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Chapter 1

Notes on use and safety

Notes and warnings in line with DIN 57 411 Part 1a/VDE 0411 Part 1a**:**

1.1 Notes on use

Mechanical effects on/interference with the display must be avoided, otherwise it could be destroyed. The manufacturer assumes no warranty in the event of destruction resulting from such mechanical effects/interference.

You must also ensure that no extraneous voltages are applied to the test socket of the instrument, since this could destroy the input circuitry.

If different cables are repeatedly connected to the test socket, the tolerances of the connectors may lead to fatigue of the contact springs in the test socket. You are consequently advised to insert a wearing part in front of the socket to avoid this.

1.2 Safety

The instrument is constructed and tested according to DIN 57 411 Part 1/VDE 0411 Part 1, protective measures for electronic measuring instruments, and left the plant in a state ensuring absolute safety. To maintain this and ensure its operation without posing any danger, the user must observe the instructions and warnings contained in this operator manual.

Before adjustment, maintenance, repair or replacement of parts requiring the instrument to be opened, you must disconnect it from all voltage sources.
Should adjustment, maintenance or repair of the opened instrument subsequently require application of voltage, this may only be performed by a **specialist** who is aware of the risks involved.
Capacitors in the instrument may still be charged, even when the instrument has been disconnected from all voltage sources.

Only use original components as replacements for safety components during repair.

If it may be assumed that operation without risk or danger is no longer possible, you must shut the instrument down and contact the engineering after-sales service.

Operation posing risk or danger may be assumed if

- the instrument exhibits visible damage,
- the instrument no longer functions correctly,
- the instrument has been stored for some time in adverse conditions,
- the instrument has suffered severe damage during transportation.

The instrument is to be examined for operational safety at regular intervals.
VBG 4, for example, stipulates such an examination every six months for instruments not operated in a stationary role.

Chapter 2

Technical data

DISPLAY	LCD illuminated, 120x32 pixel
MEASUREMENT RANGE	0 to 2.000m
Scale latitude adjustable	25m 50m 100m 400m
Resolution	0.25m 0.5m 1.0m 4.0m
Accuracy	± 1% of set measurement range
Shortening factor	0.250 to 0.999
Pulse amplifier	0 – 28dB in 4dB steps (to increase the sensitivity)
Memory locations	30 for shortening factors
Dynamic range	44dB vertically in amplitude
Sensitivity	70dB
Digital filter	Can be activated to suppress interference of external voltage on the cable
Impedance	75Ohm
Measurement connector	IEC socket 75Ohm
Measurement pulse output	4 Volt needle pulse of 5ns, 20ns or 100ns pulse width
POWER SUPPLY	
Power supply	NIMH 6V/700mAh or power supply 12 to 24 Vdc or Vac
Current drain	80mA
Operation	max. 8 h
Charging time	approx. 14 h
DIMENSIONS (WxHxD)	84 x 157 x 30
WIGHT	approx. 300g (with battery)
QUANTITY OF DELIVERY	
Included in the delivery	Protective case Power supply Manual Transport case

Chapter 3

Startup

3.1 Technical description

The instrument is a lightweight, compact, microprocessorized unit with an LCD display for troubleshooting and inspecting TV/SAT cable installations, communication and power lines.

3.1.1 Basics of pulse reflectometry

Pulse reflectometry (time domain reflectometer) is a modern application of tried and tested pulse reflection measurement technology, which for many years already has proved to be a valuable aid for troubleshooting transmission lines. It allows precise and reliable pinpointing of cable or line damage.

A pulse is continuously applied to the line being measured. If this pulse encounters a malfunction (eg shortcircuit) or an interruption, it is reflected back to its point of origin. There it is compared in phase, time and amplitude with the original pulse. The comparison of propagation time shows the distance to the point of defect and also indicates the nature of the defect.

With a better generator for producing extremely short pulses and a signal receiver with large bandwidths, it is also possible to conduct measurements of all RF cables. The sampling technique allows measurements from several hundred meters down to a few centimeters plus accurate measurement of reflection and amplitude of the order of a few millivolts.

The pulse reflectometer is consequently a kind of enclosed, unidimensional radar system in which the transmitted signal represents a very fast jump function and the reflecting signal can be observed on its display. The faster the rise of the measurement pulse, the better is the resolution (time equals distance).

The amplitude is in direct relation to the impedance, meaning that measurement of matching is possible. The pulse reflectometer method is thus suitable for measuring all cables, connectors, transformers, matching elements, striplines, broadband transformers. directional couplers and cable attenuations.

3.1.2 Measuring principle

The instrument works in the time domain. It is to be thought of as an enclosed radar system.
The measurement pulses fed into the cable are reflected by the inhomogeneities of the cable impedance (cable defects) and shown on the display.

From the shape and the time offset of the reflection it is possible to determine the nature of the defect and the distance to the defect.
The shortening factor (or pulse speed) indicates how fast electrical signals propagate in a cable in relation to the speed of light. The highest speed of propagation is achieved in the air with a shortening factor of 1.00.

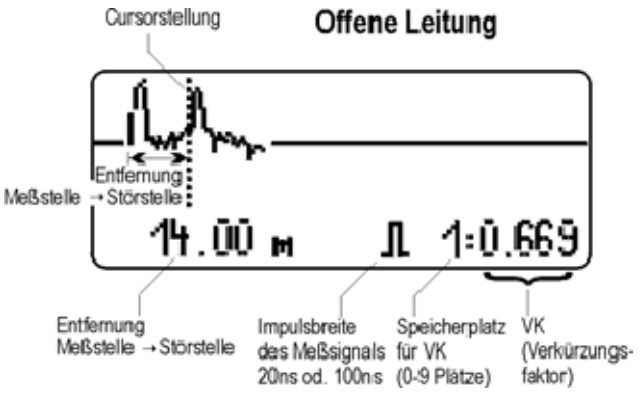
The shortening factor of the cable being investigated must be set before commencing to measure the length. If the factor is unknown, set an approximate value and determine the defect from both ends of the cable.

In order to determine an unknown shortening factor (SF) value precisely, cut the cable to exactly 10 metres with a tape measure, and change the SF on the measuring instrument during the measurement process until it shows exactly 10 metres.

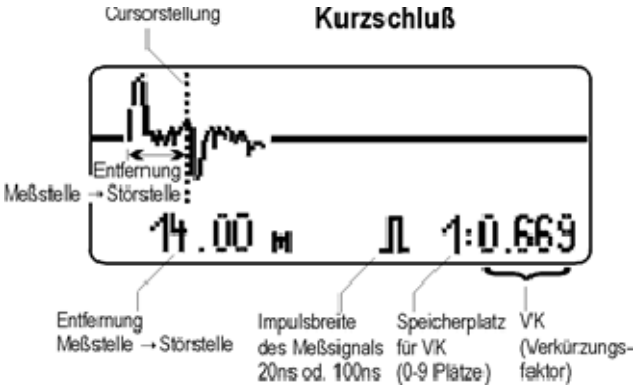
3.2 Operation

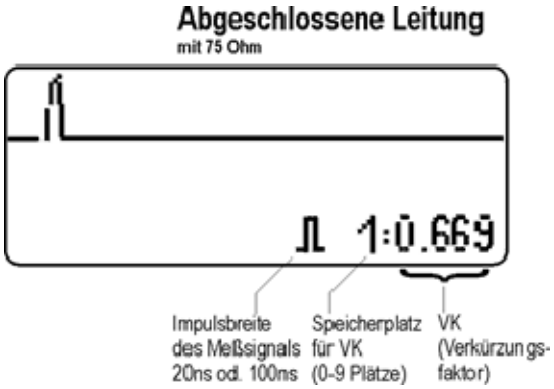
Key 1 (LEFT) = DOWN
Key 2 (CENTER) = UP
Key 3 (RIGHT) = MODE

POWER ON	- Press key 1. When you press the button, the instrument name and software button are displayed briefly, and then the battery voltage is shown for 5 seconds. (full battery approx. 6.4 V, low battery < 5.9 V - While the battery voltage is displayed, press key 3 and the unit is powered on (length display mode) . - You can select a cable when the instrument is switched off by pressing key 1 and then key 2. Use keys 1 or 2 to select the cable type and then press key 3. Press key 3 to switch from the length display to the return loss measurement (the shortening factor and cable loss/100 m at 50 MHz are preset for the measurement.
POWER OFF	- Press key 2 and 3 simultaneously, the unit shuts down. - Automatically after 4 min of not actuated. - When the battery voltage drops to 5.9 V, this is shown in the display. At 5.5 V, the instrument shuts down.
SELECT MEASUREMENT RANGE / PARAMETERS	- Briefly press key 3. The cursor is activated (highlighted). - Selected the measurement range with key 1 and 2.
MOVE CURSOR	- With key 1 or 2. Fast cursor movement → Hold the key down. - Switchover of the measurement range is automatic when the cursor crosses a band limit.
SELECTING VARIOUS SETTINGS: LENGTH RANGE RESOLUTION OUTPUT PULSE WIDTH DIGITAL FILTER MEMORY LOCATION SHORTENING FACTOR	- Press and hold key 3 (0.5 seconds) until the symbol required is highlighted. - Press keys 1 and 2 to change the value selected. - Press keys 1 and 3 simultaneously to permanently save the width of the output pulse and the shortening factor. - To return to the default setting →, press key 3 briefly.
RETURN LOSS (REFLECTION LOSS dbRL) **DETERMINING**	- Position the cursor on the echo pulse peak and read out the return loss at the bottom left of the display. - The cable loss/100 m at 50 MHz is shown in the cable selection at the bottom right of the display and must be set in accordance with the cable data sheet (see attachment). If the cable loss is set correctly, the instrument displays the actual (local) return damping. - The cable's pulse attenuation is deducted and the pulse amplification is adjusted automatically. - A pulse width of 20 ns (medium pulse) is best suited for measurement.
DIGITAL FILTER	- In order to suppress or minimise interference in the curve displayed due to external voltages on the cable, a digital mean filter “Fi” can be activated using keys 1 or 2. The curve display is then extended to 3 seconds.
PULSE AMPLIFIER SETTING	- Press key 3 briefly and set the amplification with keys 1 or 2.

DETERMINE SHORTENING FACTOR OF CABLE	- Connect a cable (eg 10 or 100 m). - Set the cursor to the cable length and alter the shortening factor until the pulse echo is behind the cursor.
CHANGING THE SAVED CABLE TYPES	- Press keys 1 and 2 simultaneously for 5 seconds until the cable types are displayed. - Choose the memory location using keys 1 and 2. - Select the value to be changed with key 3 (highlighted), and use keys 1 and 2 to change it. - You can lock unrequired memory locations using ON/OFF (via the memory location number). - Press keys 1 and 3 simultaneously to save.
Zero adjustment of transmission pulse (only possible from storage)	- Select a storage location for shortening factor. - Press key 1 and 2 same time until <⎍> is appears on the display. - Adjust impulse with key 1 or 2 until the cursor is placed at the impulse start. - Storage of this with pressing key 1 and 3 at the same time. - Back to initial state → with key 3.
SAVING THE SETTINGS	- Press keys 1 and 3 simultaneously to save the settings preselected in the display. They are then available when the instrument is switched on.
LOW BATTERY WARNING AND SHUTDOWN	- If the battery voltage drops to 5.9 V, the voltage is shown flashing at the top right of the display. At < 5.5 V the instrument shuts down.
CHARGE	- Plug-in power supply (12 - 24Vdc or Vac) on charge socket 5.5/2.1mm, plus inside (12 – 28V) - Charging time approx. 14 h.
FAULT LOCATION	- Connect the cable to device, select the measurement range and evaluate the diagram. The transmit positive pulse can be seen at the beginning at 0 m. If the connected cable end is open, an additional positive pulse appears on the display (pulse-echo). - Position the cursor on the start of the pulse and read the length of the cable.  - For a shorted cable end there is a negative pulse, which is reflected from the end of the cable.

<table>
<tr>
<td>FOULT LOCATION</td>
<td>
- Position the cursor on the start of the pulse and read the length of the cable.



- If a fault-free cable is terminated with a resistance identical to the wave resistance of the cable, no reflection is observed.


- If there are interruptions, contact defects on joints, pinches, shorts or branches/splitters in the region investigated, the length to the beginning of the cable can be determined from the pulse echos.

If a wide output pulse is used for measurement, the pulse echos are more pronounced. Defective branches and splitters then produce stronger pulse echos.
</td>
</tr>
<tr>
<td>SHORTENING FACTOR</td>
<td>
Coaxial cable with PE dielektric 0.66
Coaxial cable with foam PE 0.82 (0.78 – 0.95)
Stripline with foam insulation 0.83
Coaxial cable with air insulation 0.9 (0.88 – 0.92)
Electric cable 0.49 – 0.57 (ca. 0.53)
</td>
</tr>
</table>

Attention! The shortening factor is stored by simultaneous pressing of the keys 1 and 3.

When storing the shortening factor the factor must be indicated inverted on the display.

Do not measure on live lines. Voltage strength max. 65 Vdc..

Appendix

Cable types

Delivery condition – Stored in EEPROM.

Program position	Cable type name	Cable diameter		Type of dielectric	Shortening factor	Cable loss over 50 MHz at 100m
		Inner conductor	Dielektric			
P1	Mini cable	0.41 mm	1.90 mm	CPE	0.78	10.9 dB
P2	H 123	0.65 mm	2.90 mm	CPE	0.85	7.5 dB
P3	H 121, MK 75	0.80 mm	3.50 mm	CPE	0.84	5.7 dB
P4	MK 15, LCD 90	1.02 mm	4.40 mm	CPE	0.85	4.3 dB
P5	COAX 12	0.70 mm	4.60 mm	PE	0.66	5.6 dB
P6	H 126 DUOBOND PLUS, KOKA 799	1.00 mm	4.60 mm	CPE	0.82	4.5 dB
P7	75100 AKZ 3-5 (RG6)	1.00 mm	4.60 mm	CPE	0.85	4.4 dB
P8	LCD 95, DIGITAL 94	1.13 mm	4.80 mm	CPE	0.85	4.3 dB
P9	COAX 6 (LG)	1.70 mm	6.95 mm	CPE	0.89	2.3 dB
P10	LCM 14, MK 15, KOKA 7	1.63 mm	7.20 mm	CPE	0.84	2.8 dB
P11	TELASS B1.1 / 7.3	1.10 mm	7.25 mm	PE	0.66	3.8 dB
P12	PRG 11	1.55 mm	7.25 mm	CPE	0.81	2.7 dB
P13	1 ikx 1.1 / 7.3; KOKA 741	1.10 mm	7.30 mm	PE	0.66	3.3 dB
P14	1 nkx	2.20 mm	8.80 mm	PEH	0.88	1.8 dB
P15	75-7-12 D	2.60 mm	10.00 mm	AIR	0.85	1.6 dB
P16	COAX 4	2.20 mm	10.20 mm	CPE	0.82	1.9 dB
P17	1 qkx	3.30 mm	13.50 mm	PEH	0.88	1.2 dB
P18	75-7-16 D	3.80 mm	13.80 mm	AIR	0.92	1.1 dB
P19	COAX 3	3.40 mm	14.90 mm	CPE	0.84	1.3 dB
P20	1 skx	4.90 mm	19.40 mm	PEH	0.88	0.9 dB
P21	Electric cable	0.00 mm	0.00 mm		0.53	5.0 dB