Megger

Operating Manual

Test and Fault Locating System SPG 40

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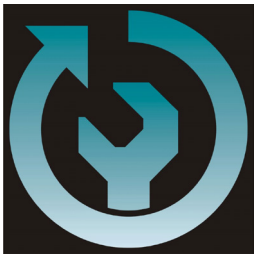
1 Safety Advice

1.1 General Advice

General

This manual contains basic advice for the installation and operation of the product. It is essential to make this manual accessible to the authorised and skilled operator. He needs to read this manual closely. The manufacturer is not liable for damage to material or humans due to neglectance of this manual and this and the following safety advices.

Setting up and operating the instrument may only be done by authorised and skilled personnel. According to DIN VDE 0104 (EN 50191) and DIN VDE 0105 (EN 50110) as well as the accident prevention regulation (Unfallverhütungsvorschrift UVV), skilled personnel is defined as a person who is qualified to work, judge and realize dangers due to his professional education, knowledge and experience and his knowledge of applicable regulations. Locally applying regulations have to be observed.



Working with equipment of Megger

All electrical regulations of the country where the instrument is operated have to be observed as well as national regulations for prevention of accidents and existing regulations for the safety and operation of equipment of the involved companies. After working with the equipment, make sure to de-energise, protect against re-energising, discharge, ground and short-circuit the instrument and installations that have been worked on. Original accessories ensure safe operation of the equipment. It is not allowed and the warranty is lost if other accessories than the original ones are used with the equipment. Repairs and service must only be done by Megger or authorised service departments of Megger. Megger recommends having the equipment serviced and checked once per year at a Megger service location.

Intended application

Safe operation is only realised when using the equipment for its intended purpose (see chapter "Introduction"). Using the equipment for other purposes may lead to human danger and damage of equipment of involved installations. The limits described under technical data may not be exceeded. Operating products of Megger in condensing environment may lead to flash-over, danger and damage. The instruments should only be operated under tempered conditions. It is not allowed to operate Megger products at direct contact with humidity, water or near aggressive chemicals nor explosive gases and fumes.

Behaviour at malfunction of normal operation

The equipment may only be used when working properly. When irregularities or malfunctions appear that cannot be solved consulting this manual, the equipment must immediately be put out of operation and marked as not functional. In this case inform the person in charge who should inform the Megger service to resolve the problem. The instrument may only be operated when the malfunction is resolved.

Operation in traffic environment

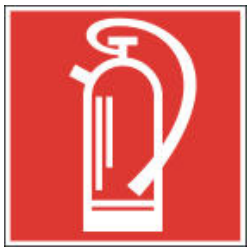
To ensure safety for operators and traffic, the country-specific regulations must be observed.

Transport and operating position

The device may only be operated and transported in an upright (standing) position!

Using cardiac pacemaker

Physical processes during operation of high voltage may endanger persons wearing a cardiac pacemaker when near these high voltage facilities.



Fire fighting in electrical installations

- Recommended extinguishing agent: carbon dioxide (CO_2)
- Carbon dioxide is electrically non conductive and does not leave residue. It is safe to use in energized facilities as long as the minimum distances are observed.
- It is essential to observe the safety instruction on the extinguishing agent.
- Applicable is DIN VDE 0132.

1.2 Electrical Advice

Dangers when operating with high voltage

Special attention and safety-conscious behaviour is needed when operating high voltage facilities and especially non-stationary equipment. The regulations VDE 0104 about setting up and operation of electric test equipment, i.e. the corresponding EN 50191 as well as country-specific regulations and standards must be observed.

Advice about handling high voltage

Safety installations may not be by-passed nor deactivated.

Operation requires minimum two people whereas the second person must be able to activate the emergency-OFF button in case of danger.

To avoid hazardous electric charges of metallic parts in the vicinity, all metallic parts must be grounded.

To avoid drawing dangerous arcs, switching should only be done in de-energized condition.

HV test equipment and burn-down equipment is short-circuit proof. Hazardous voltage may be present if a short circuit is opened during operation. If measuring short-circuit current is necessary, it is advisable to connect an arrester in parallel with the measuring instrument (e.g. 90 V glow arrester).

Adequate safety precautions must be met when using transient measuring techniques, using HV test instruments or surge generators.

The equipment and all accessories must be connected according to applicable standards VDE, EN or DIN as well as country-specific regulations.

Always follow the 5 Safety Rules !

These five safety rules must always be followed when working with high voltage:

1. De-energise
2. Protect against re-energising
3. Confirm absence of voltage
4. Ground and short-circuit
5. Cover up or bar-off neighbouring energised parts

2 Technical Description

Display		¼ VGA display for status, input, help and results, „single-button-operation“
Insulation Test		
Voltages		500 ... 5000 V, in steps of 500 V
Ranges		1 kΩ, 1 MΩ, 100 MΩ
DC Testing		0 … 40 kV DC Leakage current display: 0 ... 1/10 mA auto-ranging (0 … 100 mA during changing phase)
Breakdown recognition		0 ... 40 kV;
Burning		0 ... 8 kV ; 700 mA 0 ... 20 kV ; 100 mA
Surge generator	SPG 40-25	0 … 12.5 kV and 0 … 25 kV
	SPG 40-32	0 … 16 kV and 0 … 32 kV
Surge generator - options:		0 ... 4 kV, 0 ... 8 kV or 0 … 4/8 kV 0 ... 3 kV, 0 ... 6 kV or 0 … 3/6 kV
Surge energy		max. 1000 Joules in each range (optional: 2000 Joules)
Surge rate		3 … 10 sec. and single pulse
Sheath fault location		0 ... 5 kV, 0 … 10 kV, adjustable current output pulse ratio: continuous, 1:3 ; 1:4; 1:6 (sec)
HV-Fault Prelocation (with optional TDR)		
		ARM (integrated filter),
		Impulse Current (integrated coupler)
		Decay (integrated coupler)
		ICE-Plus
Operating temp.		-10 ... + 50 °C
Mains supply		230 VAC ±10% (optional: 115 VAC ±10%); 50 / 60 Hz (Sinus)
Power input		1.7 kVA max.
AC mains fuses		2 x T 8 A (for 230 V)
		2 x T 16 A (for 115 V)
Protection category		IP20 (according to EN 60529)
Dimensions		545 x 430 x 1050 mm (L x W x H)
Weight		approx. 116 kg

3 Scope of delivery and Options

Scope of delivery[1]:

Description	Item
Test and fault locating device	SPG 40
Set of cables	VL SPG-40
consisting of:	
AC mains connection	NKG S2
Earthing connection cable	EK 1
Auxiliary earth cable	MK 54-B
High voltage connection (25 on manual cable reel)	HSK 27
MC connection adapter	HKZ 02-1 (red) and HKZ 03-1 (black)
Operating manual	

Options:

Description	Item
NH adapter	700-10-0437
Operational earth connection with brass screw-on clamp	EKS 80
Operational earth connection adapter with big and flexible handle-screw	EKD 80
TDR (Time Domain Reflectometer)	Teleflex SX, T 3060 or others
Surge Wave Receiver	Digiphone
Step Voltage Indicator	ESG NT
Line Location System	Ferrolux or others
External operating panel	Dimensions incl. foot plate (B x H x T): 500 x 430 x 240 mm
External safety device with HV operaring function	1006953
External safety device	820003206

[1] If permanently installed in a test van or on a trolley, the scope of delivery may be different.

4 Introduction

The SPG 40 has been developed for fault locating in low and medium voltage networks. Its functions are:

- DC-Testing,
- Breakdown recognition,
- Measuring leakage resistance,
- ARM filter for prelocating with a TDR (optional),
- Further prelocating methods (Decay, ICE, ICE-Plus)
- Pinpoint locating with step voltage or acoustic method,
- Burning.

4.1 Stand-alone unit

The SPG 40 uses easyGO operation with just one rotary selector. For safety reasons the high voltage setting must be activated with a separate hardware button.

The operating panel is located in the top panel of the SPG 40 but it is optionally available as external control unit.

4.2 Combined fault locating system Surgeflex 40 (SFX 40)

Combined with a reflectometer of type Teleflex SX or T3060, the SPG 40 is enhanced by the most common HV pre-locating methods and so upgraded to a fully fledged fault locating system (SFX 40).

While – when combined with the T3060 – the operating steps are to be carried out individually on the operating elements of the respective device, the Teleflex SX is suitable for direct control of the SPG 40. Supplemented by the necessary HV operating elements (Teleflex SX-M), it can thus be used for comprehensive remote control of a spatially separate SPG 40 in a test van (Compact City).

5 Safety

WARNING

Risk of fatal injury from electric shock!

Switching off or bypassing the safety equipment described in the following two sections will put persons and materials at significant risk. For this reason, prior to a manual shut-off the operator must ensure that the earthing conditions allow the device to be worked with safely on his own responsibility by taking suitable measures and measurements.

Because the SPG 40 generates a hazardous voltage of more than 1 kV it must be operated by trained specialists only. The following safety measures should be followed:

5.1 Key Switch

For product liability reasons measuring devices generating hazardous voltages have to be protected against accidental activation by unauthorised users. For this purpose the SPG 40 has a key switch, to avoid unauthorised operation by persons other than the operator. (see page 17, Fig. 2)

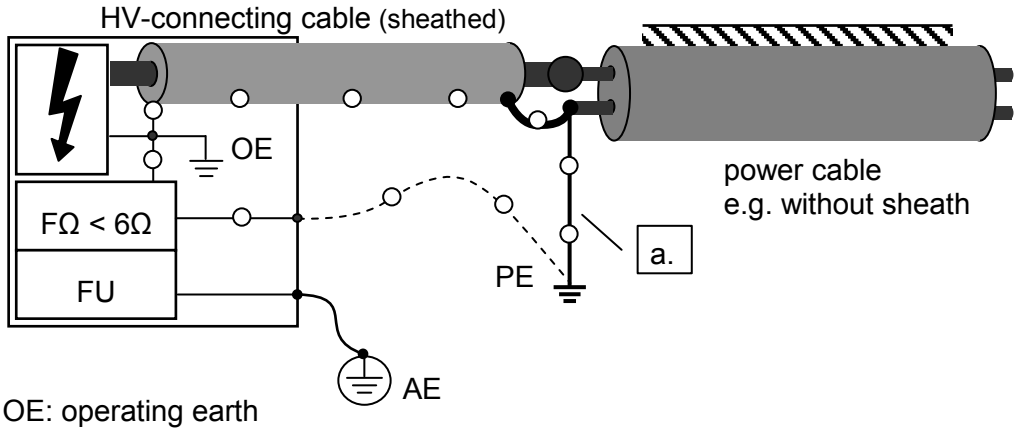
5.2 FΩ protection device

For safe earthing the loop ‘operating earth’ – ‘safety earth’ is monitored (indicated in the following figure with o). The resistance between operating and safety earthing must not exceed 6 Ω, otherwise the device cannot be switched to ‘stand-by’. If this should happen during operation (i.e. earth clamp gets disconnected), the SPG 40 will immediately shut off and ground the cable and the HV part of the unit. The menu ‘safety circuit’ will appear, signaling ‘FOHM loop resistance – error’. It may be necessary to make a connection a. operating earth – safety earth to meet the requirements (see chapter 6.2.4).

In some rare cases it is possible that the station earthing loop between operational earth and safety earth does not have a resistance lower than 6 Ω. **Providing that all of the conditions set out in chapter 6.2.2 are fulfilled**, the protective monitoring may be switched off in the setup in this case (see chapter 7.1). This is done at operators responsibility. An indication will show in the main menu that F Ω protection is switched off.

5.3 FU-Safety Circuit

Also for safety for the operator, the auxiliary earth connection [23] must be connected to a ground rod as close as possible to the SPG 40. The FU-safety circuit of the SPG 40 will immediately shut the unit off and ground the cable and the HV part of the unit over a resistor if the voltage between the instrument and the surrounding earth gets higher than 33 V AC / -40 V DC, or if the resistance of the earth loop between safety earth and auxiliary earth gets higher than 150 kΩ. The menu 'safety circuit' will appear on screen, signaling 'FU – step voltage - error'.



OE: operating earth

PE: safety earth / station earth

AE: auxiliary earth

Fig. 1: FΩ – monitoring

In some areas the ground resistance between instrument (earthed at station earth) and the terrain where the instrument is set up may be higher than 150 kΩ due to ground conditions (e.g. dry sand, rock). **Providing that all of the measures described in chapter 6.2.3 have been taken**, the step voltage monitoring may be switched off in the setup in this case (see chapter 7.1). This is done at operators responsibility. An indication will show in the main menu that FU protection is switched off.

5.4 VDE clauses 0104

5.4.1 Mobile (non-stationary) test unit

VDE standard 0104 states that the set-up of the instrument, including the beginning of the cable to be measured, represents a non-stationary test installation and is considered as a test site without protection against human contact. The same also applies to the end(s) of the cable to be tested.

5.4.2 Area of Danger

Test sites without protection against direct human contact are considered ‘areas of danger with various zones of danger levels’ and have to be cordoned off, secured and marked accordingly.

5.4.3 Emergency OFF button

Test sites in general have to be equipped with an emergency OFF button. The SPG 40 has a red emergency OFF button on the face plate (see page 17, Fig. 2). An external safety device with an emergency stop switch is optionally available (820003206). It can be connected to the jack [6] on the rear connecting panel (see page 18, Fig. 3) When using the SPG 40 without the external emergency OFF button, the standard dummy plug has to be placed in jack [20] so that the device can be switched on.

6 Operating

6.1 Connections and controls

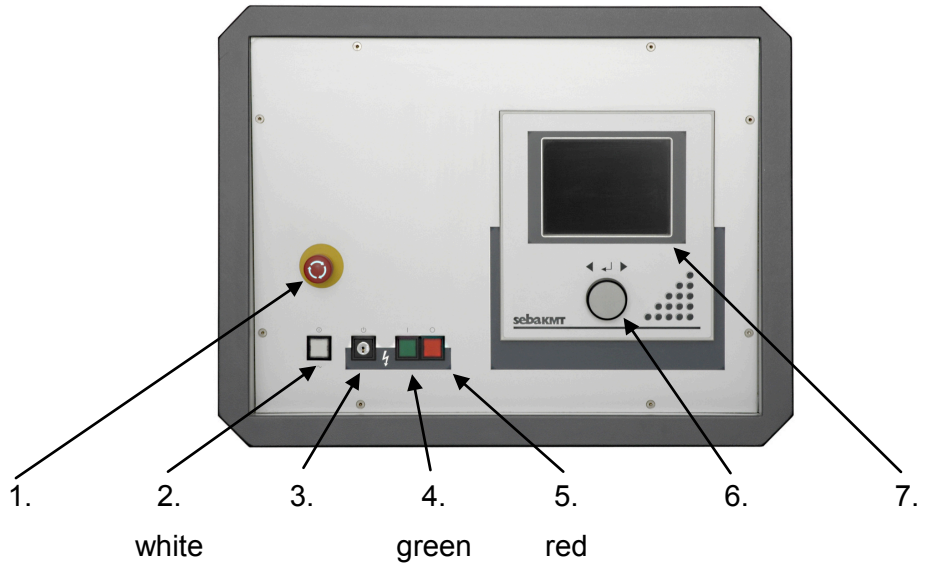


Fig. 2: Controls

	Element	Function
1.	**emergency OFF button**	
2.	**push-button – white**	**on/off switch**
	press:	activates system controls
	lit:	device is switched on
3.	**key switch**	
4.	**push-button – green:**	**HV-ON key**
	lit:	HV readiness for switching on (high voltage can be switched on)
	press:	Switches the high voltage on; earthing of the output is cancelled
5.	**push-button - red :**	**HV-OFF key**
	lit:	HV-operation (high voltage present at output)
	press:	switches high voltage off (output will be grounded over a discharge resistor)
6.	**rotary selector with enter function**	
7.	**display**	

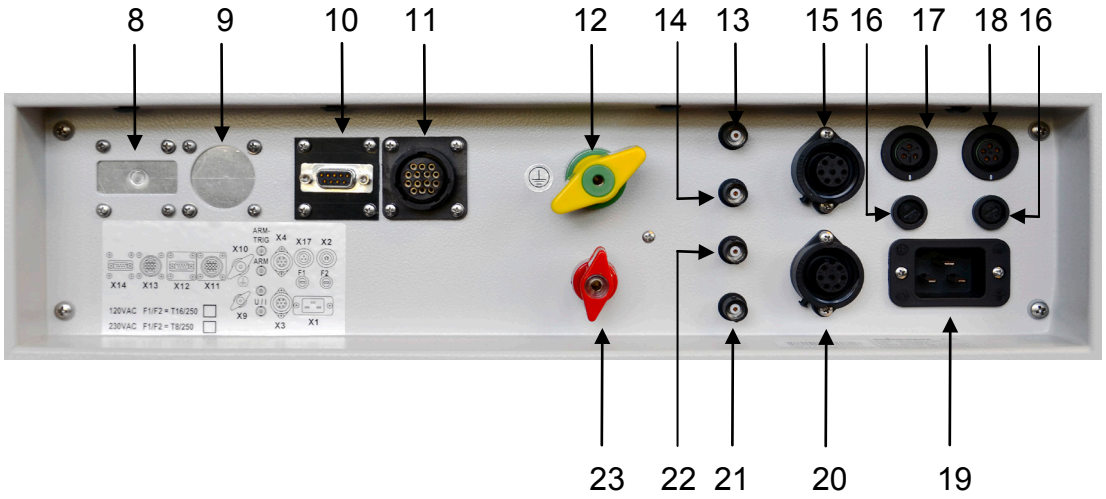


Fig. 3: Connections - back

8. CAN bus connection to external control panel (optional)
9. Control connection to external control panel (optional)
10. CAN bus connection to Teleflex SX / T 30-E control panel
11. Control line to separated control elements [1]
    - SPG 40-1 (since 2015): Teleflex SX-M, system control panel of a test van or external safety device
    - SPG 40 (until 2014): „T30-E HV-Control“ box
12. Safety earth
13. ARM trigger
14. ARM signal
15. Safety circuit for earth connection and door contacts
16. Fuses [1] 115 V: T16 A H250 ;
    230 V: T8 A H250
17. Protected 13.5 VDC power output for TFX SX and T30-E (max. 60 W)
18. Integration and status check of an external HV connector
19. AC power supply 115 / 230 V [1] / 50/60 Hz
20. External emergency-off-button and signal lights (see "options")
21. Output of signal for surge pulse mode (impulse current mode)
22. Output of signal for decay mode
23. Auxiliary earth connection for FU-protection

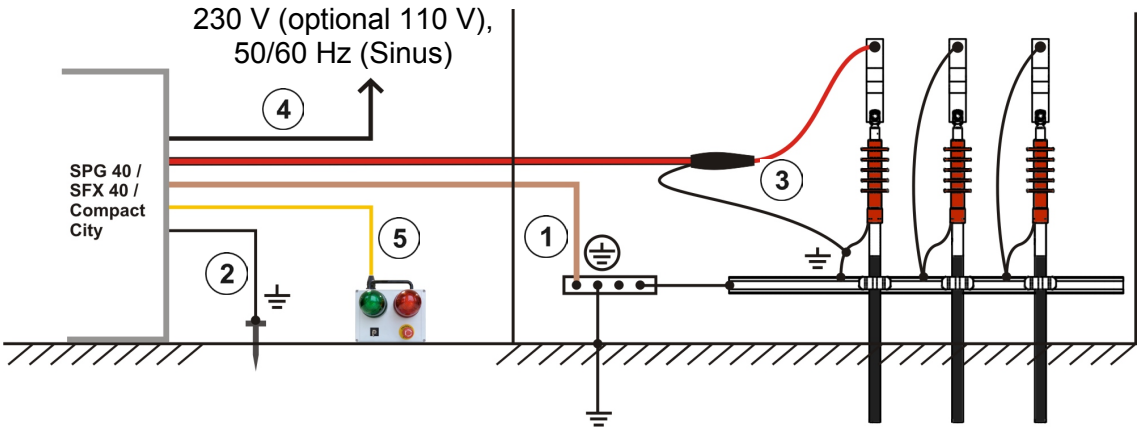
[1] depending on instrument version, see type label on instrument.

6.2 Electrical Connection

During electrical connection, please observe the safety precations in section 1.2.

6.2.1 Connection Sequence

The electrical connection must be carried out in the sequence shown in the figure. Connection to the mains occurs last!



1. Connection of the earthing cable
2. Connection of the FU cable (auxiliary earth)
3. Connection to the test object
4. Connection to the mains
5. Connection of the external safety device (optional)

6.2.2 Safety Earth

The SPG 40 has to be earthed before use. To do so connect the protective earth connection [10] to a good safety earth (e.g. station earth, etc.) using the earth lead EK1 supplied.

Note that the earthing clamp should only be attached to clean metallic points of contact.

The device should never be operated without the earth lead being connected. The earth lead establishes the connection between the device and the safety earth and ensures that the device is touch-proof.

The earthing provided through the earth contact of the mains connection is not sufficient.

Without the earth lead being connected, the housing leakage current could exceed 3.5 mA, if the earth connection to the wall socket is interrupted (safety hazard according to EN 61010).

6.2.3 Auxiliary Earth / FU-Safety Circuit

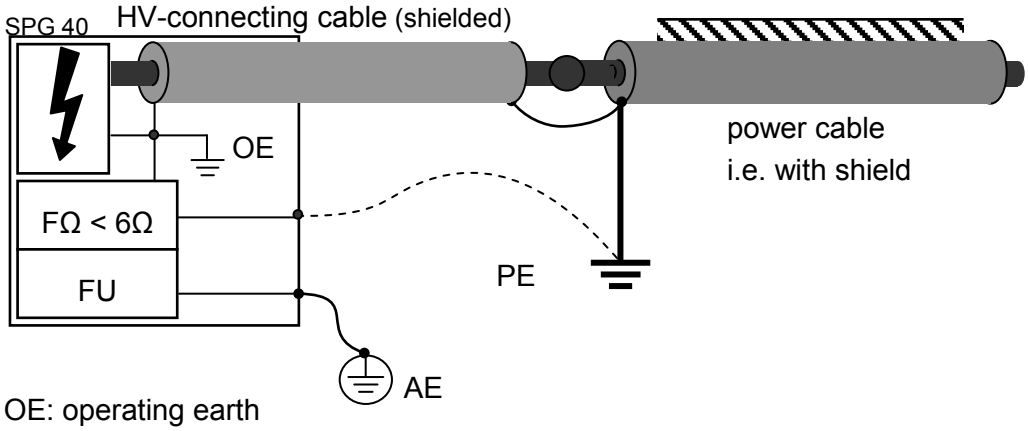
Connect the auxiliary earth connection [23] to a earthing rod as close as possible to the SPG 40 with the connecting cable MK 54-B supplied. The FU-safety circuit of the SPG 40 will immediately shut the unit off and ground the cable and the HV part of the unit if the voltage between the instrument and the surrounding earth gets higher than 33 V AC / -40 V DC, or if the resistance of the earth loop between safety earth and auxiliary earth gets higher than 150 kΩ.

If the safety circuit menu appears and the “FU” fault is reported after switching the system on despite the connected auxiliary earth, the following tips may provide a remedy:

- Try inserting the earthing rod in other locations which may be more suitable. In heavily built-up areas, the gaps between the concrete slabs can be used, for example.
- Use water to moisten the location where the earthing rod has been inserted.
- Attach the auxiliary earth to a foundation earth (e.g. a lightning protection system). Do not use the same foundation earth to which you have already connected the main earthing cable.

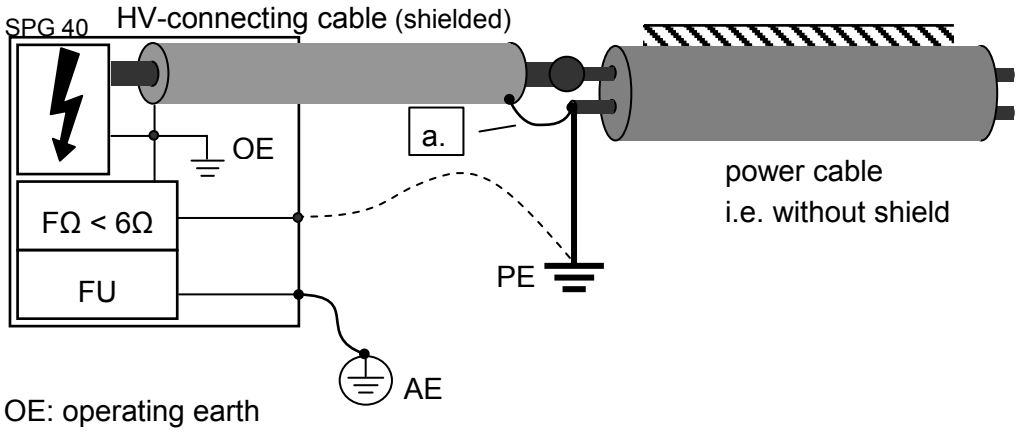
6.2.4 Connecting the HV-line to a faulty cable

The HV-connecting cable has to have a minimum length of 25 m (scope of delivery) to avoid excess currents. These currents could develop due to the discharge characteristic of the surge capacitor when the flash-over in the cable occurs at a very short distance of the point of connection.



OE: operating earth
PE: safety earth / station earth
AE: auxiliary earth

Fig. 4: Connecting to LV cable with sheath



OE: operating earth
PE: safety earth / station earth
AE: auxiliary earth

Fig. 5: Connecting to a multi-conductor cable without sheath

a) Testing, acoustic field pinpoint locating, prelocation (with TDR)

If possible the operating earth of the HV connection line should be connected to the earthed shield of the faulty cable (Fig. 4).

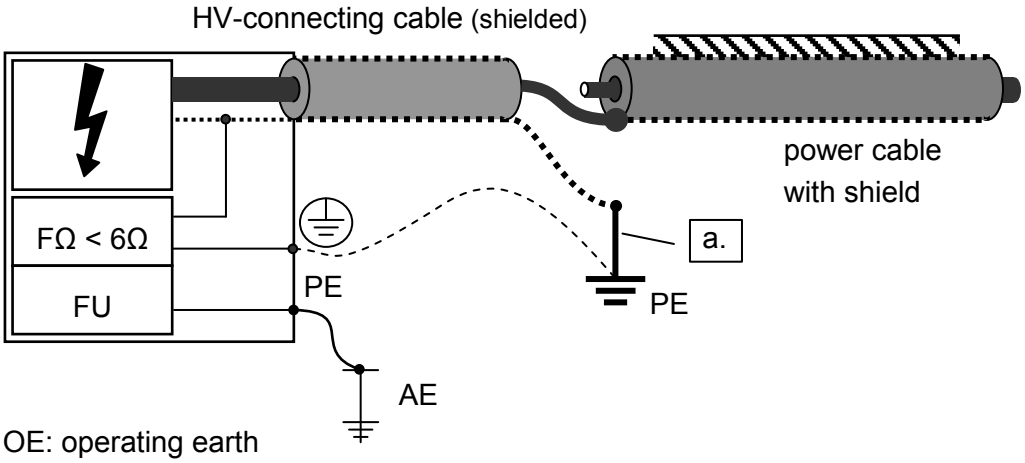
If no sheath is available, or in case of a 'phase – phase fault', the operating earth should be connected to one of the two faulty conductors. This core now has to be connected to the operating earth or a PEN-conductor using an earth bridge [a.] (Fig. 5). Without this bridge the SPG 40 could not be turned on due to the F-Ohm protection (see chapter 5.2).

The center conductor of the HV connecting cable is connected to the faulty phase.

b) Sheath testing / Step voltage pinpoint locating

Shielded cables: the shield of the object to be tested has to be separated from the earth on both ends and connected to the main conductor of the HV connecting cable.

Unshielded cables: the coax "centre" conductor of the HV feed line is connected to the cable shield. The operating earth (shield) of the HV connecting cable has to be connected to the operating earth of the station.



OE: operating earth
PE: safety earth / station earth
AE: auxiliary earth

Fig. 6: Connecting to the cable shield

6.2.5 Cordoning off open cable ends

As the high voltage pulses or DC voltage applied to the faulty cable are hazardous, the cable ends have to be cordoned off in accordance with local safety regulations (i.e. VDE 0104 regulations). The user has to make sure that also the ends of branches (tees) are cordoned off and protected.

6.2.6 Electrical connection of a time domain reflectometer

The combination of SPG 40 and a reflectometer is usually supplied already wired ex works on a trolley or as a test van assembly (Compact City). Two individual devices, however, can also be quickly and easily combined on site using the required connection cable.

For notes on connecting the reflectometer, please read the corresponding operating manual.

6.2.7 Connecting the SPG 40 to the mains

Now the SPG 40 can be connected to the mains. Make sure that the mains voltage is the same as the supply voltage of the SPG 40 (230 V AC or 115 V AC, according to the type label of the instrument).

! Notes concerning generator operation: The device may only be operated using a generator if this has been approved by Megger. Megger must therefore always be consulted before initial use of a generator! Generators which do not supply a sine wave voltage must not be used!

6.3 Menus and Mode Operation

6.3.1 Switching On

Only when the AC mains connection is not plugged in, the SPG 40 is completely turned off. The moment that the AC mains connector is plugged into a power supply, the SPG 40 is in stand-by mode – no button is lit yet.

Press the white push button [2] to start the SPG 40.

The white push-button lights up. The control and safety circuits are activated and system controls switches the operating menu on. The device will automatically go on ‘stand-by’.

There is no high voltage generated at this point as the HV outlet is still earthed.

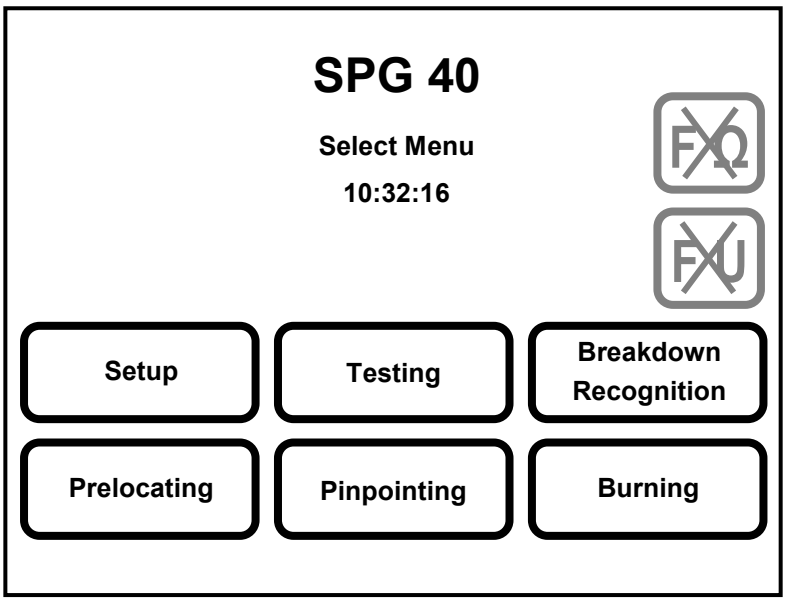


Fig. 7: Main menu

For a more detailed explanation of the main menu see chapter 7.

6.3.2 Rotary Selector

Turn = select or change values

Press = confirm (enter function)

Operation is made simple by the easyGO functions. Modes are selected in the menu by turning, and activated by pressing the rotary selector [6].

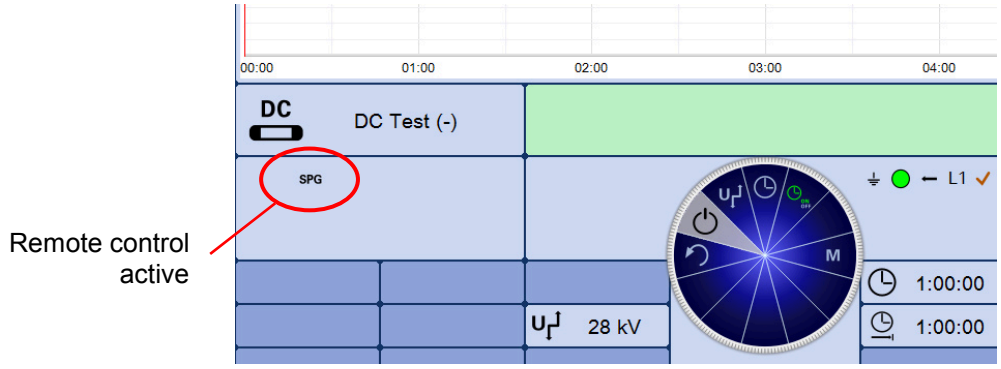
Within a mode, values are changed by turning. To confirm the selected settings the rotary selector has to be pressed again (ENTER).

The main menu operating modes are explained in chapter 7, page 27.

6.4 Remote control using Teleflex SX

In remote control mode, all operating modes (with the exception of the optional ICE Plus locating method) can be controlled directly from the Teleflex SX. The SPG 40 display is darkened in this mode and the encoder [6] has no function.

The remote control mode on the Teleflex SX must be activated before measurement is begun.



To do so, SPG 40 and Teleflex SX must be connected to each other properly and both must be switched on. Aside from that, the firmware version on both devices must support remote control mode.

For notes on the necessary firmware versions, on activating the remote control mode and on operating the Teleflex SX, please read the Teleflex SX operating manual.

6.5 High Voltage control

6.5.1 High Voltage HV on

Once the test mode has been selected the "HV enabled" mode is established by activating the field "HV – ON". The command ‘push green button’ appears in the status line at the bottom of the screen once HV – ON has been entered. Subsequently, the green illuminated button [4] must be pressed (if this does not happen within 5 seconds, the “HV – ON” field must be re-activated).

Now the SPG 40 is in "HV enabled" mode: the red button [5] lights up as the light in the green button [4] goes off and HV is activated. Now the selected mode is active. This configuration means Danger –High Voltage enabled", shown in the display as the high voltage arrow-symbol, even if no HV is generated at the output. The soft-discharge grounding is deactivated.

Note: If the green button [4] goes off without the red button [5] lighting up (e.g. broken light bulb), the device is also on ‘High voltage enabled’ and **High voltage** could be on!

6.5.2 High voltage is active

In the testing, breakdown recognition, ARM and pinpoint locating (acoustic field method) modes the desired value of the voltage is first pre-set by turning the rotary selector. High voltage is present at the output after the enter button has been pushed.

The red push-button [5] is lit.

! In the burning and pinpoint locating (step voltage) modes the voltage adjustment does not have to be confirmed with the rotary selector but is immediately active at the output.

6.5.3 Turning OFF high voltage

Turning the high voltage off is done by pressing the red lit button [5] or by activating the field HV-OFF. The HV source will be shut off and the cable under test as well as the SPG 40 will be grounded over a discharge resistor. The display will show the safety ground symbol. The instrument is in the state "HV stand-by" and the green button is lit.

7 Functions

7.1 Setup- Menu

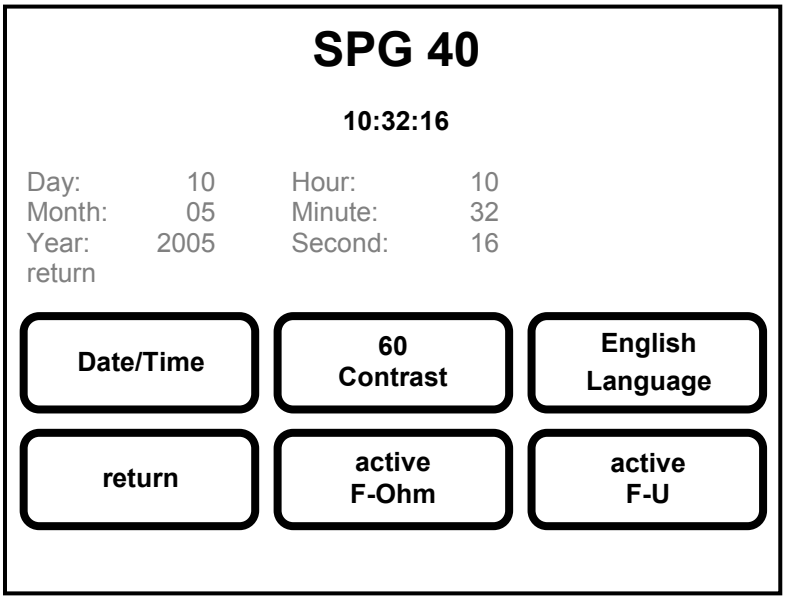


Fig. 8: Setup menu

7.2 Safety Menu

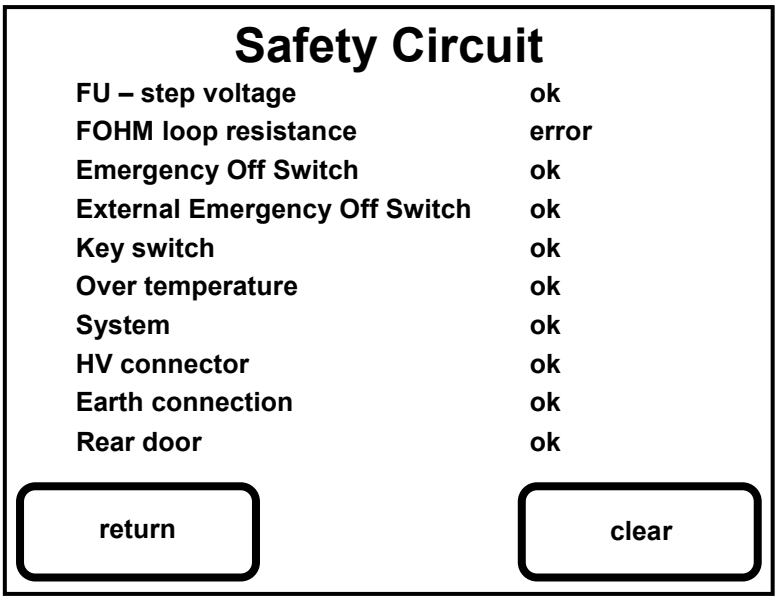


Fig. 9: Menu safety circuit

The Safety Menu will appear automatically in case of any error.

To return to the normal operating mode the error must be eliminated and confirmed with “clear”.

7.3 Testing Mode

The Testing mode offers the possibility of an insulation resistance test up to 5 kV or a DC proof test up to 40 kV.

7.3.1 Insulation Resistance Test

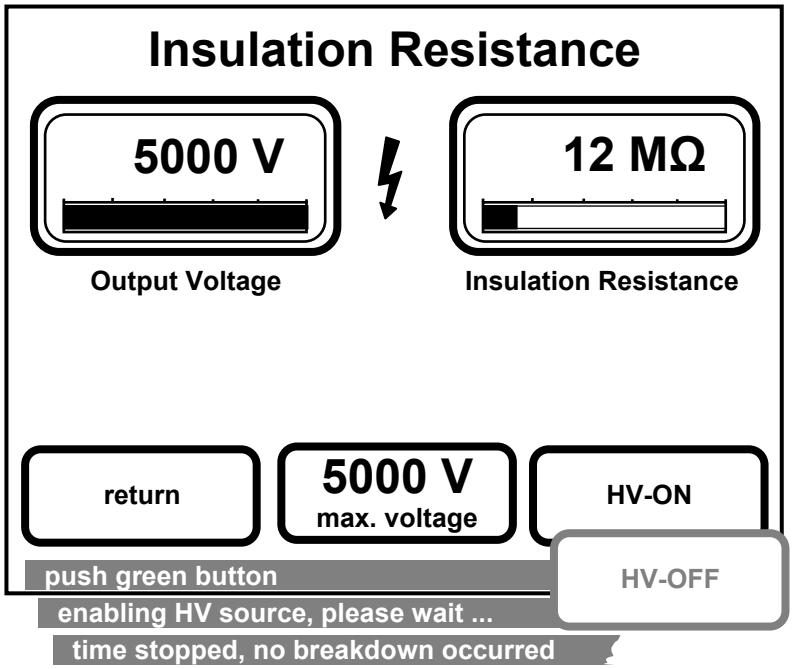


Fig. 10: Menu Insulation Resistance Test

1. Select operating mode ‘testing’ in main menu.
2. Select 'Insulation Test 5 kV'
3. Activate field “HV-ON”.
4. Press green button (within 5 sec.).
5. Set maximum voltage in steps of 500 V.
6. Read insulation resistance value.
7. Turn off with the field “HV-OFF” or by pushing the red button [5].

7.3.2 40 kV – DC Proof Test

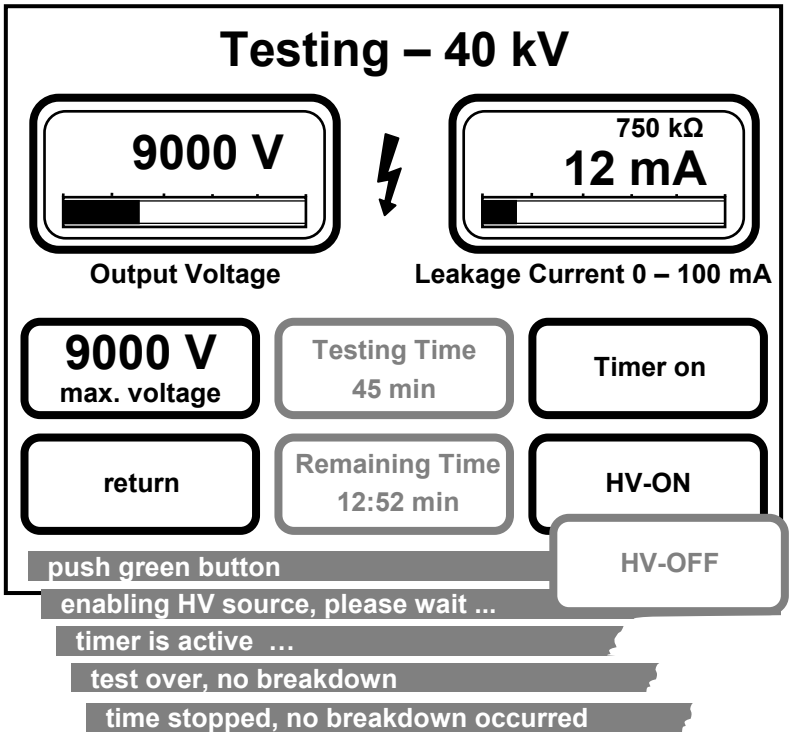


Fig. 11: Menu DC-Testing

Operation :

1. Select operating mode ‘testing’ in main menu.
2. Activate field “HV-ON”.
3. Press green button (within 5 sec.).
4. Set maximum voltage
   (increase in 2 kV steps, decrease in 1 kV steps).
   If the clock is activated the voltage setting cannot be changed
5. Set clock (only if wanted).
   Total testing time and remaining test time are shown.
   Testing with timer : breakdown recognition active
   Testing without timer : insulation resistance measurment
6. Turn off with the field “HV-OFF” or by pushing the red button [5].

If a breakdown occurs during the test with the timer turned **on**, the SPG 40 will shut off and ground the cable over a discharge resistor and the breakdown voltage will be displayed (identical to 'Breakdown recognition'-mode). If a breakdown occurs during testing but with the timer turned **off**, the SPG 40 will not switch off automatically but will continue to show the insulation resistance. The insulation resistance is shown on the top right corner of the display as soon as a minimum voltage of 100 V and a minimum current of 10 µA are measured. The displays of insulation resistance and leakage current measurement are auto-ranging.

7.4 Operation mode Breakdown Recognition

Breakdown recognition is the simplest way of finding the breakdown voltage. The operator sets the maximum voltage as an upper limit for the automatic test. The SPG 40 raises the output voltage slower than in testing mode up to the selected maximum voltage with a time ramp of between 0.8 and 4 kV/sec until a breakdown occurs. After a breakdown occurred, the breakdown voltage is shown.

This mode does not have a timer function as in testing, but the SPG 40 will automatically turn off the high voltage after the breakdown has occurred. Beside the 40 kV range there is an 8 kV range available for better resolution of the result.

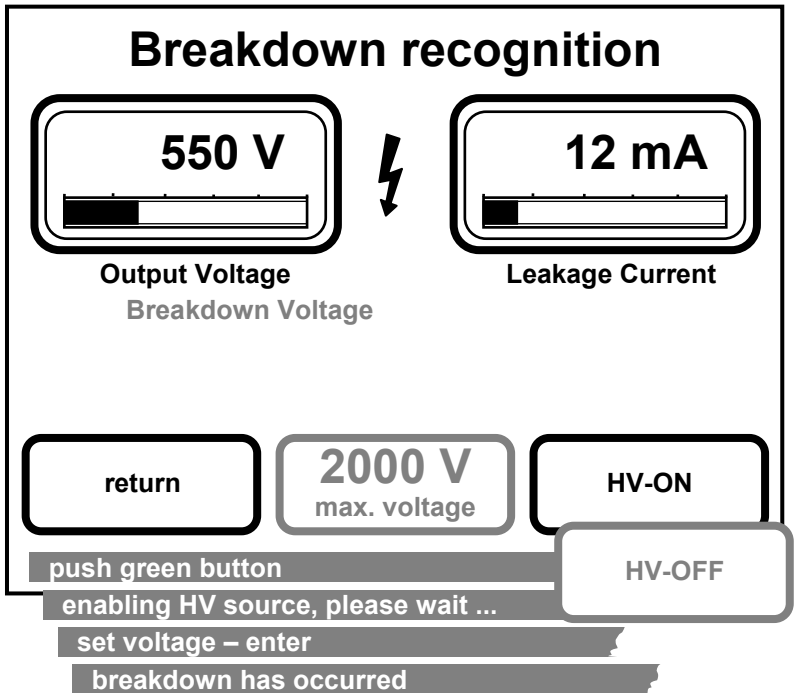


Fig. 12: Menu Breakdown Recognition

Operation :

1. Select “breakdown recognition” in main menu.
2. Select voltage range for breakdown recognition 8 kV or 40 kV
3. Activate field “HV-ON”.
4. Push green button (within 5 sec.)
5. Select maximum voltage (set value)
6. Press the rotary selector to start test, voltage will start rising.
   If a breakdown occurs, the breakdown voltage is shown at the top left. The information line at the bottom of the display will show “breakdown has occurred” and the SPG 40 will turn off the high voltage and ground the tested cable and the SPG 40 over a discharge resistor. If no breakdown occurs the high voltage remains on.
7. Turn off with the field “HV-OFF” or by pushing the red button [5]

7.5 Fault Prelocating

7.5.1 Prelocating mode ARM (Arc Reflection Method)

The ARM method requires a TDR (Time Domain Reflectometer) to be connected. Selecting this mode will internally connect the ARM filter and surge generator. Connect the signal connection of the TDR to the connection for ARM [14] and the TDR trigger connection to the ARM Trigger [13].

Releasing a "Single Shot" will discharge the surge capacitor of the SPG 40 via an inductive filter (choke) into the faulty cable.

Wear Ear Protection

Surge operation can cause high and sudden noise levels. It is strongly recommended to wear hearing protection during surge operation. Keep in mind that this will limit the operators awareness for ambient dangers.

Ventilation

The surge operation creates ozon. It is necessary to operate the instrument under well ventilated condition to keep ozon levels below limit values for the operator.

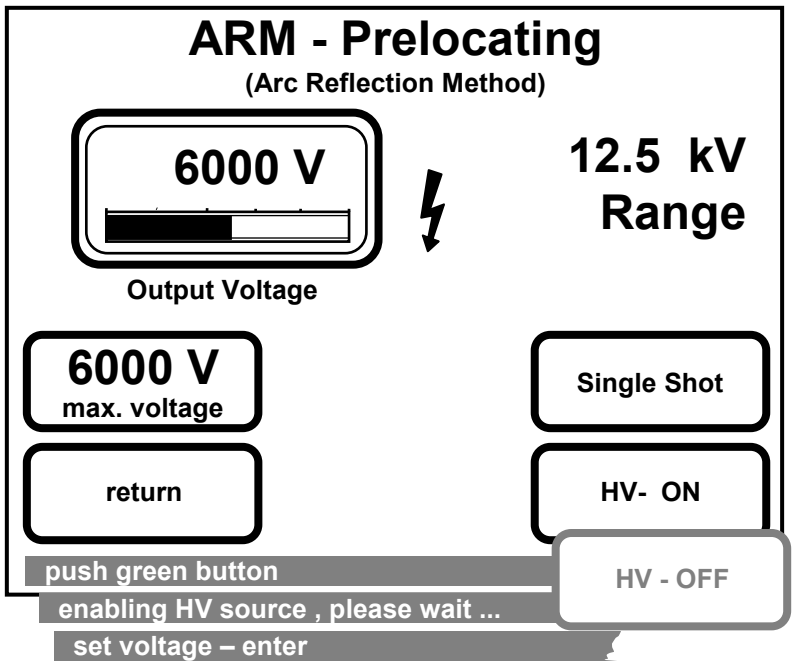


Fig. 13: Menu Arc Reflection Method ARM

Operation :

1. Select ‘Prelocation’ in main menu.
2. Activate field ‘ARM’.
3. After selecting the desired voltage range the above menu (Fig. 13: Menu Arc Reflection Method ARM) appears.
   Note: When using half the voltage of the selected range only a quarter of the energy is available or when using 1/3 of the voltage, only 1/9 of the energy is available.
4. Activate field “HV-ON”.
5. Push green button (within 5 sec.)
6. TDR adjustments:
   6 a. Adjust settings of the connected TDR and acquire reference trace with the SPG 40 still set at 0 kV.
   Also when retrieving a new reference trace at a later time, the voltage should again be set to 0 kV to avoid interference with the power supply.
   Remember to set the trigger delay of the TDR to 500 µs.
   6 b. Arm trigger of the TDR for triggering the fault trace.
7. Select voltage.
8. Release single pulse: By activating the field “single pulses” only one single pulse is released into the faulty cable and will create a flash-over. This will trigger the TDR to store the fault trace.
9. Turn off with the field “HV-OFF” or by pushing the red button [5].

7.5.2 Prelocating mode ICE (Impulse Current Equipment)

The ICE method (also called "surge pulse" method) requires a TDR (Time Domain Reflectometer) to be connected to the connection I [21]. The TDR must be set to ICE-mode.

Wear Ear Protection

Surge operation can cause high and sudden noise levels. It is strongly recommended to wear hearing protection during surge operation. Keep in mind that this will limit the operators awareness for ambient dangers.

Ventilation

The surge operation creates ozon. It is necessary to operate the instrument under well ventilated condition to keep ozon levels below limit values for the operator.

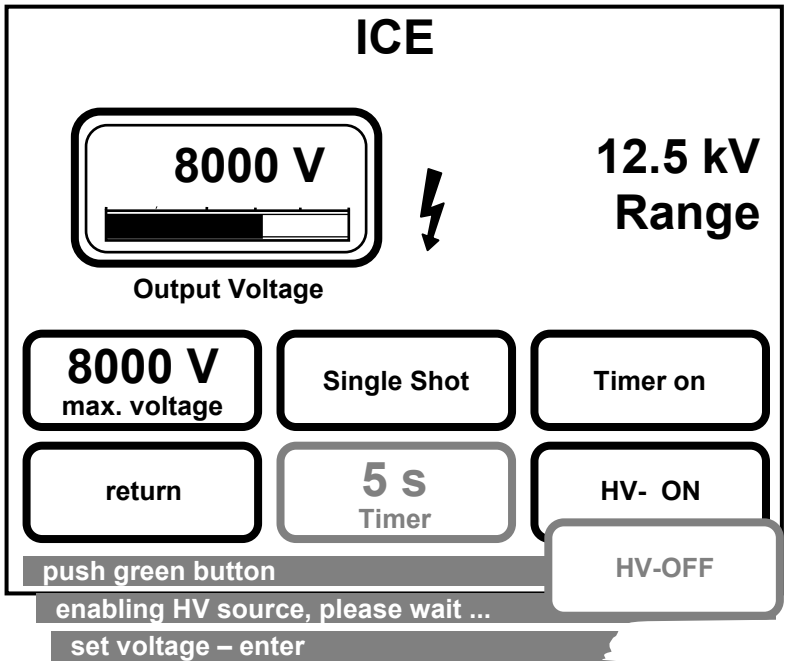


Fig. 14: Menu ICE (impulse current / surge pulse method)

Operation :

1. Select 'Prelocation' in main menu.
2. Activate field 'ICE'.
3. After selecting the desired voltage range the above menu appears (Fig. 14: Menu ICE (impulse current / surge pulse method)).
   Note: The impulse energy is 1000 J at full voltage in the respective selected range. When using half the voltage of the selected range only a quarter of the energy is available or when using 1/3 of the voltage, only 1/9 of the energy is available.
4. Activate field "HV-ON".

5. Push green button (within 5 sec.)
6. TDR adjustments:
   6 a. Adjust settings of the connected TDR.
   6 b. Arm trigger of the TDR.
7. Select max. voltage.
8. Release single pulse:
   By activating the field “single pulses” only one single pulse is released into the faulty cable.
   This will trigger the TDR to store a ICE-diagram if the settings were correct. Else change settings of the TDR and release another single pulse.
9. Turn off with the field “HV-OFF” or by pushing the red button [5].

7.5.3 Prelocating mode Decay

The Decay method requires a TDR (Time Domain Reflectometer) to be connected to the connection U [22]. The TDR must be set to Decay-mode.

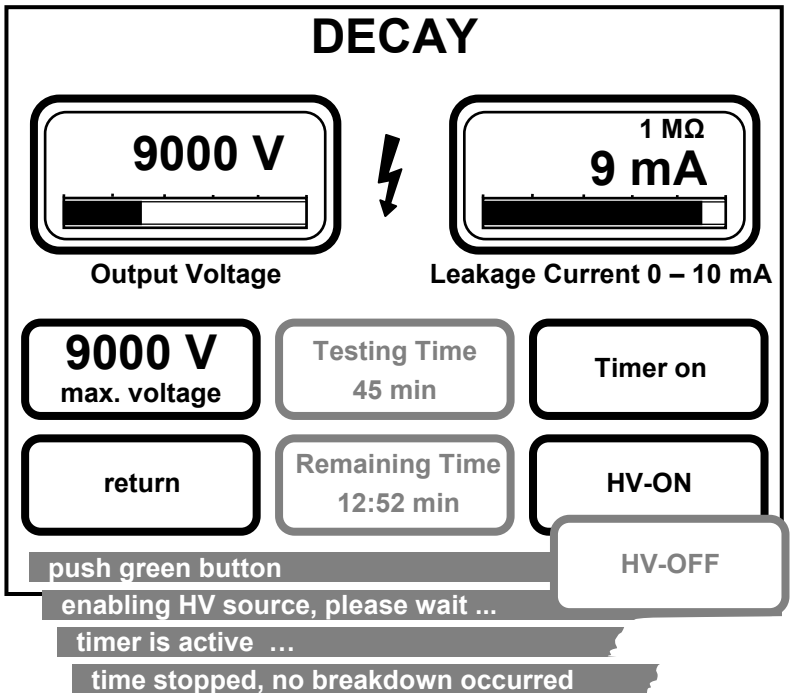


Fig. 15: Menu Decay

Operation :

1. Select operating mode ‘Prelocation’ in main menu.
2. Select operating mode ‘Decay’ in prelocation menu.
3. Activate field “HV-ON”.
4. Press green button (within 5 sec.).
5. Adjust settings of the connected TDR.
6. Arm trigger of the TDR.
7. Set maximum voltage (increase by 2 kV, decrease by 1 kV).
8. Voltage rises to where a breakdown occurs (or max. voltage setting). The breakdown will trigger the TDR to store a Decay-diagram if the settings were correct. Else change settings of the TDR and increase voltage to where a breakdown occurs again.
   If the clock is activated the voltage setting cannot be changed
9. Turn off with the field “HV-OFF” or by pushing the red button [5].

If a breakdown occurs during the test with the timer turned **on**, the SPG 40 will shut off and ground the cable over a discharge resistor and the breakdown voltage will be displayed (identical to 'Breakdown recognition'-mode).

If a breakdown occurs during testing but with the timer turned off, the SPG 40 will not switch off automatically but will continue to show the insulation resistance. The insulation resistance is shown on the top right corner of the display as soon as a minimum voltage of 100 V and a minimum current of 10 µA are measured. The displays or insulation resistance and leakage current measurement are auto-ranging.

7.5.4 Prelocating mode ICE-Plus (optional)

The ICE-Plus method is not influenced by branches (tees) in LV networks.

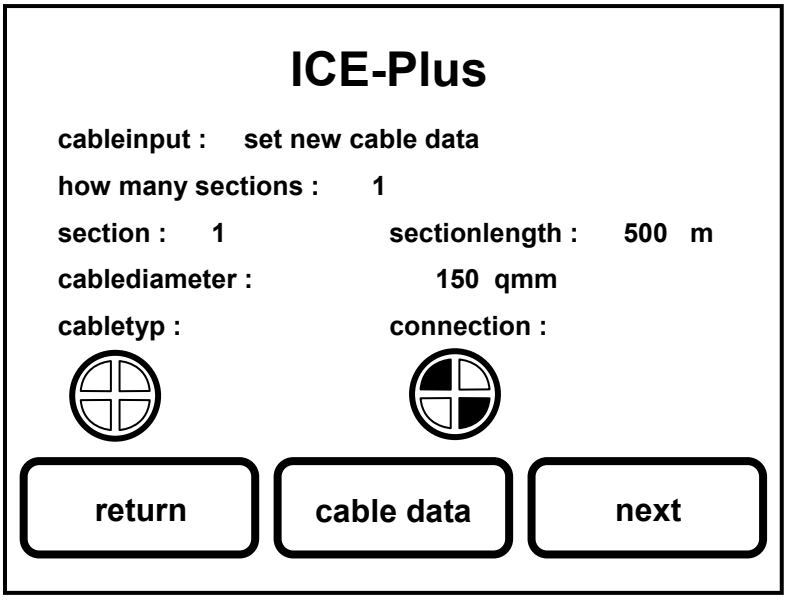


Fig. 16: Menu ICE-Plus - cable data

Operation :

1. Select operating mode ‘Prelocation’ in main menu.
2. Select operating mode ‘ICE-Plus’ in prelocation menu.
3. Activate field "cable data".
4. Under “cableinput” (at the top) select one of the following:

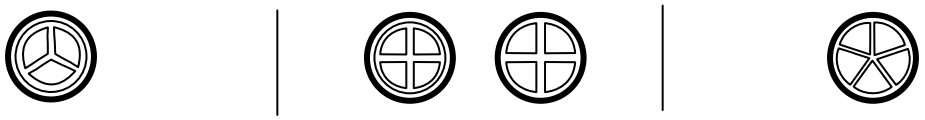
   “accept old cable data” (no changes, continue with step 10)

   “modify cable data” (change previous data)

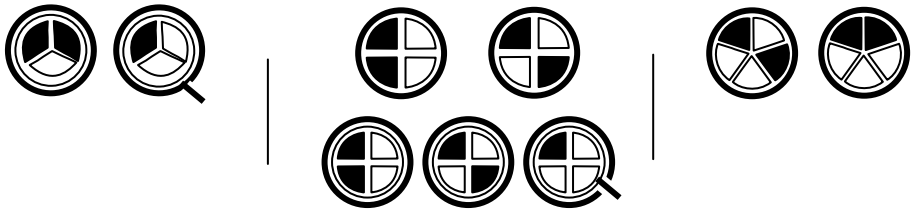
   “set new cable data” (enter a completely new set of data)
5. Enter the number of sections for mixed cables (max. 5 parts)
6. Enter lengths of sections. When dealing with mixed cables, the exactness of the result depends on how exact the input is. For single sections the length just has to be changed if the object to be measured is longer than the pre-set value.

   If the length entered is to short and the fault is behind the stated cable end, this is shown at the bottom of the display with “Faultdistance > Cablelength”.
7. Select the conductor diameter from the provided values.
8. Selection of cable type. Select one of the following possibilities:

   with sheath | 4 conductors | 5 conductors without sheath



9. Connection: The following connections are available:



10. Confirm the cable data input by pressing “next”.
11. Another menu opens, as shown in the figure below.

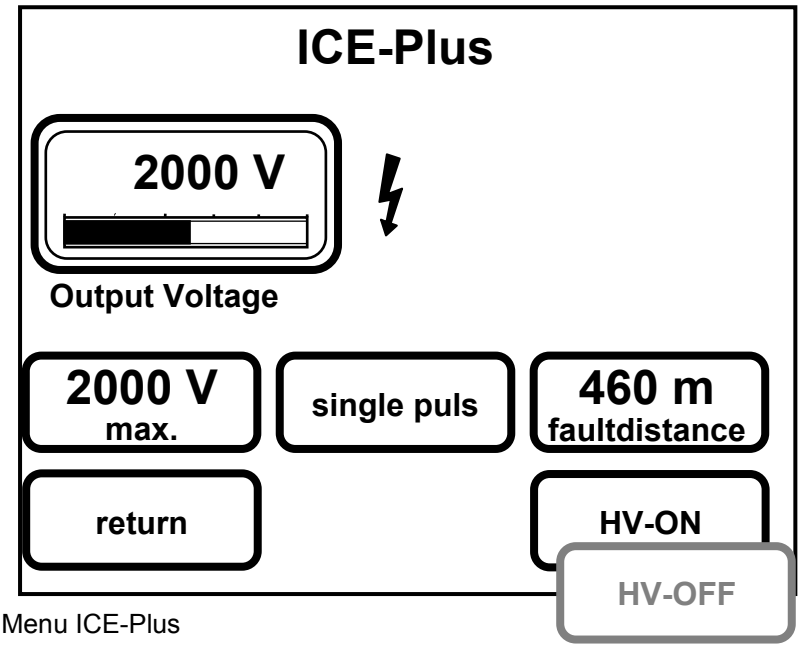


Fig. 17: Menu ICE-Plus

12. Activate field “HV-ON”.
13. Press green button (within 5 sec.).
14. Enter max. voltage (set value). This value should be at least 1500 V for good results (check maximum test voltage of the cable!) and always a good amount higher than the fault breakdown voltage.
15. Press the field ‘single pulse’. The impulse capacitor is now discharged into the faulty cable and the fault length shown on the display.
16. Turn off with the field “HV-OFF” or by pushing the red button [5].

7.6 Pinpointing Mode

There are two kinds of pinpoint locating to choose from:

- The sound field method with a surge wave generator.
- The step voltage method with a DC output voltage 0 … 5 kV, which can be pulsed.

7.6.1 Acoustic method

Wear Ear Protection

Surge operation can cause high and sudden noise levels. It is strongly recommended to wear hearing protection during surge operation. Keep in mind that this will limit the operators awareness for ambient dangers.

Ventilation

The surge operation creates ozon. It is necessary to operate the instrument under well ventilated condition to keep ozon levels below limit values for the operator.

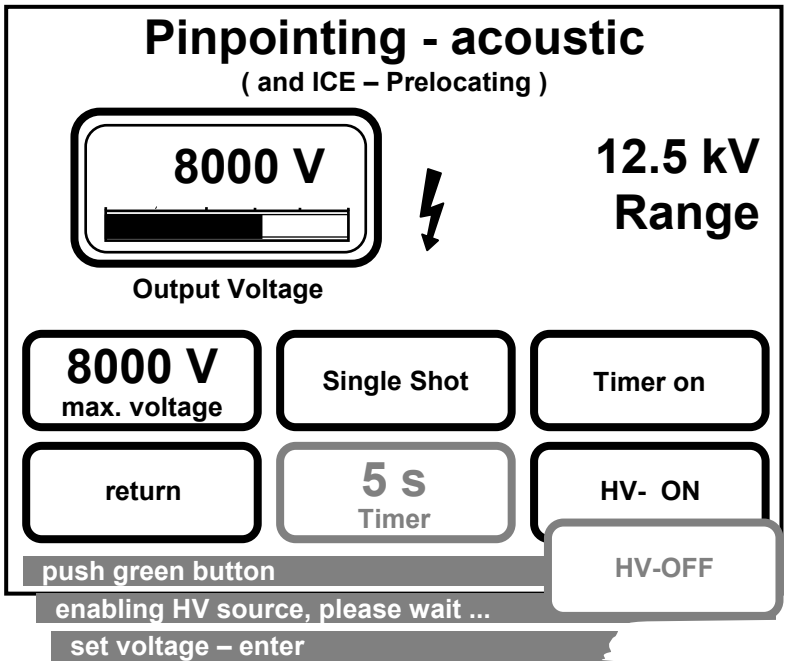


Fig. 18: Menu ICE (impulse current / surge pulse method)

Operating :

1. Select ‘Pinpointing’ in main menu.
2. Activate field ‘Acoustic’.
3. After selecting the desired voltage range the above menu appears (Fig. 18: Menu ICE (impulse current / surge pulse method)).
   Note: The impulse energy is 1000 J at full voltage in the respective selected range. When using half the voltage of the selected range only a quarter of the energy is available or when using 1/3 of the voltage, only 1/9 of the energy is available.
4. Activate field “HV-ON”.
5. Push green button (within 5 sec.)
8. Select max. voltage.
9. Single pulse or timing:
   By activating the field “Single Shot” only one single pulse is released into the faulty cable.
   After the field ‘Timer on’ has been activated, another field appears. Here a pulse rate ranging from 3 to 10 seconds can be selected.
10. Use your pinpoint locator to locate the fault
11. Turn off with the field “HV-OFF” or by pushing the red button [5].

7.6.2 Step Voltage Method

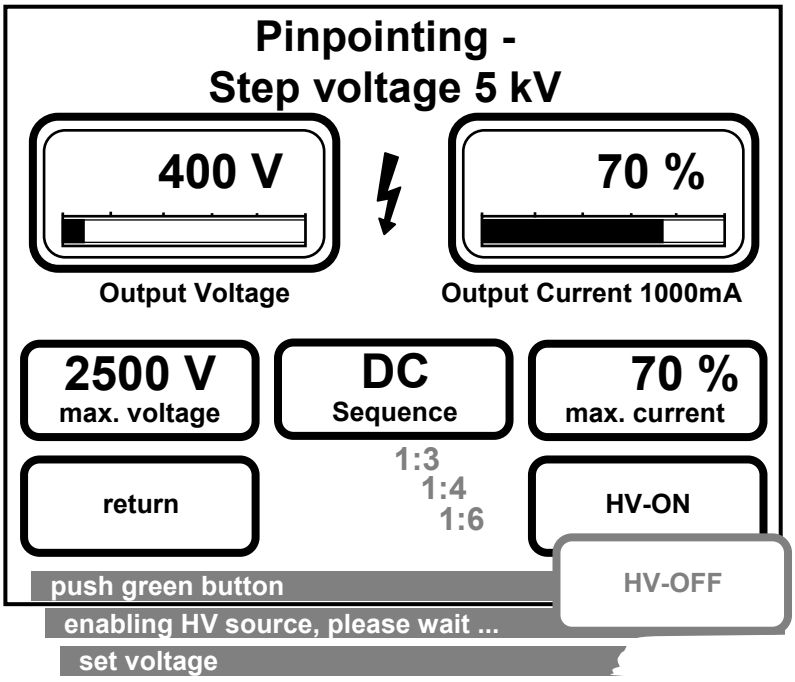


Fig. 19: Menu Pinpoint locating-Step voltage

Operation :

1. Select ‘Pinpointing’ in main menu
2. Activate field ‘Step Voltage’.
3. Select 5 kV or 10 kV voltage range. The above menu will appear.
4. Activate field “HV-ON”.
5. Push green button (within 5 sec.)
6. Set voltage, but watch output current.
   Important! In this operating mode the set voltage is immediately present at the output.
7. Setting pulse rate. Available are DC and pulse rates 1:3 / 1:4 / 1:6
8. Select max. current. Default is 10% of current scale max. value. (max. 75% = 750 mA).

voltage range	current range	max. current
5 kV	1000 mA	750 mA
10 kV	1000 mA	750 mA

9. Pinpoint the fault location with a step voltage locator (e.g. ESG 80-2)
10. Turn off with the field “HV-OFF” or by pushing the red button [5].

7.7 Burn Mode

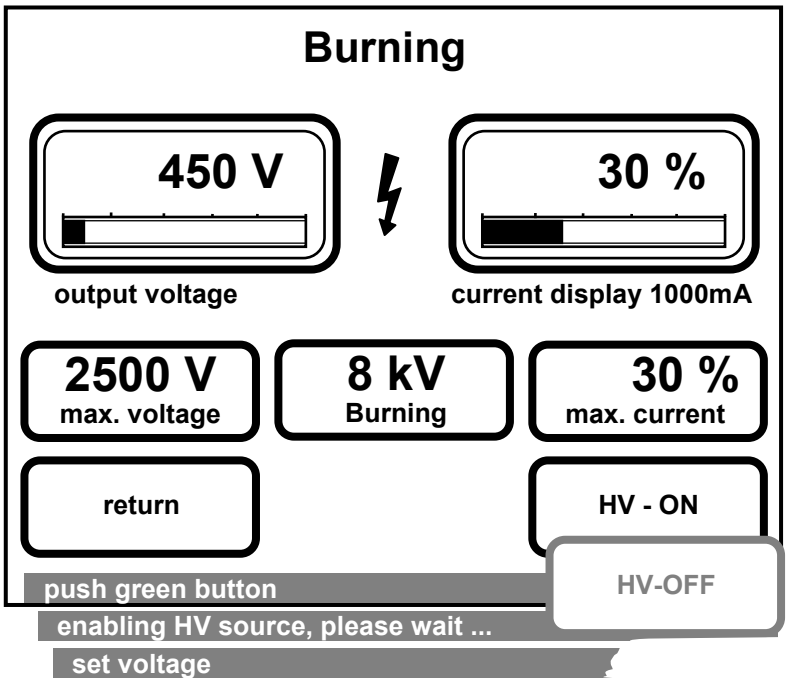


Fig. 20: Menu Burning

Operating :

1. Select ‘burning’ in main menu.
2. Select voltage range 8 kV or 20 kV.
3. Activate field “HV-ON”.
4. Press green button (within 5 sec.)
5. Setting the voltage. Observe the output current.
   Important: in the burn mode voltage is immediately present at the output, which makes it easier to set the desired output current via the voltage adjustment
5. Set max. current. Default is 30%.

   Even if voltage is changed manually, the output current stays constant as to the selected "max. current" value in relation to the end-of-scale value of the "current display".

   (in 8 kV range max. 75% = 750 mA).

voltage range	current range	max. current
8 kV	1000 mA	750 mA
20 kV	100 mA	100 mA

7. Turn off by using field ‘HV-OFF’ or by pressing red push-button [5].

8 Shutting Down the Fault Location System

After the measurements on a cable have been completed, the system can be switched off by pressing the ON/OFF button.

When disconnecting the test system, proceed in reverse sequence to the manner in which the connection (see section 6.2) was made. The following safety instructions must be strictly adhered to.

WARNING

Risk of life due to electrical shock!

- Follow the five safety rules (see section 1.2).
- Even if switched off properly and discharged using the discharge device, the system components that were under voltage should only be touched once they have been discharged using a suitable discharge rod as well as having been earthed and shorted.
- Only undo the earthing and short circuiting measures when the system has been disconnected and the test object is to be operated again.

9 Care and Maintenance

Note: Care and maintenance of instruments must only be done on de-energised instruments and only by electrically skilled personnel.

Maintenance

For installation and operation of the instrument it is not necessary to open the housing of the instrument. Opening the housing will void the warranty and liability of the manufacturer.

To identify potential problems at an early stage and keep the system in good condition, it is essential for the following tasks to be carried out independently and at appropriate intervals depending on the amount of use:

- Remove dust and dirt
- Check the functionality of the emergency stop switch
- Inspect the cables and connecting lines for cracks and damage

Additionally Megger recommends a yearly safety check of the instrument by a Megger service centre.

Repair

The equipment may only be used when working properly. When irregularities or malfunctions appear that cannot be solved consulting this manual, the equipment must immediately be put out of operation and marked as not functional. In this case inform the person in charge who should inform the Megger service to resolve the problem. The instrument may only be operated when the malfunction is resolved.

Cleaning

Cleaning a Megger product may only be done with the instrument turned off High Voltage equipment must also be discharged and short-circuited. Under these conditions a slightly wet towel may be used to whip off the equipment. Avoid using aggressive cleaners and substances like acids.

10 Service and Service Contacts

Megger products are undergoing a tight quality monitoring. If you should experience any problems or if you would like to inquire about any other comprehensive Megger service, please contact us. The current services of Megger are listed on the internet under

www.megger .com

Service international:

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🖷 +49 (0) 9544/68-2273
servicesd@sebakmt.com

Service Centres in Germany:

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Baunach	Radeburg	Grevenbroich
Dr.-Herbert-Iann-Str. 6	Röderaue	Blumenstrasse 27
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