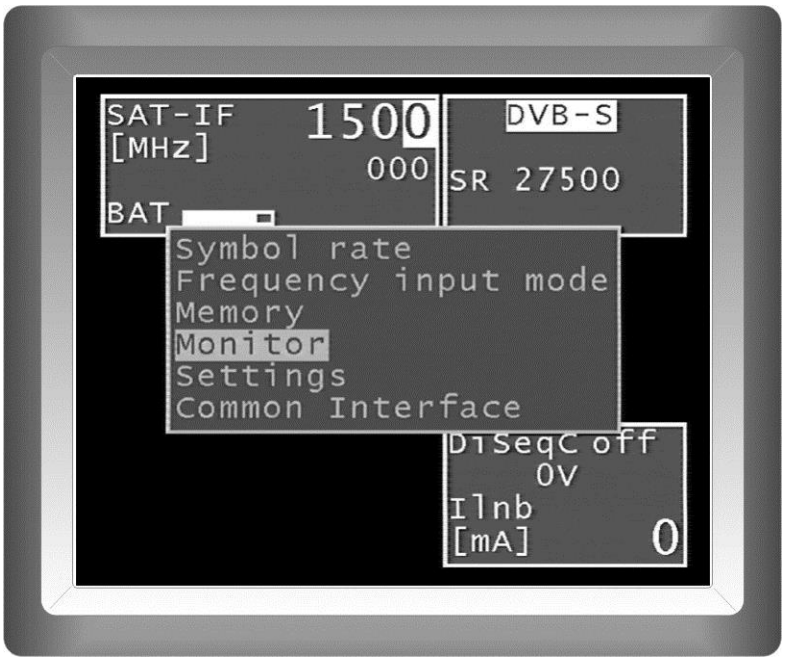
The instrument has a SCART socket on its right side for AV input and output.

18.1 AV output

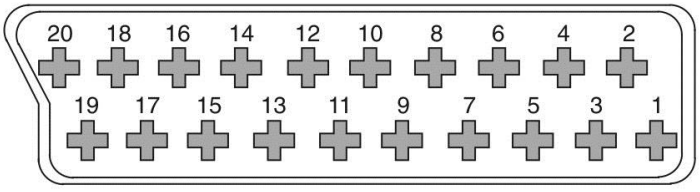
The video signal on the SCART output is always identical to the contents of the TFT display.
The audio signal that is reproduced by the loudspeaker is, at the same time, available on the **left** channel of the SCART socket's audio output.

18.2 Monitor input

A video signal applied to the video input of the SCART socket may be reproduced on the TFT display using the measuring instrument's monitor function.
Correspondingly, an audio signal from the **left** channel of the audio input is reproduced by the instrument's loudspeaker.
The instrument may not be tuned to a station if you wish to access its monitor function. You can do this using **ESCAPE**. Next, **MODE** -> **Monitor** can be used to access the related function. Use **ESCAPE** to exit the monitor.



18.3 Scart socket (EU AV)



1 = not used	8 = not used	15 = not used
2 = not used	9 = not used	16 = not used
3 = Audio output left	10 = not used	17 = Video ground
4 = Audio ground	11 = not used	18 = Video ground
5 = not used	12 = not used	19 = Video output
6 = Audio input left	13 = not used	20 = Video input
7 = not used	14 = not used	Screen = Chassis ground

Chapter 19

DVI interface

The measuring device has a DVI/HDMI interface to connect a "full HD" TV set. This can be used to test if the DVI/HDMI interface on an LCD display is functioning properly, for example. The DVI interface is located on the right-hand side of the instrument.
DVI stands for "Digital Visual Interface" (HDMI is short for "High Definition Multimedia Interface"). The interface is designed physically as a DVI-I socket. However, the protocol conforms to HDMI. This means that audio data are output in addition to video data. The measuring device can be connected to the HDMI input of a TV set using a DVI/HDMI adapter. However, the measuring receiver does not support HDCP (High-bandwidth Digital Content Protection). HDCP restricts the siphoning off of digital and audio material within the HDMI connection. HDCP is requested by the program being played. If an HDTV program requires HDCP, the measuring device cannot output the data via the DVI/HDMI interface. The TV set that is connected then has now picture.

Important! *- Audio transmission only operates if the TV set is connected using an HDMI adapter before the measuring receiver is switched on.*
- The picture format transmitted via DVI is, as on the display of the measuring receiver, in 4:3 format. Therefore there may be a "distortion" of the picture, depending upon the video content.
- The resolution is fixed at 1920x1080i.

Chapter 20

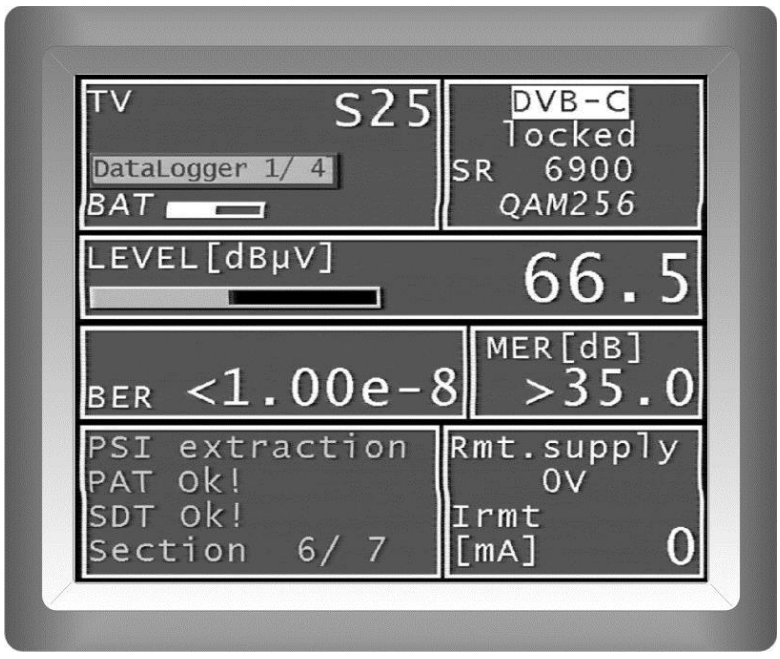
DATA LOGGER

The instrument is equipped with measurement data memory (data logger). This allows you to save measured values automatically on a USB stick as an XML file. The data can then be read and processed using MSExcel or OpenOfficeCalc.

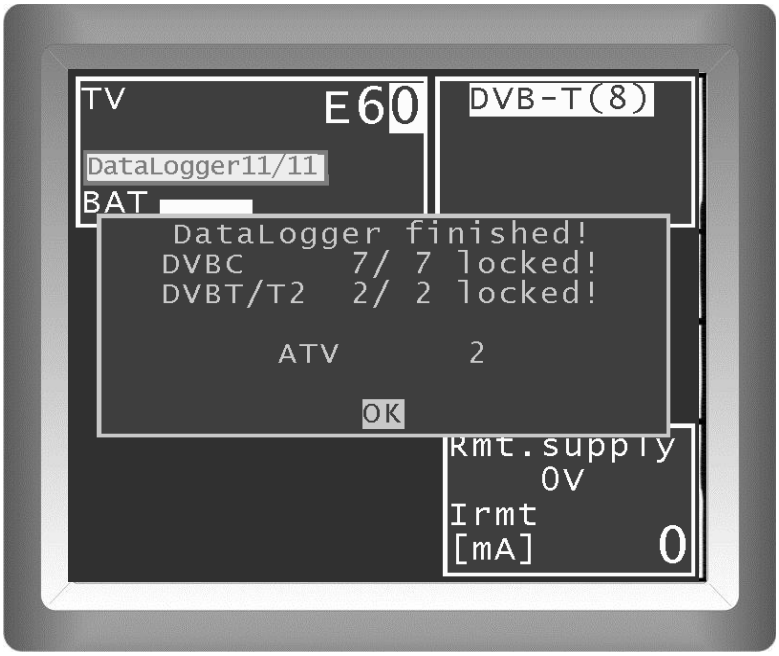
20.1 Automatic recording of measurement sets

If the included USB stick has been inserted, the menu item “Data Logger” can be activated by selecting **MODE > DataLogger.** The menu appears with the selection **MODE > DataLogger** “New Measurement” or “Directory”. Measurements can be added by selecting the menu item “New Measurement”. You are then prompted to enter a name for the system (measuring location). This can then be set alphanumerically by using the left/right arrow keys and the rotary pulse encoder. Press **ENTER** to complete the entry. The entered name is identical to the file name of the XML file, which contains the measured values at the end. If a file with the same name already exists, you will receive a warning. A different name can be entered by pressing **ESCAPE**, or press **ENTER** to overwrite the existing file. After this, enter the individual measurement parameters. The instrument now refers to the tuning memory, whereby only the first and last memory locations must be entered for the measurements. Any blank storage positions are skipped. After this, the instrument automatically accesses the tuning memory individually and saves the measured values in the XML file mentioned above. The measurement’s progress can be tracked following the corresponding message in the frequency window.

The following illustration shows the process.



If the signal does not lock due to poor signal quality or an incorrect parameter, and if, as a result, not all measured values can be recorded, “Signal unlocked” appears.
The series of measurements can be continued by pressing **ENTER** and can be interrupted by pressing **ESC**.
At the end of the series of measurements, a status message is displayed in a window. This message shows how many of the measurements were successful.
If all of the measurements were successful then the window is blue; otherwise it is red. The display is shown until it is confirmed by pressing **ENTER**.



20.2 Transferring and evaluating the measurements on the PC

To evaluate, document or process the set of measurements, the data must first be transferred to a PC or laptop using the USB stick. As previously mentioned, the measurement data saved in the form of an XML file on the USB stick can be read and processed by MSExcel or OpenOfficeCalc. Right-click on the required file and select **"Open with"** > **MSExcel** or **OpenOfficeCalc**.

Important! *Transfer is only possible with MSExcel vers. 2002 or later.*

The illustration below shows a set of measurements in MSExcel.

SYSTEMNAME.XML

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Bereich	Kanal	Frequenz/MHz	LNB	Modus	Modulation	Symbolrate	Pegel/dBµV	TT1/dB	TT2/dB	MER/dB	CBER	VBER
2	TV	S21	303.25		ATV			75.5	-14.5	-20.5			
3	TV	S22	311.25		ATV			76.5	-14.0	-20.5			
4	TV	S23	319.25		ATV			75.0	-14.0	-20.0			
5	TV	S24	327.25		ATV			75.5	-13.5	-20.0			
6	TV	S25	338.00		DVB-C	QAM256	6900	72.0			>35.0	<1.00e-8	
7	TV	S26	346.00		DVB-C	QAM256	6900	73.0			>35.0	<1.00e-8	
8	TV	S27	354.00		DVB-C	QAM 64	6900	67.0			34.8	<1.00e-8	
9	TV	S28	362.00		DVB-C	QAM 64	6900	67.0			34.9	<1.00e-8	
10	TV	S29	370.00		DVB-C	QAM 64	6900	66.0			34.1	<1.00e-8	
11	TV	S30	378.00		DVB-C	QAM 64	6900	67.0			>35.0	<1.00e-8	
12	TV	S31	386.00		DVB-C	QAM 64	6900	65.5			35.0	<1.00e-8	
13	TV	S32	394.00		DVB-C	QAM 64	6900	65.5			>35.0	<1.00e-8	
14	TV	S33	402.00		DVB-C	QAM256	6900	71.5			>35.0	<1.00e-8	
15	TV	S34	410.00		DVB-C	QAM256	6900	71.5			>35.0	<1.00e-8	
16	TV	S36	426.00		DVB-C	QAM256	6900	71.0			>35.0	<1.00e-8	
17	TV	S37	434.00		DVB-C	QAM256	6900	72.0			>35.0	<1.00e-8	
18	TV	S38	442.00		DVB-C	QAM 64	6900	66.0			33.9	<1.00e-8	
19	TV	S39	450.00		DVB-C	QAM 64	6900	66.5			34.7	<1.00e-8	
20	TV	S40	458.00		DVB-C	QAM256	6900	71.0			>35.0	<1.00e-8	
21	TV	S41	466.00		DVB-C	QAM256	6900	71.5			>35.0	<1.00e-8	
22	TV	S02	113.00		DVB-C	QAM 64	6875	69.5			32.4	2.98e-8	
23	TV	S03	121.00		DVB-C	QAM 64	6875	71.0			>35.0	<1.00e-8	
24													
25													
26													
27													
28													
29													

SYSTEMNAME

20.3 Deleting measurement sets from the device

If a USB stick has been inserted into the device, choose **MODE** > **DataLogger** > **Directory** to access files saved on the card. The free memory capacity of the USB stick can also be read in percent. For example the file shown above needs 18 KB on the USB stick. With a capacity of 512 MB, approx. 29,000 of these sets of measurements can be saved.
A file can be deleted by moving the cursor with the rotary pulse encoder onto the file you wish to remove and selecting **ENTER.** The device first issues a warning message. This allows sets of measurements that are no longer needed to be removed, which give a clearer overview for later evaluations.

Chapter 21

List of Channels

21.1 B/G standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier in MHz	Centre Frequency (MHz) DVBC/DVBT
I	2	48.25	53.75	50.50
	3	55.25	60.75	57.50
	4	62.25	67.75	64.50
	D73	70.75	73.00	73.00
USB				
	S2	112.25	117.75	113.00
	S3	119.25	124.75	121.00
	S4	126.25	131.75	130.00
	S5	133.25	138.75	135.50
	S6	140.25	145.75	142.50
	S7	147.25	152.75	149.50
	S8	154.25	159.75	156.50
	S9	161.25	166.75	163.50
	S10	168.25	173.75	170.50
III	5	175.25	180.75	177.50
	6	182.25	187.75	184.50
	7	189.25	194.75	191.50
	8	196.25	201.75	198.50
	9	203.25	208.75	205.50
	10	210.25	215.75	212.50
	11	217.25	222.75	219.50
	12	224.25	229.75	226.50
OSB	S11	231.25	236.75	233.50
	S12	238.25	243.75	240.50
	S13	245.25	250.75	247.50
	S14	252.25	257.75	254.50
	S15	259.25	264.75	261.50
	S16	266.25	271.75	268.50
	S17	273.25	278.75	275.50
	S18	280.25	285.75	282.50
	S19	287.25	292.75	289.50
	S20	294.25	299.75	296.50
ESR	S21	303.25	308.75	306.00
	S22	311.25	316.75	314.00
	S23	319.25	324.75	322.00
	S24	327.25	332.75	330.00
	S25	335.25	340.75	338.00
	S26	343.25	348.75	346.00
	S27	351.25	356.75	354.00
	S28	359.25	364.75	362.00
	S29	367.25	372.75	370.00
	S30	375.25	380.75	378.00
	S31	383.25	388.75	386.00
	S32	391.25	396.75	394.00
	S33	399.25	404.75	402.00
	S34	407.25	412.75	410.00
	S35	415.25	420.75	418.00
	S36	423.25	428.75	426.00
	S37	431.25	436.75	434.00
	S38	439.25	444.75	442.00
	S39	447.25	452.75	450.00
	S40	455.25	460.75	458.00
	S41	463.25	468.75	466.00

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier in MHz	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	476.75	474.00
	22	479.25	484.75	482.00
	23	487.25	492.75	490.00
	24	495.25	500.75	498.00
	25	503.25	508.75	506.00
	26	511.25	516.75	514.00
	27	519.25	524.75	522.00
	28	527.25	532.75	530.00
	29	535.25	540.75	538.00
	30	543.25	548.75	546.00
	31	551.25	556.75	554.00
	32	559.25	564.75	562.00
	33	567.25	572.75	570.00
	34	575.25	580.75	578.00
	35	583.25	588.75	586.00
	36	591.25	596.75	594.00
	37	599.25	604.75	602.00
V	38	607.25	612.75	610.00
	39	615.25	620.75	618.00
	40	623.25	628.75	626.00
	41	631.25	636.75	634.00
	42	639.25	644.75	642.00
	43	647.25	652.75	650.00
	44	655.25	660.75	658.00
	45	663.25	668.75	636.00
	46	671.25	676.75	674.00
	47	679.25	684.75	682.00
	48	687.25	692.75	690.00
	49	695.25	700.75	698.00
	50	703.25	708.75	706.00
	51	711.25	716.75	714.00
	52	719.25	724.75	722.00
	53	727.25	732.75	730.00
	54	735.25	740.75	738.00
	55	743.25	748.75	746.00
	56	751.25	756.75	754.00
	57	759.25	764.75	762.00
	58	767.25	772.75	770.00
	59	775.25	780.75	778.00
	60	783.25	788.75	786.00
	61	791.25	796.75	794.00
	62	799.25	804.75	802.00
	63	807.25	812.75	810.00
	64	815.25	820.75	818.00
	65	823.25	828.75	826.00
	66	831.25	836.75	834.00
	67	839.25	844.75	842.00
	68	847.25	852.75	850.00
	69	855.25	860,75	858,00

21.2 D/K standard (OIRT)

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
I RI	=1	49.75	56.25	52.50
RII	=2	59.25	65.75	62.00
RIII	=3	77.25	83.75	80.00
II RIV	=4	85.25	91.75	88.00
RV	=5	93.25	99.75	96.00
USB	S1	111.25	117.75	114.50
	S2	119.25	125.75	122.00
	S3	127.25	133.75	130.00
	S4	135.25	141.75	138.00
	S5	143.25	149.75	146.00
	S6	151.25	157.75	154.00
	S7	159.25	165.75	162.00
	S8	167.25	173.75	170.00
III RVI	=6	175.25	181.75	178.00
RVII	=7	183.25	189.75	186.00
RVIII	=8	191.25	197.75	194.00
RIX	=9	199.25	205.75	202.00
RX	=10	207.25	213.75	210.00
RXI	=11	215.25	221.75	218.00
RXII	=12	223.25	229.75	226.00
OSB	S9	231.25	237.75	234.00
	S10	239.25	245.75	242.00
	S11	247.25	253.75	250.00
	S12	255.25	261.75	258.00
	S13	263.25	269.75	266.00
	S14	271.25	277.75	274.00
	S15	279.25	285.75	282.00
	S16	287.25	293.75	290.00
	S17	295.25	301.75	298.00
	S18	303.25	309.75	306.00
	S19	311.25	317.75	314.00
	S20	319.25	325.75	322.00
	S21	327.25	333.75	330.00
	S22	335.25	341.75	338.00
	S23	343.25	349.75	346.00
	S24	351.25	357.75	354.00
	S25	359.25	365.75	362.00
	S26	367.25	373.75	370.00
	S27	375.25	381.75	378.00
	S28	383.25	389.75	386.00
	S29	391.25	397.75	394.00
	S30	399.25	405.75	402.00
	S31	407.25	413.75	410.00
	S32	415.25	421.75	418.00
	S33	423.25	429.75	426.00
	S34	431.25	437.75	434.00
	S35	439.25	445.75	442.00
	S36	447.25	453.75	450.00
	S37	455.25	461.75	458.00
	S38	463.25	469.75	466,00

Range	Channel	Video Carrier (MHz) to ATV	Sound Carrier in MHz	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	477.75	474.00
	22	479.25	485.75	482.00
	23	487.25	493.75	490.00
	24	495.25	501.75	498.00
	25	503.25	509.75	506.00
	26	511.25	517.75	514.00
	27	519.25	525.75	522.00
	28	527.25	533.75	530.00
	29	535.25	541.75	538.00
	30	543.25	549.75	546.00
	31	551.25	557.75	554.00
	32	559.25	565.75	562.00
	33	567.25	573.75	570.00
	34	575.25	581.75	578.00
	35	583.25	589.75	586.00
	36	591.25	597.75	594.00
	37	599.25	605.75	602.00
V	38	607.25	613.75	610.00
	39	615.25	621.75	618.00
	40	623.25	629.75	626.00
	41	631.25	637.75	634.00
	42	639.25	645.75	642.00
	43	647.25	653.75	650.00
	44	655.25	661.75	658.00
	45	663.25	669.75	666.00
	46	671.25	677.75	674.00
	47	679.25	685.75	682.00
	48	687.25	693.75	690.00
	49	695.25	701.75	698.00
	50	703.25	709.75	706.00
	51	711.25	717.75	714.00
	52	719.25	725.75	722.00
	53	727.25	733.75	730.00
	54	735.25	741.75	738.00
	55	743.25	749.75	746.00
	56	751.25	757.75	754.00
	57	759.25	765.75	762.00
	58	767.25	773.75	770.00
	59	775.25	781.75	778.00
	60	783.25	789.75	786.00
	61	791.25	797.75	794.00
	62	799.25	805.75	802.00
	63	807.25	813.75	810.00
	64	815.25	821.75	818.00
	65	823.25	829.75	826.00
	66	831.25	837.75	834.00
	67	839.25	845.75	842.00
	68	847.25	853.75	850.00
	69	855.25	861.75	858.00

21.3 M/N standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
I	A02	55.25	59.75	57.00
	A03	61.25	65.75	63.00
	A04	67.25	71.75	69.00
	A05	77.25	81.75	75.00
	A06	83.25	87.75	81.00
USB	S02	112.25	116.75	114.50
	S03	119.25	123.75	121,50
	S04 to S08			
	continuous as with the B/G standard			
	7MHz channel spacing			
	4.5MHz video-sound carrier interval			
	S09	161.25	165.75	163.50
	S10	168.25	172.75	170.50
III	A07	175.25	179.75	177.00
	A08	181.25	185.75	183.00
	A09	187.25	191.75	189.00
	A10	193.25	197.75	195.00
	A11	199.25	203.75	201.00
	A12	205.25	209.75	207.00
	A13	211.25	215.75	213.00
OSB	S11	231.25	235.75	233.50
	S12	238.25	242.75	240,50
	S13 to S39			
	continuous as with the B/G standard			
ESR	7MHz channel spacing			
	4.5MHz video-sound carrier interval			
	S40	455.25	459.75	250.00
	S41	463.25	467.75	258.00
IV	14	471.25	475.75	473.00
	15	477.25	481.75	479.00
	16	483.25	487.75	485.00
	17	489.25	493.75	491.00
	18	495.25	499.75	497.00
	19	501.25	505.75	503.00
	20	507.25	511.75	509.00
	21	513.25	517.75	515.00
	22	519.25	523.75	521.00
	23	525.25	529.75	527.00
	24	531.25	535.75	533.00
	25	537.25	541.75	539.00
	26	543.25	547.75	545.00
	27	549.25	553.75	551.00
	28	555.25	559.75	557.00
	29	561.25	565.75	563.00
	30	567.25	571.75	569.00
	31	573.25	577.75	575.00
	32	579.25	583.75	581.00

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
IV	33	585.25	589.75	587.00
	34	591.25	595.75	593.00
	35	597.25	601.75	599.00
	36	603.25	607.75	605.00
	37	609.25	613.75	617.00
	38	615.25	619.75	623.00
	39	621.25	625.75	629.00
	40	627.25	631.75	635.00
	41	633,25	637,75	635.00
	42	639,25	637,75	641.00
V	43	645.25	649.75	647.00
	44	651.25	655.75	653.00
	45	657.25	661.75	659.00
	46	663.25	667.75	665.00
	47	669.25	673.75	671.00
	48	675.25	679.75	677.00
	49	681.25	685.75	683.00
	50	687.25	691.75	689.00
	51	693.25	697.75	695.00
	52	699.25	703.75	701.00
	53	705.25	709.75	707.00
	54	711.25	715.75	713.00
	55	717.25	721.75	719.00
	56	723.25	727.75	725.00
	57	729,25	733,75	731.00
	58	735,25	739,75	737.00
	59	741.25	745.75	743.00
	60	747.25	751.75	749.00
	61	753.25	757.75	755.00
	62	759.25	763.75	761.00
	63	765.25	769.75	767.00
	64	771.25	775.75	773.00
	65	777.25	781.75	779.00
	66	783.25	787.75	785.00
	67	789.25	793.75	791.00
	68	795.25	799.75	797.00
	69	801.25	805.75	803.00
	70	807.25	811.75	809.00
	71	813.25	817.75	815.00
	72	819.25	823.75	821.00
	73	825.25	829.75	827.00
	74	831.25	835.75	833.00
	75	837.25	841.75	839.00
	76	843.25	847.75	845.00
	77	849.25	853.75	851.00
	78	855.25	859.75	857.00

21.4 L standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
I	A=91	47.75	41.25*	50.50
	B=92	55.75	49.25*	58.50
	C1=93	60.50	54.00*	63.25
	C=94	63.75	57.25*	66.50
USB	S1	120.75	127.25	123.50
	S2	128.75	135.25	131.50
	S3	136.75	143.25	139.50
	S4	144.75	151.25	147.50
	S5	152.75	159.25	155.50
	S6	160.75	167.25	163.50
	S7	168.75	175.25	171.50
	1	176.00	182.50	178.75
	2	184.00	190.50	186.75
	3	192.00	198.50	194.75
	4	200.00	206.50	202.75
	5	208.00	214.50	210.75
	6	216.00	222.50	218.75
OSB	S14	224.75	231.25	227.50
	S15	232.75	239.25	235.50
	S16	240.75	247.25	243.50
	S17	248.75	255.25	251.50
	S18	256.75	263.25	259.50
	S19	264.75	271.25	267.50
	S20	272.75	279.25	275.50
	S21	280.75	287.25	283.50
	S22	288.75	295.25	291.50
	S23	296.75	303.25	299.50
	S24	303.25	309.75	306.50
	S25	311.25	317.75	314.50
	S26	319.25	325.75	322.50
	S27	327.25	333.75	330.50
	S28	335.25	341.75	338.50
	S29	343.25	349.75	346.50
	S30	351.25	357.75	354.50
	S31	359.25	365.75	362.50
	S32	367.25	373.75	370.50
	S33	375.25	381.75	378.50
	S34	383.25	389.75	386.50
	S35	391.25	397.75	394.50
	S36	399.25	405.75	402.50
	S37	407.25	413.75	410.50
	S38	415.25	421.75	418.50
	S63	423.25	429.75	426.50
	S64	431.25	437.75	434.50
	S65	439.25	445.75	442.50
	S66	447.25	453.75	450.50
	S67	455.25	461.75	458.50
	S68	463.25	469.75	466.50

***) for technical reasons it is not possible to make these sound carriers audible**.

Range	Channel	Video Carrier (MHz) to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	477.75	474.00
	22	479.25	485.75	482.00
	23	487.25	493.75	490.00
	24	495.25	501.75	498.00
	25	503.25	509.75	506.00
	26	511.25	517.75	514.00
	27	519.25	525.75	522.00
	28	527.25	533.75	530.00
	29	535.25	541.75	538.00
	30	543.25	549.75	546.00
	31	551.25	557.75	554.00
	32	559.25	565.75	562.00
	33	567.25	573.75	570.00
	34	575.25	581.75	578.00
	35	583.25	589.75	586.00
	36	591.25	597.75	594.00
	37	599.25	605.75	602.00
V	38	607.25	613.75	610.00
	39	615.25	621.75	618.00
	40	623.25	629.75	626.00
	41	631.25	637.75	634.00
	42	639.25	645.75	642.00
	43	647.25	653.75	650.00
	44	655.25	661.75	658.00
	45	663.25	669.75	666.00
	46	671.25	677.75	674.00
	47	679.25	685.75	682.00
	48	687.25	693.75	690.00
	49	695.25	701.75	698.00
	50	703.25	709.75	706.00
	51	711.25	717.75	714.00
	52	719.25	725.75	722.00
	53	727.25	733.75	730.00
	54	735.25	741.75	738.00
	55	743.25	749.75	746.00
	56	751.25	757.75	754.00
	57	759.25	765.75	762.00
	58	767.25	773.75	770.00
	59	775.25	781.75	778.00
	60	783.25	789.75	786.00
	61	791.25	797.75	794.00
	62	799.25	805.75	802.00
	63	807.25	813.75	810.00
	64	815.25	821.75	818.00
	65	823.25	829.75	826.00
	66	831.25	837.75	834.00
	67	839.25	845.75	842.00
	68	847.25	853.75	850.00
	69	855.25	861.75	858.00

21.5 I standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
I	IA=1	45.75	51.75	48.50
	IB=2	53.75	59.75	56.50
	IC=3	61.75	67.75	64.50
USB	S2	112.25	118.25	114.50
	S3	119.25	125.25	121.50
	S4	126.25	132.25	128.50
	S5	133.25	139.25	135.50
	S6	140.25	146.25	142.50
	S7	147.25	153.25	149.50
	S8	154.25	160.25	156.50
	S9	161.25	167.25	163.50
III	ID =4	175.25	181.25	178.00
	IE =5	183.25	189.25	186.00
	IF =6	191.25	197.25	194.00
	IG =7	199.25	205.25	202.00
	IH =8	207.25	213.25	210.00
	IJ =9	215.25	221.25	218.00
	IK =10	223.25	229.25	226.00
	IL =11	231.25	237.25	234.00
	IM =12	239.25	245.25	242.00
	IN =13	247.25	253.25	250.00
OSB	S15	259.25	265.25	261.50
	S16	266.25	272.25	268.50
	S17	273.25	279.25	275.50
	S18	280.25	286.25	282.50
	S19	287.25	293.25	289.50
	S20	294.25	300.25	296.50
ESR	S21	303.25	309.25	306.00
	S22	311.25	317.25	314.00
	S23	319.25	325.25	322.00
	S24	327.25	333.25	330.00
	S25	335.25	341.25	338.00
	S26	343.25	349.25	346.00
	S27	351.25	357.25	354.00
	S28	359.25	365.25	362.00
	S29	367.25	373.25	370.00
	S30	375.25	381.25	378.00
	S31	383.25	389.25	386.00
	S32	391.25	397.25	394.00
	S33	399.25	405.25	402.00
	S34	407.25	413.25	410.00
	S35	415.25	421.25	418.00
	S36	423.25	429.25	426.00
	S37	431.25	437.25	434.00
	S38	439.25	445.25	442.00
	S39	447.25	453.25	450.00
	S40	455.25	461.25	458.00
	S41	463.25	469.25	466.00

Range	Channel	Video Carrier (MHz) to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
IV	21	471.25	477.75	474.00
	22	479.25	485.75	482.00
	23	487.25	493.75	490.00
	24	495.25	501.75	498.00
	25	503.25	509.75	506.00
	26	511.25	517.75	514.00
	27	519.25	525.75	522.00
	28	527.25	533.75	530.00
	29	535.25	541.75	538.00
	30	543.25	549.75	546.00
	31	551.25	557.75	554.00
	32	559.25	565.75	562.00
	33	567.25	573.75	570.00
	34	575.25	581.75	578.00
	35	583.25	589.75	586.00
	36	591.25	597.75	594.00
	37	599.25	605.75	602.00
V	38	607.25	613.75	610.00
	39	615.25	621.75	618.00
	40	623.25	629.75	626.00
	41	631.25	637.75	634.00
	42	639.25	645.75	642.00
	43	647.25	653.75	650.00
	44	655.25	661.75	658.00
	45	663.25	669.75	666.00
	46	671.25	677.75	674.00
	47	679.25	685.75	682.00
	48	687.25	693.75	690.00
	49	695.25	701.75	698.00
	50	703.25	709.75	706.00
	51	711.25	717.75	714.00
	52	719.25	725.75	722.00
	53	727.25	733.75	730.00
	54	735.25	741.75	738.00
	55	743.25	749.75	746.00
	56	751.25	757.75	754.00
	57	759.25	765.75	762.00
	58	767.25	773.75	770.00
	59	775.25	781.75	778.00
	60	783.25	789.75	786.00
	61	791.25	797.75	794.00
	62	799.25	805.75	802.00
	63	807.25	813.75	810.00
	64	815.25	821.75	818.00
	65	823.25	829.75	826.00
	66	831.25	837.75	834.00
	67	839.25	845.75	842.00
	68	847.25	853.75	850.00
	69	855.25	861.75	858.00

21.6 DAB

Channel	Centre Frequency (MHz)	Channel	Centre Frequency (MHz)
05A	174.928	10A	209.936
05B	176.640	10B	211.648
05C	178.352	10C	213.360
05D	180.064	10D	215.072
06A	181.936	11A	216.928
06B	183.648	11B	218.640
06C	185.360	11C	220.352
06D	187.072	11D	222,064
07A	188.928	12A	223.936
07B	190.640	12B	225.648
07C	192.352	12C	227.360
07D	194.064	12D	229.072
08A	195.936	13A	230.784
08B	197.648	13B	232.496
08C	199.360	13C	234.208
08D	201.072	13D	235.776
09A	202.928	13E	237.488
09B	204.640	13F	239.200
09C	206.352		
09D	208.064		

Index

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V