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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 $70V_{\text{eff}}$ ($60V_{\text{eff}}$ = 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 electrical components.

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



Passage from the battery regulations (BattV)

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

1.2 Usage Notes

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



Make sure no external voltages higher than $70V_{\text{eff}}$ ($60V_{\text{eff}}$ = 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 mechanical 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 - 2150 MHz resolution 500 kHz Transponder frequency or 1 st IF entry
TV		44.75 - 867.25 MHz resolution 50 kHz
FM (VHF)		87.5 - 108.3 MHz resolution 50 kHz
RC (Return channel)		5 - 65 MHz resolution 50 kHz
OPERATING MODES		
SAT analog, DVBS, DVBS2 TV analog, DVBC, DVBT FM (VHF) RC (return channel) Analyzer in all ranges		
OPERATION		
Input		via keypad and rotary selector
Monitor		4" Color-TFT, QVGA 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	> 12 dB (5 - 867.25 MHz)
	return loss	> 10 dB (910 - 2150 MHz)
INPUT ATTENUATOR		
0 – 60 dB in 4 dB-increments		
LEVEL MEASUREMENT		
measuring ranges	SAT	30 – 110 dB μ V
	TV	25 – 110 dB μ V
	FM	25 – 110 dB μ V
	RC	25 – 110 dB μ V
resolution		0.5 dB
measuring accuracy		$\pm 1,5$ dB (at 20°C) $\pm 2,0$ dB (0°C-40°C)
measuring bandwidth (RB)	SAT analog	8 MHz
	SAT DVB-S	8 MHz, 4 MHz or 1 MHz depending on symbol rate
	TV analog	Video carrier 200 kHz Audio carrier 200 kHz
	DVB-T	4 MHz
	DVB-C	4 MHz oder 200 kHz depending on symbol rate
	FM	200 kHz
	RC	1 MHz
acoustic level trend indicator		can be switched on/off
level trend bar		with MaxHold Indicator

ANALYZER	digital analyzer	
Measuring bandwidth (RB)	SAT	8 MHz, 4 MHz or 1 MHz dependent on span
	TV	4 MHz, 1 MHz or 200 kHz dependent on span
	FM	200 kHz
	RC	1 MHz or 200 kHz dependent on span
Span (frequency segment)	SAT	total range, 150 MHz or 38 MHz
	TV	total range, 76 MHz or 15 MHz
	FM	total range, 15 MHz
	RC	total range, 15 MHz
Switch directly between analyzer and receiver modes		
SAT analog		
Video features	video bandwidth	5 MHz
	deemphasis	per CCIR 405-1
	inversion	for C-band reception
Audio features	audio subcarrier	5.00 – 9.75 MHz
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)
	S/N	2 – 15 dB resolution 0.1 dB
Searching function		
DVBS2 (optional)		
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)	
	PER	10^{-1} to 10^{-5} (bit error rate per BCH)
	CBER	10^{-2} to 10^{-8} (bit error rate before LDPC)
	S/N	1 – 20 dB resolution 0.1 dB
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 0.5 dB	
Searching function		
DVBC		
QAM demodulator	(per ETS 300429)	
Symbol rates	0.5 – 7.2 MSym/s	
Modulation scheme	16, 32, 64, 128, 256 QAM	
Measuring parameters	(per ETR 290)	
	BER	10^{-2} bis 10^{-8} (bit error rate per Viterbi)
	MER	10 - 35 dB resolution 0.1 dB
Searching function		

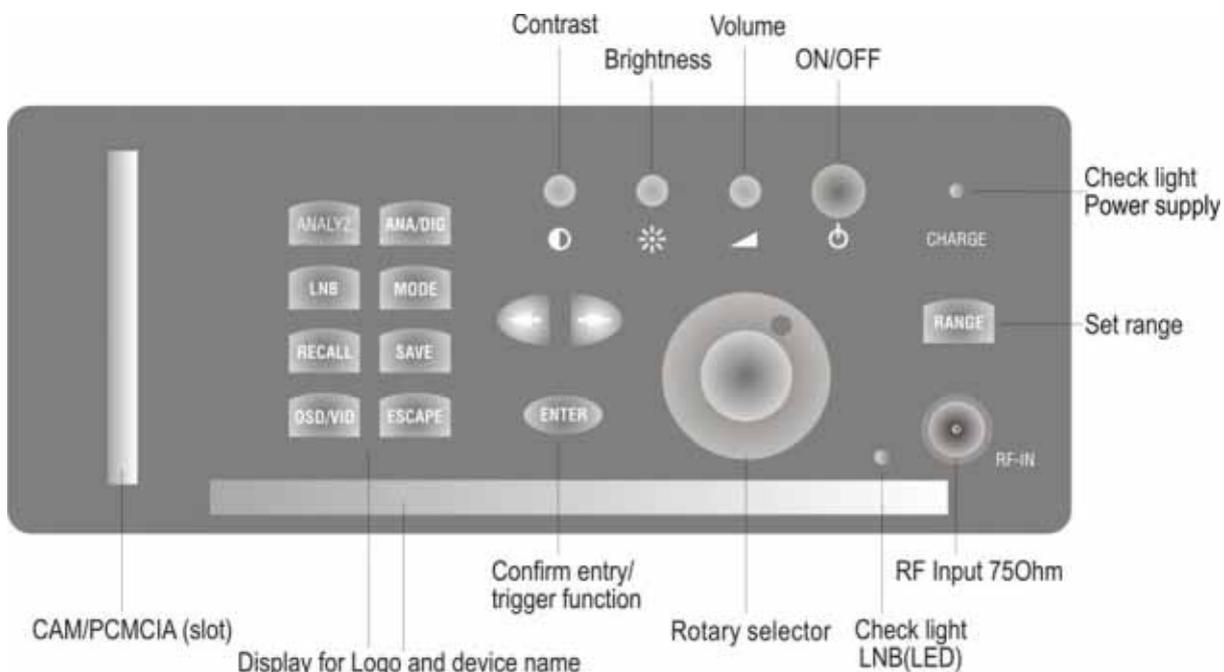
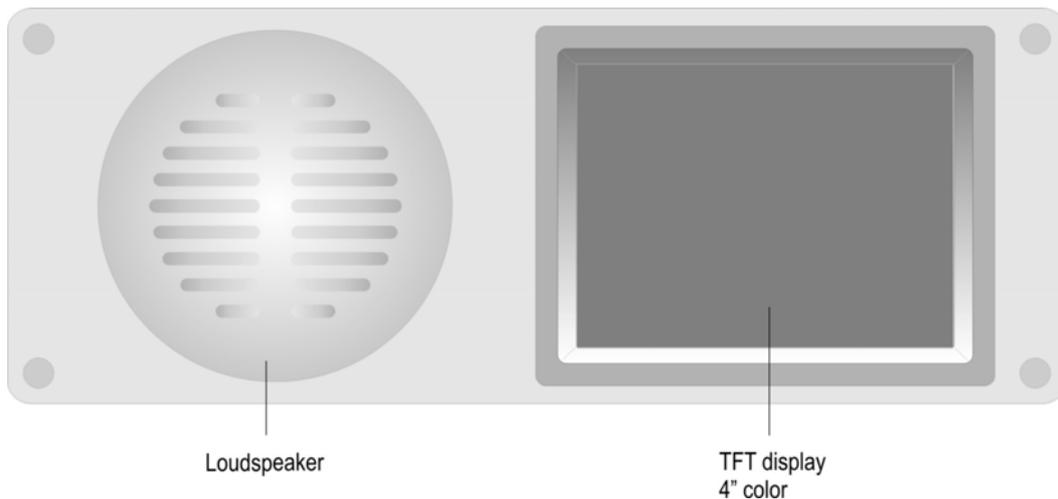
DVBT		
COFDM demodulator		(per ETS 300744)
FFT		2k, 8k
Modulation scheme		QPSK, 16QAM, 64QAM
Guard interval		1/4, 1/8, 1/16, 1/32
Measuring parameters		(per ETR 290)
	VBER	10^{-2} bis 10^{-8} (bit error rate per Viterbi)
	CBER	10^{-2} bis 10^{-6} (bit error rate before Viterbi)
	S/N	3 – 24 dB resolution 0.1 dB
Impulse response		attenuation relative to the primary impulse 0-30 dB delay relative to the primary impulse in μ s or km
Searching function		
FM (VHF)		
Mono/Stereo indicator		
Searching function		
MPEG2-Decoder		video and audio decoding per MPEG2 (ISO/IEC 13818) NIT analysis Direct tuning of the receiver from the NIT Display of MPEG2 video parameters Video bit rate measurement in Mbit/s
CI (Common Interface)		1 CI slot Presentation of card menu
Data logger		Stores measurements automatically in the form of an XML file on a CompactFlash™ card
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 1V _{pp} at 600 Ohm
RS232		9-pin Sub-D socket for software update
TUNING MEMORY		
		99 Memory locations memory protection function
REMOTE SUPPLY		
SAT		
	maximum power	500 mA (short circuit-proof)
	voltages	14V / 18V
	22 kHz 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	$\pm 5\%$ of final value
TV/FM/RC		
	maximum power	100 mA (short circuit-proof)
	voltages	5V / 18V
	current measuring	
	measuring range	0 – 100 mA
	resolution	1 mA
	measuring accuracy	$\pm 5\%$ 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	10 – 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 automatic cutout as protection against exhaustive discharge
charging time	approx. 4 hours
battery management	Battery can be charged using mains and 12 V external supply
ELECTROMAGNETIC COMPATIBILITY	
according to EN 61000-6-1 and EN 61000-6-3	
PROTECTION	
according to EN 61010-1	
DIMENSIONS (W x H x D)	
B 252mm, H 135mm, T 272mm	
WEIGHT	
ca. 5.0 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

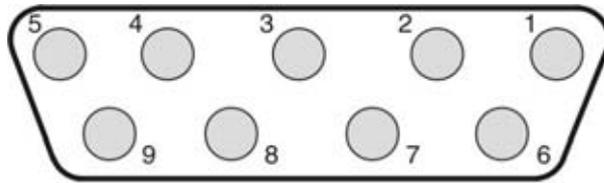
3.1 Front Panel



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		

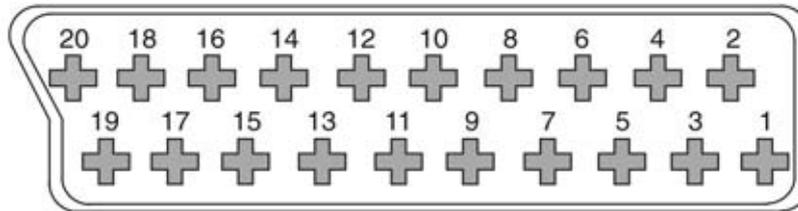
3.5 RS 232



- 1 = not used
- 2 = RX data (Receiver data)
- 3 = TX data (Transmitter data)
- 4 = not used
- 5 = chassis
- 6 = not used
- 7 = not used
- 8 = not used
- 9 = not used

3.6 SCART socket

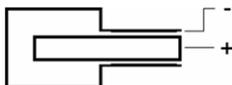
Scart socket per DIN EN 50 049



- | | | |
|-----------------------|---------------|-------------------------|
| 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 |

3.7 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

An NI-MH battery 12V/4.5Ah is included in the delivery of this instrument.

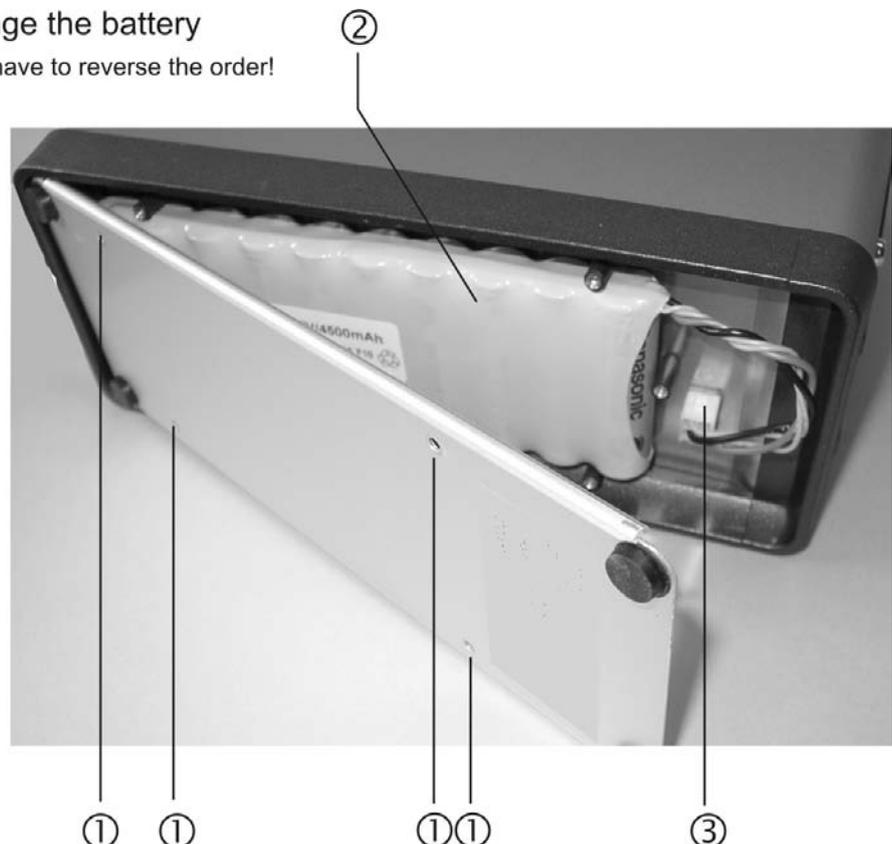
4.2.1 Replacing the battery

4.2.1.1 Instrument delivered before August 2007

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, then remove the rear cover of the instrument. After loosening 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 To build in the battery you have to reverse the order!
- ② Take out the battery pack
- ③ Disconnect the battery plug

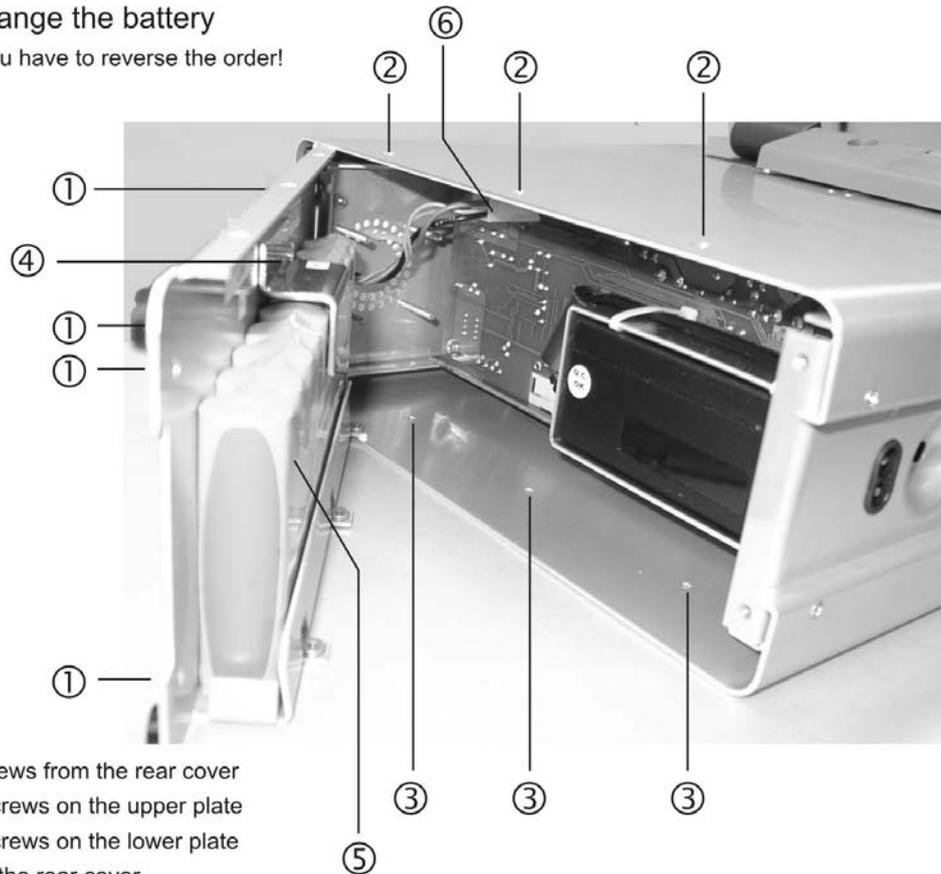
After the battery is changed, the battery charge management must be recalibrated. First, discharge the battery completely, then recharge it.

4.2.1.2 Instrument delivered later August 2007

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 loosening 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 attachment 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.

4.2.2 Battery management

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.

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.

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 10V 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 electronic components. This ventilator is controlled by a temperature sensor via a microprocessor.

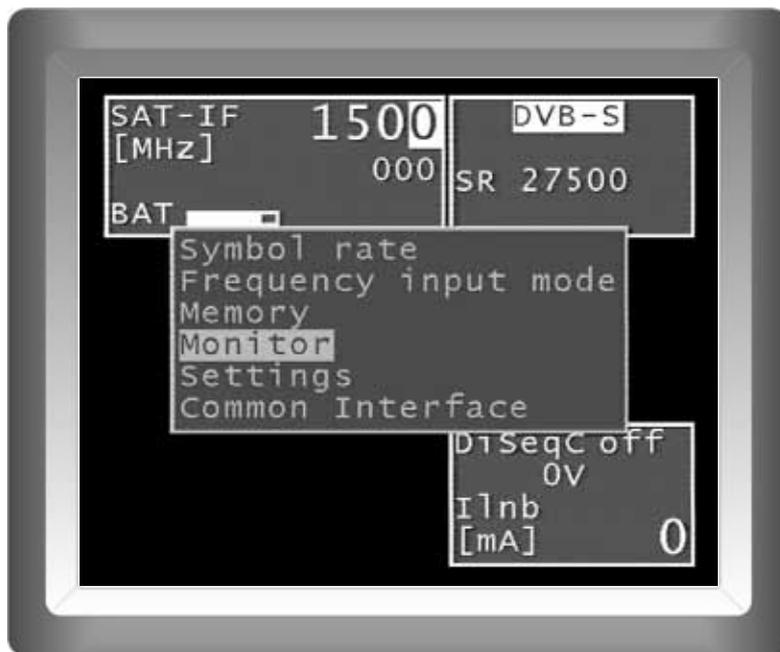
Chapter 5

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 Drehimpulsgeber. 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 2150MHz.

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

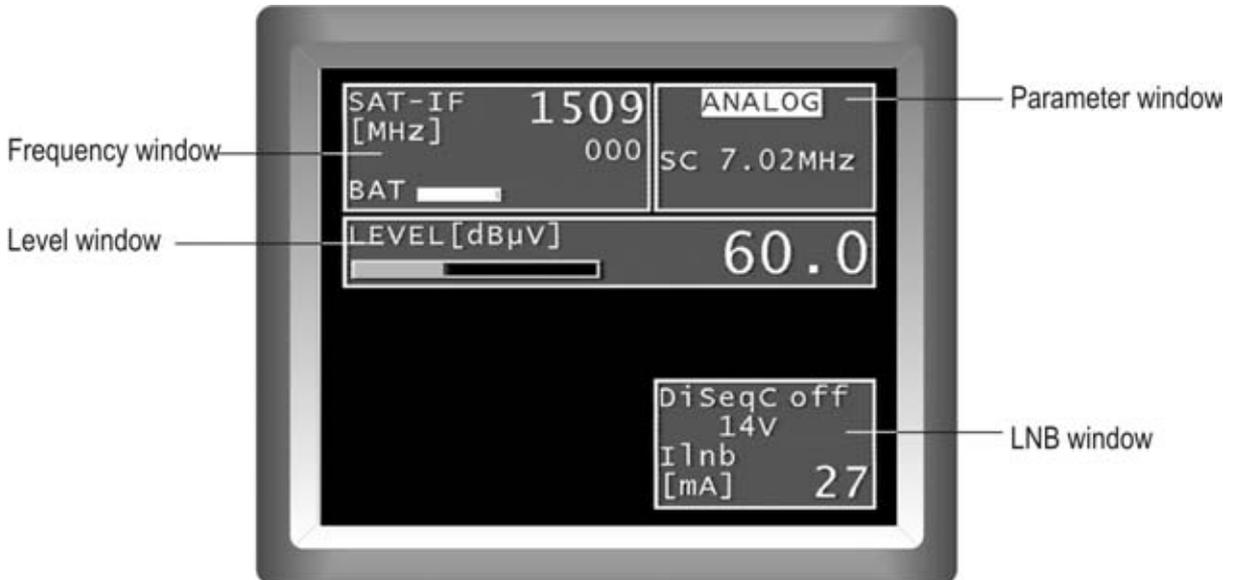
The device incorporates one user-defined LNB oscillator frequency for RF inputs in the C band. It can be changed under **MODE -> Settings -> LNB frequencies -> C band** between 4,000 and 6,000 GHz. 5,150 GHz is the factory presetting. To use the LNB oscillator frequency, select the "C band" menu item 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 9.75 MHz. The factory has set the frequencies 6.50, 7.02 and 7.20 MHz.

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 analog television signals. Start the 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!

The search function in the operating mode of UNICABLE has been 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 5 preset symbol rates for rapid input. **MODE** -> **Symbol rate** opens the selection area for the 5 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.

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 S/N measuring start.

The values measured are displayed in the BER window or S/N 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 S/N measurement

The S/N ratio of the signal in the baseband (after the demodulator) is indicated in the S/N window in dB. The measuring range is between 2.0 and 15.0dB. The resolution is 0.1dB.

6.2.3 DVBS2 mode (optional)

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 C/N).

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 5 preset symbol rates for rapid input. **MODE** -> **Symbol rate** opens the selection area for the 5 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.

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!

The search function in the operating mode of UNICABLE has been 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 S/N is triggered. The measured values are shown in the BER window and the S/N 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 the bit error rate after BCH (VBER) 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 S/N measurement

The S/N ratio of the signal in the baseband (after the demodulator) is indicated in the S/N 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 dB μ V in the level window.

The measuring range is between 30 and 110dB μ V 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 500mA current. The instrument switches off the LNB supply if a short-circuit is found or the current is too high.

The red LED on the RF input lights up as soon as the LNB supply is activated.

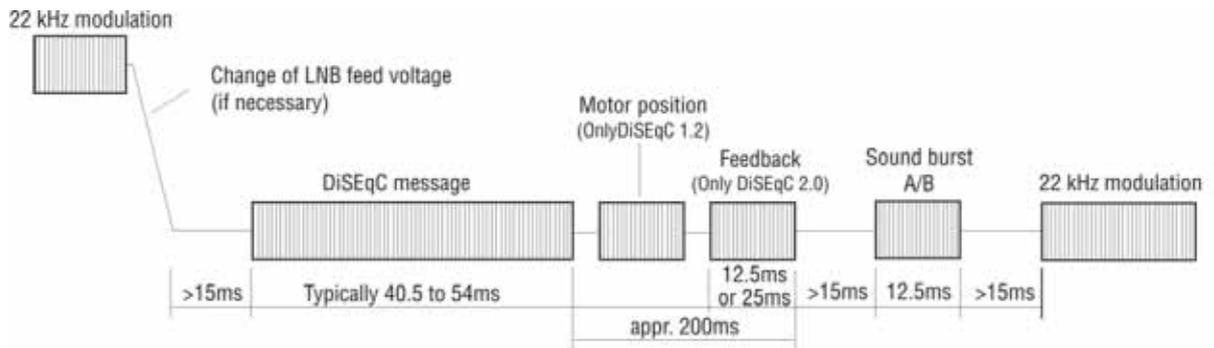
6.4.1 14/18V – 22kHz control

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

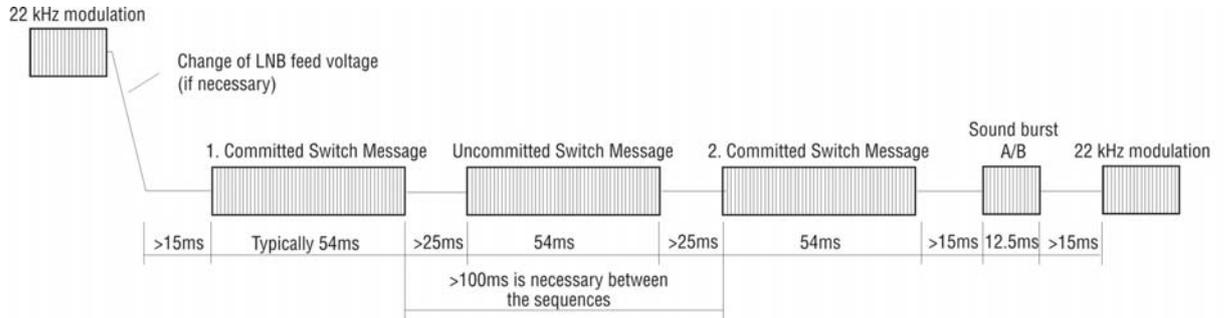
LNB -> DiSEqC -> V1.1 activates the DiSEqC V1.1 menu. V1.1 allows a total of up to 256 SAT IF levels to be controlled. V1.1 also incorporates DiSEqC component cascading. I.e. corresponding multiswitches or switching relays can be connected in series. This requires multiple repetition of the DiSEqC command(s).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

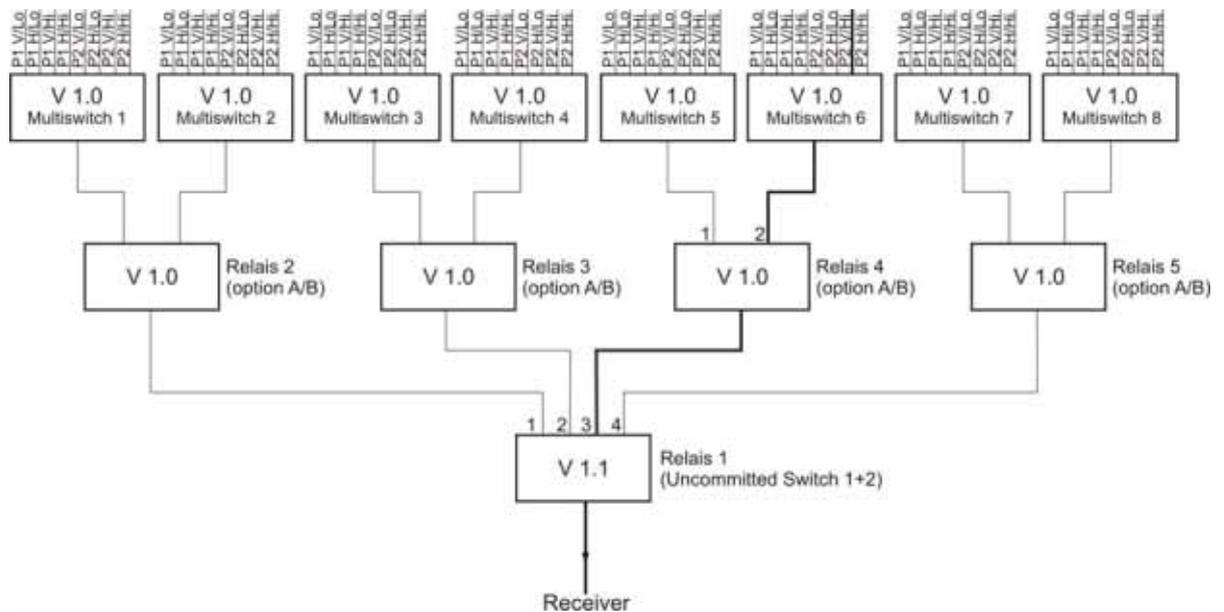
The 'uncommitted switches' are controlled in binary format here. The rotary pulse encoder allows one of the 16 possible combinations of the 4 'uncommitted switches' to be selected using a hexadecimal number ('0' hex - 'F' hex). Press **ENTER** to accept the setting.

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

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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 a 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.

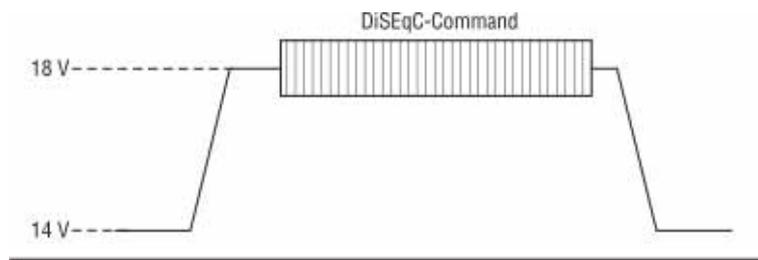
6.4.3 UNICABLE

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

LNB > DiSEqC > V2.0 activates the UNICABLE control.

A menu for editing the relationship between the satellite channel router (SCR) address and the centre frequency of the user band (UB) bandpass slot that the measuring receiver is to use is then displayed. These parameters can be obtained from the data sheet of the UNICABLE unit being used.

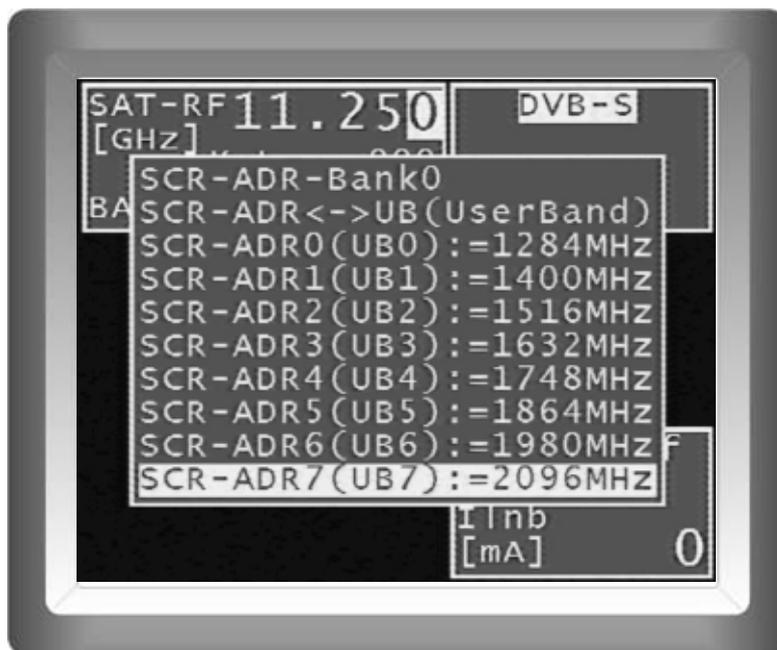
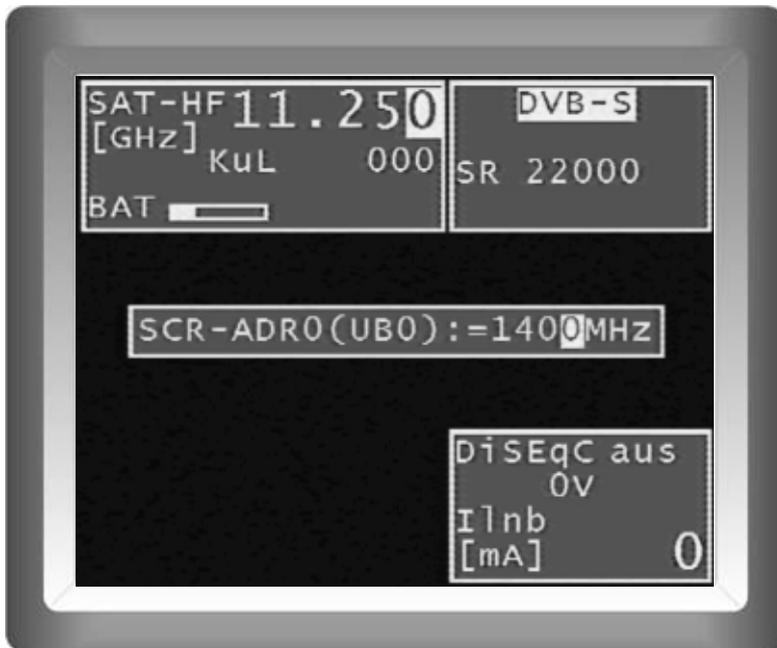


Figure xx

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

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 950 MHz and 2150 MHz.

Press **ENTER** to save your entry and return to the menu displayed in figure xx. 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

There are UNICABLE units available that operate with 8 receivers per cable and others that operate with 4 receivers per cable. These units generally operate with differing UB centre frequencies. To simplify the procedure for the user, the device offers a feature that enables switching between two SCR address banks. That means that the device has one bank 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 be changed within the two banks as described above. All entries are stored in non-volatile memory, and the device will operate with these settings when it is next switched on. In addition, the bank selection is stored in the tuning memory, allowing entries from both bank 0 and bank 1 to be stored in any memory location.

-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**.

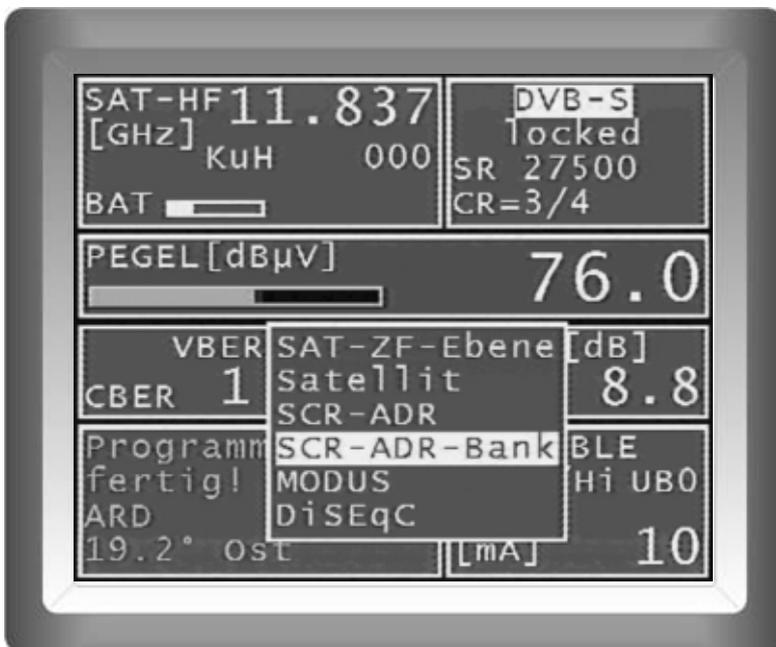
The measuring receiver is tuned as described in the "Frequency input" chapter.

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.

Note!

The search function in the operating mode of UNICABLE has been deactivated.

6.4.3 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 0 kHz. Using **MODE->Frequency offset** allows you to select the following offsets: 0 kHz, +500 kHz, +333 kHz, +167 kHz, -167 kHz, -333 kHz and -500 kHz. The frequency offset is shown in smaller font directly under the channel number (e.g. +167 kHz). 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 167 kHz. If the channel is set to E22 (482.000MHz), the receiver actually tunes to 482.167 MHz.

7.2 *Selecting the operating mode*

In the TV measuring range the operating modes ANALOG TV (ATV) and DVBC and DVBT 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)

Analog-modulated TV signals can be received and measured here.

The instrument supports the B/G, M/N, I, D/K and L TV standards as well as the PAL 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 500 and 7200 kBd (0.5 - 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 stop 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 35.0 dB; the resolution is 0.1 dB. The measured value is displayed in the MER window.

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. DVB-T8).

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 S/N measuring start. The values measured are displayed in the BER window or S/N 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 S/N measurement

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

7.2.3.6 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.

7.3 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 $\text{dB}\mu\text{V}$ in the level window. The measuring range is between 25 and 110 $\text{dB}\mu\text{V}$ with a resolution of 0.5 dB .

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.

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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. -13.0 dB).

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, 18 V and no remote supply. The supply is short circuit proof and provides a maximum of 100 mA current. 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.

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 (0 V, 5 V and 18 V) 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 – 108.3 MHz 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 (87.5 MHz – 108.3 MHz) 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.

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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 dB μ V in the level window. The measuring range extends from 25 to 110 dB μ V with a resolution of 0.5 dB.

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

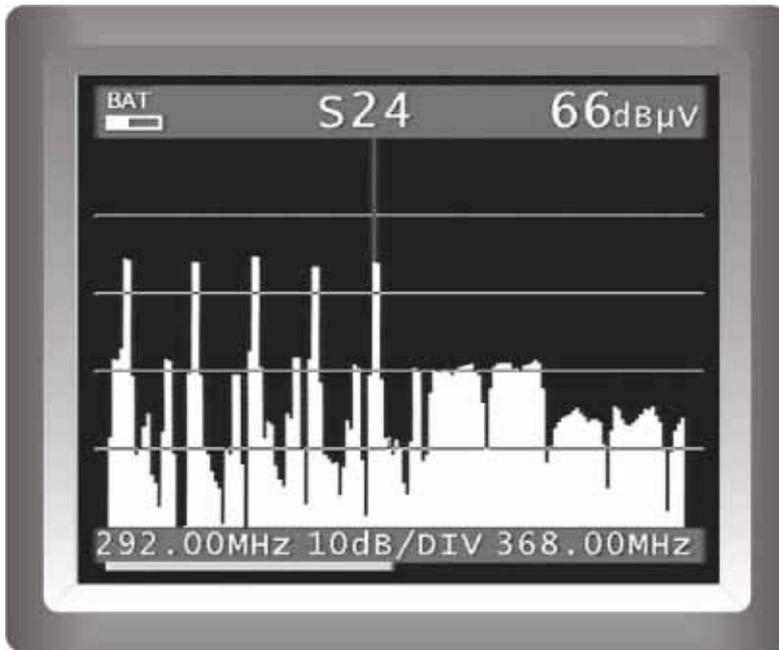
A pure (sine) tone, whose frequency changes in proportion to the level that is measured, is emitted from the loudspeaker. The frequency of the signal tone rises as the level increases.

Press **MODE > level acoustic > on (off)** to turn the function on or off at any time.

Chapter 10

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 10 dB/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.

10.1 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.

10.2 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 - 2150 MHz	150 MHz	38 MHz	Not available
TV	45 - 867 MHz	152 MHz	76 MHz	15 MHz
FM (VHF)	87.5 - 108.3 MHz	15 MHz	Not available	Not available
RC (Return channel)	5 - 65 MHz	15 MHz	Not available	Not available

10.3 **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.

10.3.1 *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 (ATV). The cursor moves to the video carrier frequency for analog channels and to the channel centre frequency for digital channels.

10.4 **Level measurement**

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

10.5 **Corrected level display with TV analyzer**

If the analyzer is in the TV 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.

10.5.1 *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.

10.5.2 *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.

10.6 **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".

10.7 **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.

10.8 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.

Chapter 11

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.

11.1 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.



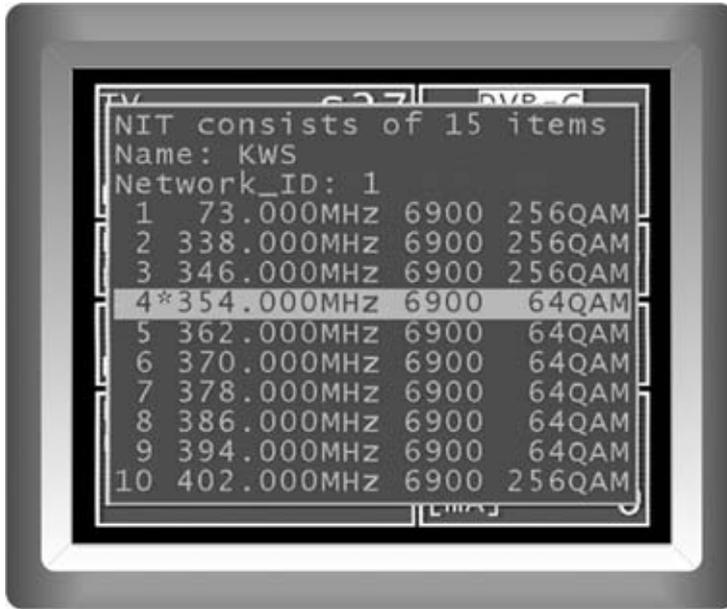
The MPEG window is seen in the lower left edge of the screen. This example shows a new program search in a DVBC channel.

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

11.2 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. Press **ENTER** 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 accordingly. Then, as described 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.

11.3 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 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, S/N).

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.

11.4 **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.

11.5 **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 section ???. The measuring time is 1 second.

11.6 **MPEG4 H.264/AVC video and dolby digital (AC-3) audio**

The MPEG2 decoder built into the measuring receiver **cannot decode MPEG4 H.264.AVC programs**. However, these programs appear in the list of video programs. The corresponding message (H.264) is in the program details.

Likewise, the MPEG2 decoder **cannot decode AC-3 audio streams**. 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.

Chapter 12

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.



12.1 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.

12.2 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.

12.3 Memory functions

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

12.3.1 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.

12.3.2 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.

12.3.3 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.

12.3.4 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.

12.3.5 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.

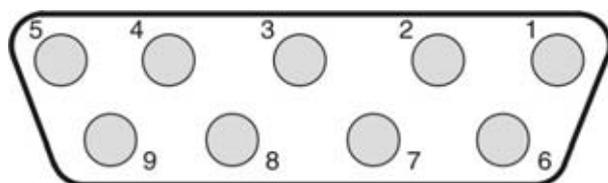
Chapter 13

RS232 Interface

The instrument is equipped with an RS232 interface. A D-Sub9 socket is located on the left side of the instrument for this. This interface allows the user to make a software update.

The manufacturer offers PC software and a special connection cable for this.

D-sub socket pin assignment:



- 1 = not used
- 2 = RX data (Receiver data)
- 3 = TX data (Transmitter data)
- 4 = not used
- 5 = chassis
- 6 = not used
- 7 = not used
- 8 = not used
- 9 = not used

Chapter 14

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.

14.1 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 to 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.

14.2 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.

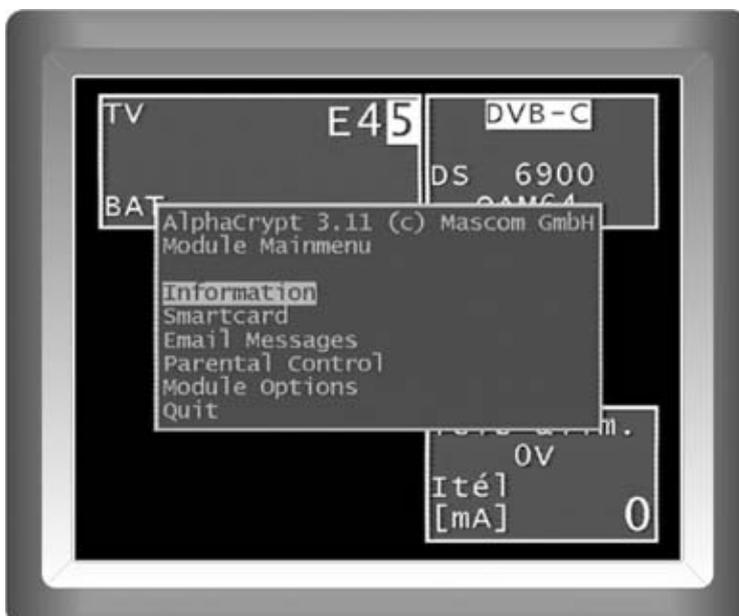
For picture and sound control of decoded programs, refer to chapter **MPEG Decoder**.

14.3 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 15

Management of the instrument

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

15.1 *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.

15.2 *Software version*

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

15.3 *BootLoader*

This function allows the user to query the software version of the bootloader. Press **MODE > settings > bootloader**. The bootloader is responsible for loading the firmware onto the main memory when the instrument is cold started.

15.4 *Serial number*

Apart from the imprint on the type designation on the rightside of the instrument, the serial number of the measuring receiver can be queried also here. Press **MODE > settings > serial number**.

15.5 *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**.

Chapter 16

AV input and output (SCART)

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

16.1 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.

16.2 Monitor input

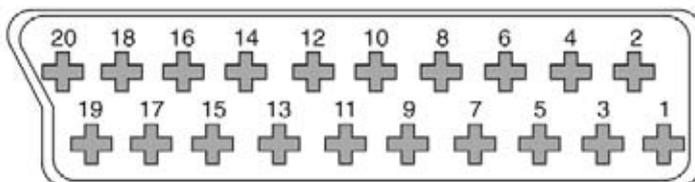
A video signal applied to the video input of the SCART socket may be reproduced on the TFT display using the measuring instrument's monitor function.

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.



16.3 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 17

DATA LOGGER (optional)

The instrument can be equipped with measured data memory (Data Logger). This allows you to save measured values automatically on a Compact Flash™ Card (CFC) as an XML file. The data can then be read and processed using MSExcel or OpenOfficeCalc.

Important! *The Data Logger (option) can only activate the data logger function if operated in **one sole** measuring receiver.*

17.1 Inserting the Compact Flash™ card into the PCMCIA slot

A Compact Flash™ card and PCMCIA adapter are included in delivery of the measurement data memory.

The device has a PCMCIA interface for inserting a CA module (see the “Common Interface” chapter). Alternatively, you can also insert a Compact Flash™ card into the adapter supplied. When the device is switched on, the software detects whether a CA module or a Compact Flash™ card has been inserted. The following illustration shows how the CompactFlash™ card is inserted into the PCMCIA slot. The card may only be plugged in and out when the device is switched on.

Important! *Printing on the Compact Flash™ card and PCMCIA adapter must both show towards the keypad.*

The card may only be plugged in and out when the device is switched on.



17.2 Automatic recording of measurement sets

If a Compact Flash™ card has been inserted in the PCMCIA slot, 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.



17.3 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. There are several ways to connect the Compact Flash™ card. If your computer accepts Compact Flash™ cards, remove the card from the PCMCIA adapter and insert it into the slot on the PC. If your computer has a PCMCIA slot, insert the Compact Flash™ card with the adapter. If your computer has neither of these interfaces, you can use any commercially standard USB Compact Flash™ adapter. As already mentioned above, the measurement data saved in the form of an XML file on the Compact Flash™ card can be read and processed by MS Excel or OpenOffice Calc. **Important! Transferring only at MS Excel version 2002.** The illustration below shows a set of measurements in MS Excel.

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Bereich	Kanal	Frequenz/MHz	LNB	Modus	Modulation	Symbolrate	Pegel/dBµV	TT1/dB	TT2/dB	MER/dB	CBER	VBER
1													
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													

17.4 Deleting measurement sets from the device

If a Compact Flash™ card has been inserted into the device, choose **MODE > DataLogger > Directory** to access files saved on the card. The free memory capacity of the Compact Flash™ card can also be read in percent. For example the file shown above needs 18 KB on the Compact Flash™ card. 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 18

List of Channels

18.1 B/G standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier in MHz	Centre Frequency (MHz) DVBC/DVBT	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	IV	21	471.25	476.75	474.00
	3	55.25	60.75	57.50		22	479.25	484.75	482.00
	4	62.25	67.75	64.50		23	487.25	492.75	490.00
USB	D73	70.75	73.00	73.00	24	495.25	500.75	498.00	
	S1	105.25	110.75	107.50	25	503.25	508.75	506.00	
	S2	112.25	117.75	113.00	26	511.25	516.75	514.00	
	S3	119.25	124.75	121.00	27	519.25	524.75	522.00	
	S4	126.25	131.75	130.00	28	527.25	532.75	530.00	
	S5	133.25	138.75	135.50	29	535.25	540.75	538.00	
	S6	140.25	145.75	142.50	30	543.25	548.75	546.00	
	S7	147.25	152.75	149.50	31	551.25	556.75	554.00	
	S8	154.25	159.75	156.50	32	559.25	564.75	562.00	
	S9	161.25	166.75	163.50	33	567.25	572.75	570.00	
III	S10	168.25	173.75	170.50	34	575.25	580.75	578.00	
	5	175.25	180.75	177.50	35	583.25	588.75	586.00	
	6	182.25	187.75	184.50	36	591.25	596.75	594.00	
	7	189.25	194.75	191.50	37	599.25	604.75	602.00	
	8	196.25	201.75	198.50	V	38	607.25	612.75	610.00
	9	203.25	208.75	205.50		39	615.25	620.75	618.00
	10	210.25	215.75	212.50		40	623.25	628.75	626.00
	11	217.25	222.75	219.50		41	631.25	636.75	634.00
	12	224.25	229.75	226.50		42	639.25	644.75	642.00
	OSB	S11	231.25	236.75		233.50	43	647.25	652.75
S12		238.25	243.75	240.50		44	655.25	660.75	658.00
S13		245.25	250.75	247.50		45	663.25	668.75	636.00
S14		252.25	257.75	254.50		46	671.25	676.75	674.00
S15		259.25	264.75	261.50		47	679.25	684.75	682.00
S16		266.25	271.75	268.50	48	687.25	692.75	690.00	
S17		273.25	278.75	275.50	49	695.25	700.75	698.00	
S18		280.25	285.75	282.50	50	703.25	708.75	706.00	
S19		287.25	292.75	289.50	51	711.25	716.75	714.00	
S20		294.25	299.75	296.50	52	719.25	724.75	722.00	
ESR	S21	303.25	308.75	306.00	53	727.25	732.75	730.00	
	S22	311.25	316.75	314.00	54	735.25	740.75	738.00	
	S23	319.25	324.75	322.00	55	743.25	748.75	746.00	
	S24	327.25	332.75	330.00	56	751.25	756.75	754.00	
	S25	335.25	340.75	338.00	57	759.25	764.75	762.00	
	S26	343.25	348.75	346.00	58	767.25	772.75	770.00	
	S27	351.25	356.75	354.00	59	775.25	780.75	778.00	
	S28	359.25	364.75	362.00	60	783.25	788.75	786.00	
	S29	367.25	372.75	370.00	61	791.25	796.75	794.00	
	S30	375.25	380.75	378.00	62	799.25	804.75	802.00	
	S31	383.25	388.75	386.00	63	807.25	812.75	810.00	
	S32	391.25	396.75	394.00	64	815.25	820.75	818.00	
	S33	399.25	404.75	402.00	65	823.25	828.75	826.00	
	S34	407.25	412.75	410.00	66	831.25	836.75	834.00	
	S35	415.25	420.75	418.00	67	839.25	844.75	842.00	
	S36	423.25	428.75	426.00	68	847.25	852.75	850.00	
	S37	431.25	436.75	434.00	69	855.25	860.75	858.00	
	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					

18.2 D/K standard (OIRT)

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT	Range	Channel	Video Carrier (MHz) to ATV	Sound Carrier in MHz	Centre Frequency (MHz) DVBC/DVBT
I	RI	=1	49.75	56.25	IV	21	471.25	477.75	474.00
	RII	=2	59.25	65.75		22	479.25	485.75	482.00
	RIII	=3	77.25	83.75		23	487.25	493.75	490.00
II	RIV	=4	85.25	91.75	24	495.25	501.75	498.00	
	RV	=5	93.25	99.75	25	503.25	509.75	506.00	
USB	S1	111.25	117.75	114.50	26	511.25	517.75	514.00	
	S2	119.25	125.75	122.00	27	519.25	525.75	522.00	
	S3	127.25	133.75	130.00	28	527.25	533.75	530.00	
	S4	135.25	141.75	138.00	29	535.25	541.75	538.00	
	S5	143.25	149.75	146.00	30	543.25	549.75	546.00	
	S6	151.25	157.75	154.00	31	551.25	557.75	554.00	
	S7	159.25	165.75	162.00	32	559.25	565.75	562.00	
	S8	167.25	173.75	170.00	33	567.25	573.75	570.00	
III	RVI	=6	175.25	181.75	34	575.25	581.75	578.00	
	RVII	=7	183.25	189.75	35	583.25	589.75	586.00	
	RVIII	=8	191.25	197.75	36	591.25	597.75	594.00	
	RIX	=9	199.25	205.75	37	599.25	605.75	602.00	
	RX	=10	207.25	213.75	V	38	607.25	613.75	610.00
	RXI	=11	215.25	221.75		39	615.25	621.75	618.00
RXII	=12	223.25	229.75	226.00		40	623.25	629.75	626.00
OSB	S9	231.25	237.75	234.00		41	631.25	637.75	634.00
	S10	239.25	245.75	242.00		42	639.25	645.75	642.00
	S11	247.25	253.75	250.00		43	647.25	653.75	650.00
	S12	255.25	261.75	258.00	44	655.25	661.75	658.00	
	S13	263.25	269.75	266.00	45	663.25	669.75	666.00	
	S14	271.25	277.75	274.00	46	671.25	677.75	674.00	
	S15	279.25	285.75	282.00	47	679.25	685.75	682.00	
	S16	287.25	293.75	290.00	48	687.25	693.75	690.00	
	S17	295.25	301.75	298.00	49	695.25	701.75	698.00	
	S18	303.25	309.75	306.00	50	703.25	709.75	706.00	
	S19	311.25	317.75	314.00	51	711.25	717.75	714.00	
	S20	319.25	325.75	322.00	52	719.25	725.75	722.00	
	S21	327.25	333.75	330.00	53	727.25	733.75	730.00	
	S22	335.25	341.75	338.00	54	735.25	741.75	738.00	
	S23	343.25	349.75	346.00	55	743.25	749.75	746.00	
	S24	351.25	357.75	354.00	56	751.25	757.75	754.00	
	S25	359.25	365.75	362.00	57	759.25	765.75	762.00	
	S26	367.25	373.75	370.00	58	767.25	773.75	770.00	
	S27	375.25	381.75	378.00	59	775.25	781.75	778.00	
	S28	383.25	389.75	386.00	60	783.25	789.75	786.00	
	S29	391.25	397.75	394.00	61	791.25	797.75	794.00	
	S30	399.25	405.75	402.00	62	799.25	805.75	802.00	
	S31	407.25	413.75	410.00	63	807.25	813.75	810.00	
	S32	415.25	421.75	418.00	64	815.25	821.75	818.00	
	S33	423.25	429.75	426.00	65	823.25	829.75	826.00	
	S34	431.25	437.75	434.00	66	831.25	837.75	834.00	
	S35	439.25	445.75	442.00	67	839.25	845.75	842.00	
	S36	447.25	453.75	450.00	68	847.25	853.75	850.00	
	S37	455.25	461.75	458.00	69	855.25	861.75	858.00	
	S38	463.25	469.75	466.00					

18.3 M/N standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT	Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT	
I	A02	55.25	59.75	57.00	IV	33	585.25	589.75	587.00	
	A03	61.25	65.75	63.00		34	591.25	595.75	593.00	
	A04	67.25	71.75	69.00		35	597.25	601.75	599.00	
	A05	77.25	81.75	75.00		36	603.25	607.75	605.00	
	A06	83.25	87.75	81.00		37	609.25	613.75	617.00	
						38	615.25	619.75	623.00	
USB	S02	112.25	116.75	114.50		39	621.25	625.75	629.00	
	S03	119.25	123.75	121.50		40	627.25	631.75	635.00	
	S04 to S08	continuous as with the B/G standard 7MHz channel spacing 4.5MHz video-sound carrier interval				41	633.25	637.75	635.00	
	S09	161.25	165.75	163.50		42	639.25	637.75	641.00	
	S10	168.25	172.75	170.50		V	43	645.25	649.75	647.00
							44	651.25	655.75	653.00
III	A07	175.25	179.75	177.00	45		657.25	661.75	659.00	
	A08	181.25	185.75	183.00	46		663.25	667.75	665.00	
	A09	187.25	191.75	189.00	47		669.25	673.75	671.00	
	A10	193.25	197.75	195.00	48		675.25	679.75	677.00	
	A11	199.25	203.75	201.00	49		681.25	685.75	683.00	
	A12	205.25	209.75	207.00	50		687.25	691.75	689.00	
	A13	211.25	215.75	213.00	51		693.25	697.75	695.00	
OSB	S11	231.25	235.75	233.50	52		699.25	703.75	701.00	
	S12	238.25	242.75	240.50	53		705.25	709.75	707.00	
	S13 to S35	continuous as with the B/G standard 7MHz channel spacing 4.5MHz video-sound carrier interval			54		711.25	715.75	713.00	
ESR	S40	455.25	459.75	250.00	55	717.25	721.75	719.00		
	S41	463.25	467.75	258.00	56	723.25	727.75	725.00		
					57	729.25	733.75	731.00		
IV	14	471.25	475.75	473.00	58	735.25	739.75	737.00		
	15	477.25	481.75	479.00	59	741.25	745.75	743.00		
	16	483.25	487.75	485.00	60	747.25	751.75	749.00		
	17	489.25	493.75	491.00	61	753.25	757.75	755.00		
	18	495.25	499.75	497.00	62	759.25	763.75	761.00		
	19	501.25	505.75	503.00	63	765.25	769.75	767.00		
	20	507.25	511.75	509.00	64	771.25	775.75	773.00		
	21	513.25	517.75	515.00	65	777.25	781.75	779.00		
	22	519.25	523.75	521.00	66	783.25	787.75	785.00		
	23	525.25	529.75	527.00	67	789.25	793.75	791.00		
	24	531.25	535.75	533.00	68	795.25	799.75	797.00		
	25	537.25	541.75	539.00	69	801.25	805.75	803.00		
	26	543.25	547.75	545.00	70	807.25	811.75	809.00		
	27	549.25	553.75	551.00	71	813.25	817.75	815.00		
	28	555.25	559.75	557.00	72	819.25	823.75	821.00		
	29	561.25	565.75	563.00	73	825.25	829.75	827.00		
30	567.25	571.75	569.00	74	831.25	835.75	833.00			
31	573.25	577.75	575.00	75	837.25	841.75	839.00			
32	579.25	583.75	581.00	76	843.25	847.75	845.00			
				77	849.25	853.75	851.00			
				78	855.25	859.75	857.00			

18.4 L standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT	Range	Channel	Video Carrier (MHz) to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
I	A=91	47.75	41.25*	50.50	IV	21	471.25	477.75	474.00
	B=92	55.75	49.25*	58.50		22	479.25	485.75	482.00
	C1=93	60.50	54.00*	63.25		23	487.25	493.75	490.00
	C=94	63.75	57.25*	66.50		24	495.25	501.75	498.00
USB	S1	120.75	127.25	123.50		25	503.25	509.75	506.00
	S2	128.75	135.25	131.50		26	511.25	517.75	514.00
	S3	136.75	143.25	139.50		27	519.25	525.75	522.00
	S4	144.75	151.25	147.50		28	527.25	533.75	530.00
	S5	152.75	159.25	155.50		29	535.25	541.75	538.00
	S6	160.75	167.25	163.50		30	543.25	549.75	546.00
	S7	168.75	175.25	171.50		31	551.25	557.75	554.00
	1	176.00	182.50	178.75		32	559.25	565.75	562.00
	2	184.00	190.50	186.75		33	567.25	573.75	570.00
	3	192.00	198.50	194.75		34	575.25	581.75	578.00
	4	200.00	206.50	202.75		35	583.25	589.75	586.00
	5	208.00	214.50	210.75		36	591.25	597.75	594.00
	6	216.00	222.50	218.75		37	599.25	605.75	602.00
OSB	S14	224.75	231.25	227.50	V	38	607.25	613.75	610.00
	S15	232.75	239.25	235.50		39	615.25	621.75	618.00
	S16	240.75	247.25	243.50		40	623.25	629.75	626.00
	S17	248.75	255.25	251.50		41	631.25	637.75	634.00
	S18	256.75	263.25	259.50		42	639.25	645.75	642.00
	S19	264.75	271.25	267.50		43	647.25	653.75	650.00
	S20	272.75	279.25	275.50		44	655.25	661.75	658.00
	S21	280.75	287.25	283.50		45	663.25	669.75	666.00
	S22	288.75	295.25	291.50		46	671.25	677.75	674.00
	S23	296.75	303.25	299.50		47	679.25	685.75	682.00
	S24	303.25	309.75	306.50		48	687.25	693.75	690.00
	S25	311.25	317.75	314.50		49	695.25	701.75	698.00
	S26	319.25	325.75	322.50		50	703.25	709.75	706.00
	S27	327.25	333.75	330.50		51	711.25	717.75	714.00
	S28	335.25	341.75	338.50		52	719.25	725.75	722.00
	S29	343.25	349.75	346.50		53	727.25	733.75	730.00
	S30	351.25	357.75	354.50		54	735.25	741.75	738.00
	S31	359.25	365.75	362.50	55	743.25	749.75	746.00	
	S32	367.25	373.75	370.50	56	751.25	757.75	754.00	
	S33	375.25	381.75	378.50	57	759.25	765.75	762.00	
	S34	383.25	389.75	386.50	58	767.25	773.75	770.00	
	S35	391.25	397.75	394.50	59	775.25	781.75	778.00	
	S36	399.25	405.75	402.50	60	783.25	789.75	786.00	
	S37	407.25	413.75	410.50	61	791.25	797.75	794.00	
	S38	415.25	421.75	418.50	62	799.25	805.75	802.00	
	S63	423.25	429.75	426.50	63	807.25	813.75	810.00	
	S64	431.25	437.75	434.50	64	815.25	821.75	818.00	
	S65	439.25	445.75	442.50	65	823.25	829.75	826.00	
S66	447.25	453.75	450.50	66	831.25	837.75	834.00		
S67	455.25	461.75	458.50	67	839.25	845.75	842.00		
S68	463.25	469.75	466.50	68	847.25	853.75	850.00		
				69	855.25	861.75	858.00		

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

18.5 I standard

Range	Channel	Video Carrier in MHz to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT	Range	Channel	Video Carrier (MHz) to ATV	Sound Carrier (MHz)	Centre Frequency (MHz) DVBC/DVBT
I	IA=1	45.75	51.75	48.50	IV	21	471.25	477.75	474.00
	IB=2	53.75	59.75	56.50		22	479.25	485.75	482.00
	IC=3	61.75	67.75	64.50		23	487.25	493.75	490.00
USB	S2	112.25	118.25	114.50		24	495.25	501.75	498.00
	S3	119.25	125.25	121.50		25	503.25	509.75	506.00
	S4	126.25	132.25	128.50		26	511.25	517.75	514.00
	S5	133.25	139.25	135.50		27	519.25	525.75	522.00
	S6	140.25	146.25	142.50		28	527.25	533.75	530.00
	S7	147.25	153.25	149.50		29	535.25	541.75	538.00
	S8	154.25	160.25	156.50		30	543.25	549.75	546.00
	S9	161.25	167.25	163.50		31	551.25	557.75	554.00
	III	ID =4	175.25	181.25		178.00	32	559.25	565.75
IE =5		183.25	189.25	186.00		33	567.25	573.75	570.00
IF =6		191.25	197.25	194.00		34	575.25	581.75	578.00
IG =7		199.25	205.25	202.00		35	583.25	589.75	586.00
IH =8		207.25	213.25	210.00		36	591.25	597.75	594.00
IJ =9		215.25	221.25	218.00		37	599.25	605.75	602.00
IK =10		223.25	229.25	226.00	V	38	607.25	613.75	610.00
IL =11		231.25	237.25	234.00		39	615.25	621.75	618.00
IM =12		239.25	245.25	242.00		40	623.25	629.75	626.00
IN =13		247.25	253.25	250.00		41	631.25	637.75	634.00
OSB	S15	259.25	265.25	261.50		42	639.25	645.75	642.00
	S16	266.25	272.25	268.50		43	647.25	653.75	650.00
	S17	273.25	279.25	275.50		44	655.25	661.75	658.00
	S18	280.25	286.25	282.50		45	663.25	669.75	666.00
	S19	287.25	293.25	289.50		46	671.25	677.75	674.00
	S20	294.25	300.25	296.50		47	679.25	685.75	682.00
	ESR	S21	303.25	309.25		306.00	48	687.25	693.75
S22		311.25	317.25	314.00		49	695.25	701.75	698.00
S23		319.25	325.25	322.00		50	703.25	709.75	706.00
S24		327.25	333.25	330.00	51	711.25	717.75	714.00	
S25		335.25	341.25	338.00	52	719.25	725.75	722.00	
S26		343.25	349.25	346.00	53	727.25	733.75	730.00	
S27		351.25	357.25	354.00	54	735.25	741.75	738.00	
S28		359.25	365.25	362.00	55	743.25	749.75	746.00	
S29		367.25	373.25	370.00	56	751.25	757.75	754.00	
S30		375.25	381.25	378.00	57	759.25	765.75	762.00	
S31		383.25	389.25	386.00	58	767.25	773.75	770.00	
S32		391.25	397.25	394.00	59	775.25	781.75	778.00	
S33		399.25	405.25	402.00	60	783.25	789.75	786.00	
S34		407.25	413.25	410.00	61	791.25	797.75	794.00	
S35		415.25	421.25	418.00	62	799.25	805.75	802.00	
S36		423.25	429.25	426.00	63	807.25	813.75	810.00	
S37		431.25	437.25	434.00	64	815.25	821.75	818.00	
S38		439.25	445.25	442.00	65	823.25	829.75	826.00	
S39		447.25	453.25	450.00	66	831.25	837.75	834.00	
S40		455.25	461.25	458.00	67	839.25	845.75	842.00	
S41		463.25	469.25	466.00	68	847.25	853.75	850.00	
					69	855.25	861.75	858.00	

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