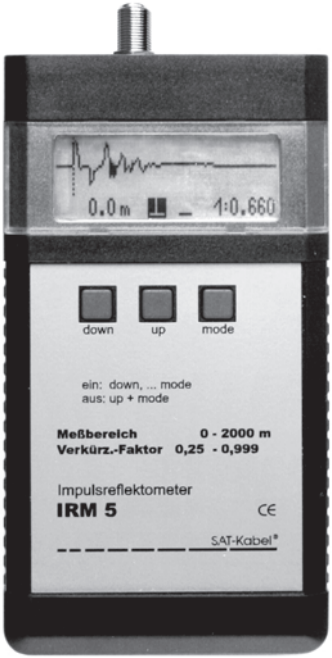
IRM 5



Pulse reflectometer

We thank you for buying of a product of the company SAT-Kabel®.
This operating instructions shall help you to understand the functions of the instrument and to ease its use. If you have questions about this instrument or suggestions for further improvements, please get in touch with us.

This instruction has been performed to the best of our knowledge. Developments and technical amendments are subject to change without notice.
Topical made operating instructions in a PDF format can also downloaded from our Internet homepage *www.sat-kabel.de*.

Content

1. General

The **IRM 5** is a impulse reflectometer, processor controlled, with LCD display for check and locate faults in telecommunication and power cables. For a more accurate analysis the return loss of coaxial cables is measured additionally. It is handy and easy to operate. The special features are:

- already 20 cable types are pre-programmed, additional types can be added in the menu
- length measurement at the leading edge of the reflected pulse
- return loss measurement on the reflected pulse
- pulse amplification adjustable at cable bruise, bad connectors and other components withtoo less return loss.

2. Delivery volume

1 **IRM 5**, incl. high-quality NiMH accumulator
1 plugin charging device AC/AC
1 operating instructions

optional available:

Symmetrical measuring cable with adapter **SMK-IRM**
F measuring cable with adapter **MKA 150HQ**
Car charging cable **KFZ-LK**
Plastic case **TKSI**
Imitation leather bag **KLT**
Protective housing green, with carrying strap **SGW**

3. Measurement principle

Fed into a cable measuring pulses are reflected by the inhomogenities of the cable impedance (cable fault) and made visible on the display. From the form and the time displacement of the reflection, the nature of the fault and the fault distance can be determined. It is also advisable to acquire practical experience by sample measurements.

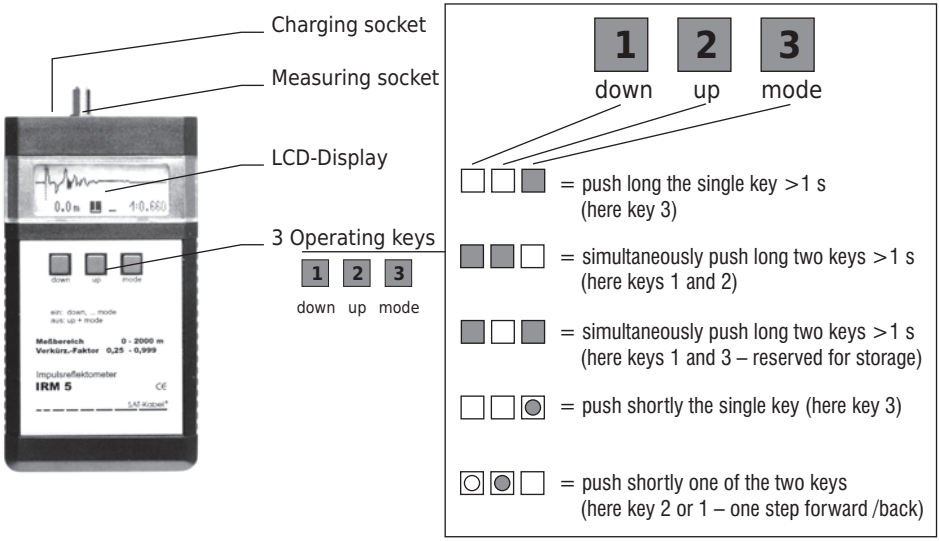
4. Charging

Connect the plugin charging device (containing in the delivery volume) to the charging socket of the IRM 7 (ø5.5/2.1 mm, plus pole inside). The power supply voltage (11...24 V) and charging control is shown on the display.

5. Important notes

- **Measurement only on strain-free objects!**
- Do not expose incident solar radiation, heath and extreme coldness!
- The working temperature range is 0 °C until +40 °C
- Avoid shocks by bumps or falling down. We recommend the use of the imitation leather bag.
- The F-measuring socket is a high-quality component. This one is designed for a maximum diameter of 1.1 mm of the inner conductor. We recommend for a good care of the socket to use a measuring cable with F-connector plus an according adapter.

6. Operational elements



7. Operating

7.1 Operating functions standard

Switch on

1 | Push button 1 and then button 2.Now select with buttons 1 and 2 to the desired cable type and then press button 3 – Propagation factor and cable loss are preset for the measurement

2 | Push button 1 and then button 3, selection of the cable type is skipped –propagation factor and cable loss must be yet adjusted manually to measure .

During switching on the state of charge of the battery in the display will briefly appear (battery is full: ca. 7 V, low battery: ca. 5.5 V). After switching on the **IRM 5** is the length measurement mode. Here enter additional settings for the measurement to be made (see 8.2).

Switch off Push buttons 2 and 3 simultaneously until display disappears

Without operation the device switches off itself after four minutes. If the battery voltage drop to 5.9 volts, there is a fade-in on the display. At 5.5 V the device switches off to protect the battery.

7.2 Advanced operating functions

Move the cursor button 1 »down« press briefly – one step left
button 2 »up« press briefly – one step to the right
Hold down for quick cursor movement the respective key

Menu button 3 »mode« push long (L) – a menu item continue
button 3 »mode« push short (K) – a menu item back

Save settings push button 1 and 3 simultaneously– the previous settings will remain permanent

7.2.1 Pulse amplifier

To increase the sensitivity of the **IRM 5**, the gain can be adjusted in 4-dB steps from 0 to 36 dB. The gain »V« is starting from the length display to select by shortly pressing the button 3. With the buttons 1 and 2 the gain can be stepwise changed. Set it back by a short push on button 3.

7.2.2 Parameter of length measurement adjust

Resolution | Firstly can be adjusted in the menu the resolution of the trace in steps. By long pressing of the button 3 - until the icons appear inverted - you get to the first parameter of the measurement. Here can be set with the buttons 1 or 2 the required value.

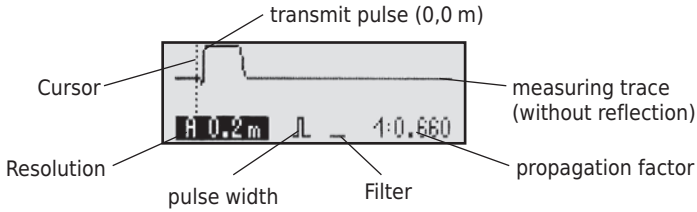
Pulse width| After repeated long pressing of button 3 (until icon inverted), the pulse width can be changed. Rule of thumb: short cable - short pulse

Filter | Next lets switch a filter. This can make at a restless trace by interference from external voltages a better visibility. The disadvantage of pulse reflectometer is generally: The presentation of the measured curve is delayed. In our case, at about three seconds.

Storage space for propagation factors | The next setting option is to select a stored propagation factor. If the propagation factor is not already selected when switched on or it will need a change in use, this can be done here.

Propagation factor| As the last the propagation factor can be adjusted manually by repeatedly long press of the button 3. The propagation factor must always be set accordingly before measuring the cable.

If the necessary settings have been made, by briefly pressing button 3 the parameter settings are stepwise leaving again.



7.2.3 Vertical resolution

By long pushing of the keys 1 and 2 the zoom can be switched on or off. Referred to the operating scheme on page 6 and 7, the zoom only can used to functions under the dashed line. If the zoom is switched on, the entire display is used for the display of the measuring curve. An already set gain keeps remained. The zoom can switch off by a repeated long pushing of the keys 1 and 2.

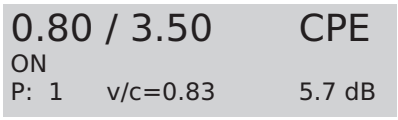
7.2.4 Setting start mode

If you want immediately after switching on the **IRM 7** to have a certain setting of the resolution available, it will be stored by pressing button 1 and 3.

7.3 Change of the cable characteristic values

If necessary the cable parameters can be changed in the memory locations or also add new ones. It is essential to ensure to work very carefully, because these values are critical for each measurement. It may happen, for example, that the propagation factor must be determined first. A method is described under item 8.2.

1 | To enter the programming mode, when switched off the device, the buttons 1 +2 are to press simultaneously so long until the display of the memory locations appear.



2 | By shortly pressing of the button 3 parameter to be changed are to be selected (inverted display) and to change by the buttons 1 and 2. Unused memory locations can be displayed and disappear here with the parameter »ON« or »OFF«. Disappeared storage locations do not appear when switching on.

The adjustable parameters are:

0.80	– diameter inner conductor
3.50	– diameter screening
CPE	– dielectric
ON/OFF	– memory location displayed/disappeared
P: 1	– memory location (e. g. 1)
v/c=0.83	– propagation factor – 0.83 here
5.7 dB	– cable attenuation at 100 m at 50 MHz

3 | The saving is done by simultaneously pressing buttons 1 and 3 – DO NOT FORGET!

8. Measuring with the pulse reflectometer

8.1 Basic principle

The basic physical principle is the echo. There are here signals sent out in e.g. the form of sound. If they hit an obstacle, then a part of it is sent back again, therefore reflected. Simple examples are the echo of a rock wall or the sonar in the maritime.

This principle works the same as well on electric lines. Only one takes as a signal electrical pulses - one can not call into a cable. It therefore is sent these impulses into a cable and must only measure the time after which a reflection of it arrives

back at the sending point. To get accurate results, you need to pay attention to something: e. g., that the cable offers a resistance to the signals. This in turn depends on the structure of the cable. There is except of the cable loss still a very important parameter - the propagation factor. Very important for coaxial cable is the characteristic impedance and consequently the adaptation or matching. On this basis the measurements are made.

For the practitioner the inner workings of a pulse reflectometer is not essential. The manufacturer takes care of this. More important is to get involved with the process of a practical measurement. For it must be said in advance that measurements with a pulse reflectometer the most diverse displays shown. Therefore practical experiences that include test measurements and tests, are a prerequisite for reliable interpretation of the displayed waveforms. Here applies the old saw »Practice makes perfect!«

Before to further details still 3 basic principles in practice:

- Only measure on de-energized cables!
  The input of the device is NOT designed for high voltages (max. 65 VAC/DC)
- If possible measure of both cable ends. This increases the accuracy.
- Work for longer cables with an assistant. It simplifies recognition of the correct cable end

8.2 Propagations factor (v/c or pulse velocity)

The Propagation factor (v/c or pulse velocity) declares the velocity of electrical signals in the cable in relation to the speed of light.The propagation factor of the cable under test must always preset before the length measurement. If the propagation factor is unknown, a approximate value is set and the fault is determined from both ends of the cable

Propagations factors of standard cable

Power cables	0.49–0,57, (ca. 0.53)
Coaxial cable with PE dielectric	0.66
Coaxial cable with foam-PE	0.77–0.85
Air isolation	0.88–0.92

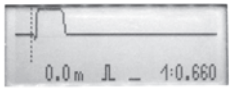
Measuring of the propagation factor (v/c) of the cable

Connect a cable with known length (e.g. 100 m) on the **IRM 5**. Set the cursor on the cable length and change the propagation factor so that the pulse echo appears behind the cursor.

8.3 Length and distance measurement - for the practitioner

The main application of a pulse reflectometer is determining the cable length, either the length of a laid cable or the distance routed to a certain modification, such as cable failure, inserted component. There are only two ideal states:

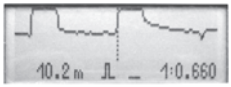
1. The cable matches - only transmit pulse recognizable
   Resistance equal to 75 ohms (coaxial cable)



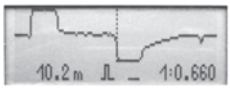
2. The cable has mismatches - there will be reflections

The 2. state in turn knows also two ideal cases:

1. The cable end is open - the transmit pulse and reflection
   Resistance is greater than 75 ohms - reflected pulse upward

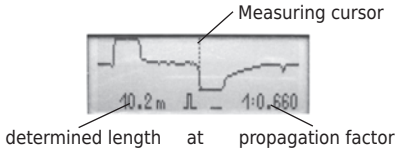


2. The cable end is shorted - transmit pulse and reflection
   Resistance is less than 75 ohm - reflected pulse down



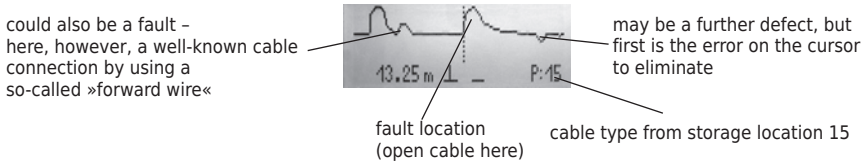
On the basis of this behavior can quickly an open or a shorted cable end are recognized. Even in longer cables if the open end is short-circuited by an assistant at intervals, so the cable end can be seen by changing deflection of the reflected pulse from top to bottom and vice versa clearly.

Now missing is the distance to the reflection point, so the cable end or the defective part in the cable or a component (connector, tap, etc.). For it the cursor is required. This is positioned with buttons 1 and 2 to the leading edge of the first recognizable reflection. Immediately to the left bottom of the screen is displayed the distance in meters.



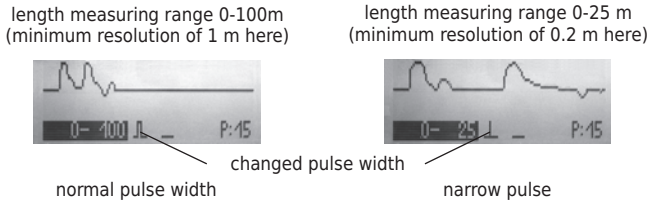
*In measurements with pulse reflectometer always leading edge to leading edge of the pulses is measured. For some devices it has to be positioned a second cursor. At the **IRM 5** it has been done internally, so that only one cursor is needed. It should be a device for the practitioner.*

It is usually went to the first clear reflection in the trace. Subsequent »spikes« are further defects or reflections of the first reflection, usually seen at the same distance and a smaller deflection. With several »defects« in the cable must always the first be removed in order to measure accurately the next again.



***Forward wire** | This is a coaxial cable having a known length (for example 10 m), which is inserted before the actual DUT. The purpose of this cable is that when a fault location immediately after the beginning of this cable is to be badly distinguished from the original pulse or possibly even hidden. By this forward wire this point, however, is shifted by a known length to the right. They will appear in the actual distance plus 10 meters of forward cable.*

Thus the distance is to be determined as accurately as possible, firstly the resolution of the display has to adjust according the measured cable length .



As a second setting as required, can the pulse width be adjusted (see above). In general, however, is worked with the normal setting of 20 ns. Only for very short cable lengths, a narrow pulse is to be used, so that the transmitted pulse does not already covers a fault location in the immediate vicinity. For extremely long cables (power cables), however, a wider pulse is necessary to have enough energy for the long distance – that due to cable resistance the pulse in the resolution of the display does not disappear.

In the third setting, a filter can be switched to suppress disturbances. However this slows down the entire measurement process.

The fourth, most important adjustment relates to the structure of the cable. This results in the cable-specific propagation factor. This is before the measurement, so when switch on the IRM 7, to choice as cable type from the stored list or to enter manually.

The measuring curves are in practice however usually between those relatively easy to interpret curves. The reasons are eg.:

Cable connector | usually be seen in the form of a small sine wave; on thick coaxial cable only with high measurement gain, at very good connectors (generally the thick, large) almost never to find

Taps, splitter | in the form similar to a sine wave, usually also asymmetrical. The size reflects the state.

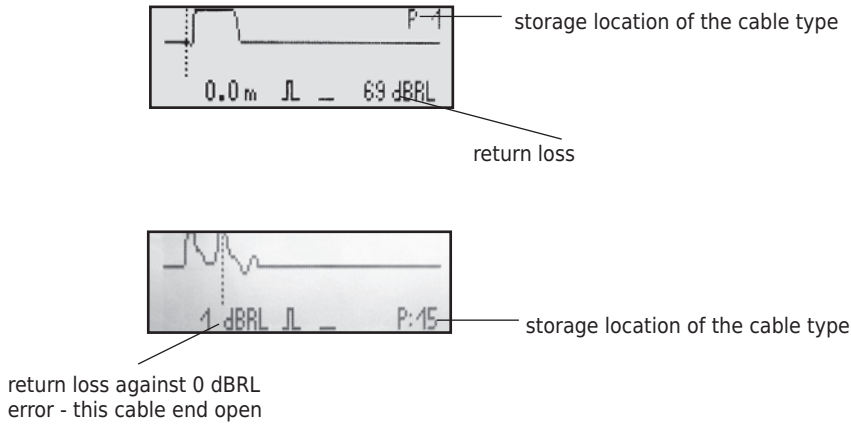
Water in the cable | Measuring curve linear in the range of adaptation, however some sections strongly serrated, also by mechanical overloads

8.4 Measuring the return loss - for the practitioner

An important statement about the quality of a cable or components present in the line allowed the return loss, also reflection attenuation (dBRL) called. Since most taps and splitter have a lower return loss as coaxial cable, it is of interest if these are still intact.

In intact coaxial cables the return loss is in the range of about 45 ... 65 dB. Everything else indicates more or less an existing fault. For the passive components, the set point can be found in the data sheets. If the measured values are below, there are often already unexplained complications, often at the digital signals in the return path.

To measure the return loss with the **IRM 5**, it is necessary first selecting the appropriate type of cable (switch on with button 1 then button 2). After selecting the cable type then push button 3. Now appears in the bottom-right, the return loss in dBRL. Top right is the selected storage location of the cable type displayed. The cursor is now to set on the peak of the pulse of the reflection under test, and the return loss can be read on the display. The IRM determines in a specified area selected by the device from the cursor to the lowest value of the return loss. Is the cable attenuation set correctly, the **IRM 5** shows the actual return loss (local return loss). The pulse attenuation of the cable is deducted from the **IRM 5**.

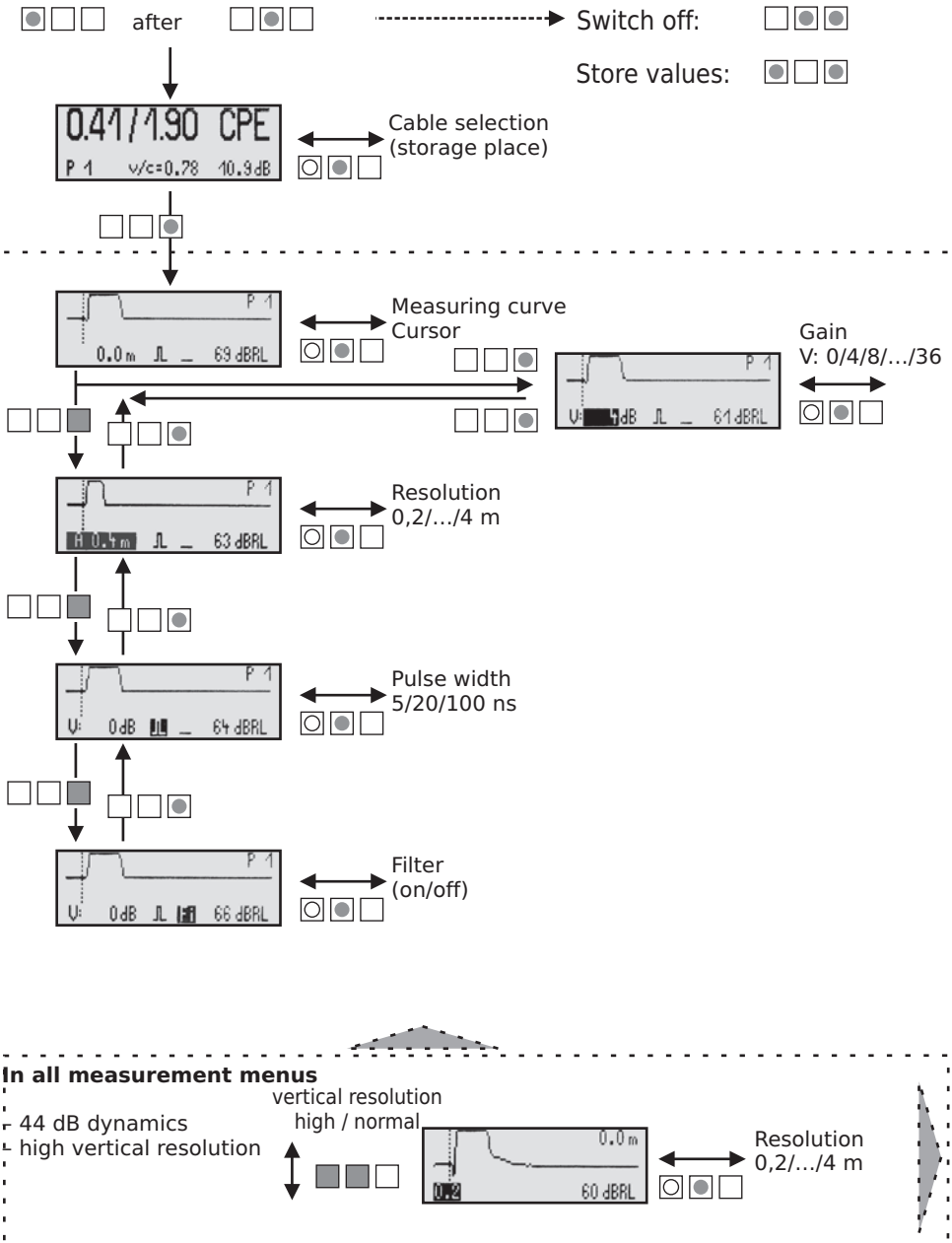


9. Technical data

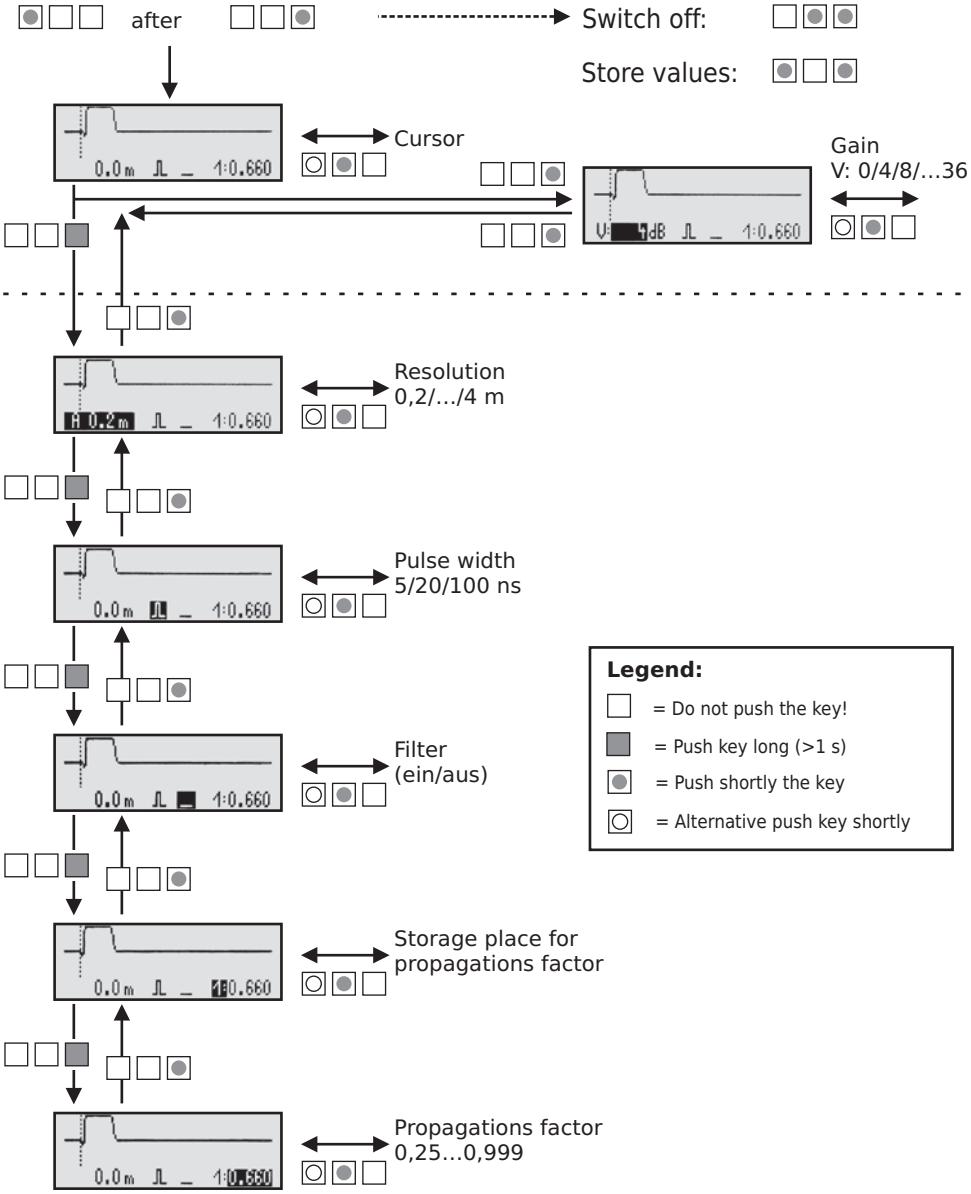
Measuring ranges	0–2000 m
Resolution	0.25 m / 1 m / 4 m, switchable
Accuracy	0.2 % of the measuring range
Propagation factor	0.250–0.999
Storage places	30 for cable type and propagation factor already 20 pre-programmed
Dynamic	44 dB
Sensitivity	70 dB
Digital filter	switchable for suppression of external voltages on the cable
Impedance	75 Ohm
Output	F-socket
Output pulse	4 V, 5 ns / 20 ns / 100 ns wide
Display	LCD 120 × 32 pixel, illuminated
Operation	with 3 keys
Power supply	NiMH-accumulator 6V/750 mAh; AC/AC adapter
Powwer consumption	80 mA
Dimensions	157 mm × 84 mm × 30 mm
Weight	300 g

10. Operating scheme IRM 5

Measuring of the return loss



Measuring without return loss



11. Stored cable data

(State 01/2012)

program place	cable type designation	cable diameter inner conductor	cable diameter dielectric	kind of dielectric	propagation factor	cable attenuation at 50 MHz at 100 m
P 1	mini cable	0.41 mm	1.90 mm	CPE	0.78	10.9 dB
P 2	H 123	0.65 mm	2.90 mm	CPE	0.85	7.5 dB
P 3	COAX 12	0.70 mm	4.60 mm	PF	0.66	5.6 dB
P 4	H 121., MK 75	0,80 mm	3,50 mm	CPF	0,84	5.7 dB
P 5	H 126 DUOBOND PLUS, KOKA 799	1.00 mm	4.60 mm	CPE	0.82	4.5 dB
P 6	MK 15, LCD 90	1.02 mm	4.40 mm	CPE	0.85	4.3 dB
P 7	75100 AKZ 3-S (RG6)	1.00 mm	4.60 mm	CPE	0.85	4.4 dB
P 8	TELASS B1,1/7,3	1.10 mm	7.25 mm	PE	0.66	3.8 dB
P 9	1 ikx 1,1/7,3; KOKA 741	1.10 mm	7.30 mm	PE	0.66	3.3 dB
P 10	LCD 95, DIGITAL 94	1.13 mm	4.80 mm	CPE	0.85	4.3 dB
P 11	PRG 11	1,55 mm	7.25 mm	CPE	0.81	2.7 dB
P 12	LCM 14, MK 15, KOKA 7	1.63 mm	7.20 mm	CPE	0.84	2.8 dB
P 13	COAX 6 (LG)	1.70 mm	6.95 mm	CPE	0.89	2.3 dB
P 14	COAX 4	2.20 mm	10.2 mm	CPE	0.82	1.9 dB
P 15	1nkx	2.20 mm	8.80 mm	PEH	0.88	1.8 dB
P 16	1qkx	3.30 mm	13.50 mm	PEH	0.88	1.2 dB
P 17	COAX 3	3.40 mm	14.9 mm	CPE	0.84	1.3 dB
P 18	1skx	4.90 mm	19.40 mm	PEH	0.88	0.9 dB
P 19	75-7-12 D	2.60 mm	10.00 mm	AIR	0.85	1.6 dB
P 20	75-7-16 D	3.80 mm	13.80 mm	AIR	0.92	1.1 dB

12. Cleaning

The surface of the housing can be cleaned with a dry, soft and lintfree cloth. Do not use aggressive solvents for the cleaning.

13. Guarantee State July 2006

For this instrument will be granted a service life (in following called guarantee) to following conditions:

- This guarantee is valid for new instruments purchased in Germany.
- New instruments and their components, which are defective because of production faults and/or material faults, are repaired from SAT-Kabel®.
- For wear parts, like accumulators, keyboards, housings, bags, connecting cables this guarantee is valid for 6 month from the purchasing date.
- The guarantee claim expires at matings by the purchaser or third persons.
- At defects, caused by improper handling or operating, by wrong installation or store, by improper connection or mounting, no guarantee is granted.
- For not justified demand of our service we charge for our service the usual payment for material, working hours and forwarding costs.
- Repairs are only made with filled service covering.

Forms for service coverings and further information are found in the standard form contracts under: www.sat-kabel.de

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