

ESG NT2

Earth Fault Locator

USER GUIDE

Issue: C (04/2024) - EN
Article number: 128311597



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1 Basic notes

Safety precautions This manual contains basic instructions for the initial use and operation of the device. For this reason, it is important to ensure that the manual is always available to authorised and trained operating personnel. Operating personnel should read the manual thoroughly. The manufacturer will not be held liable for any injury or damage to personnel or property through failure to observe the safety precautions contained in this manual.

The specific standards and regulations in each country must also be observed!

Labelling of safety instructions The following signal words and symbols are used in this manual and on the product itself:

Signal word / symbol	Description
DANGER	Indicates a potential hazard which will result in death or serious injury if not avoided.
WARNING	Indicates a potential hazard which may result in death or serious injury if not avoided.
CAUTION	Indicates a potential hazard which may result in moderate or minor injury if not avoided.
NOTICE	Indicates a potential hazard which may result in material damage if not avoided.
	Serves to highlight warnings and safety instructions. As a warning label on the product it is used to draw attention to potential hazards which have to be avoided by reading the manual.
	Serves to highlight warnings and safety instructions that explicitly indicate the risk of an electric shock.
	Serves to highlight important information and useful tips on the operation of the device/system. Failure to observe may lead to unusable measurement results.

Working with products from Megger It is important to observe the generally applicable electrical regulations of the country in which the device will be installed and operated, as well as the current national accident prevention regulations and internal company directives (work, operating and safety regulations).

Use genuine accessories to ensure system safety and reliable operation. The use of other parts is not permitted and invalidates the warranty.

Operating staff This system and its peripheral equipment may only be operated by trained or instructed operating personnel. Anyone else must be kept away.

The system may only be installed by a specialist electrician. DIN VDE 0104 (EN 50191), DIN VDE 0105 (EN 50110) and the German accident prevention regulations (UVV) define a specialist electrician as someone whose knowledge, experience and familiarity with the applicable regulations enables him to recognise potential hazards.

Repair and maintenance Repair and maintenance work may only be performed by Megger or authorised service partners. Megger recommends having the system tested and maintained at a Megger service centre once per annum.

Megger also offers its customers on-site service. Please contact your service centre as needed.

Declaration of conformity (CE) The system corresponds with the regulations of the following European directives:

Directives: EMC Directive (204/108/EC)

Standards: EMC

Technical safety

EN 55011, EN 61000-6-4 ,
EN 61000-4-2, EN 61000-4-3,
EN 61000-4-4, EN 61000-4-8

EN 61010-1, EN 50249, GPSG

Use of third party software This product contains protected software, which is licensed under the General Public License (GPL) and the Lesser General Public License (LGPL). This certifies your right to request the source code for these software components. You can find detailed information on the GPL/LGPL licenses under www.gnu.org.

Images from the Icons8 library (www.icons8.de) are also used within the software.

Disposal Depending on where the device is used, the end user may be obliged by law (e.g. the German Electrical and Electronic Equipment Act (ElektroG)) to dispose of it separately from household waste.

Megger Germany GmbH as the manufacturer of the device undertakes to accept and properly dispose of the old device when a comparable new device is purchased.

If the old device is to be returned directly upon delivery of the new device, Megger Germany GmbH must be informed in advance if possible. Batteries and rechargeable batteries that can be removed from the old device must be handed in separately. The end user is responsible for deleting personal data from the old device.



The above points apply to all electrical and electronic equipment labelled with the adjacent symbol.

2 Technical description

2.1 System description

Description The ESG NT2 is a portable earth fault locator suitable for outdoor use for precisely pinpointing sheath faults in plastic insulated PE and VPE medium voltage cables.

Sheath faults are pinpointed using the step voltage method. The measuring current flowing into the ground at the fault location forms a potential gradient at the point of escape, which is measured using earth spikes and the downstream indicator unit. The step voltage rises when both earth spikes are situated in front of the fault position. If the fault position is passed by, the step voltage polarity changes, which then subsides again the further away you go.

Features The ESG NT2 combines the following features in a single device:

- Automatic sensitivity adjustment to the voltage
- Patented, automatic zero point reference with elimination of DC voltage interference
- Automatic synchronization to generator speed
- Wide measurement range due to high level of sensitivity
- Suppression of interference (50/60 Hz, 16 $\frac{2}{3}$ Hz, 100/120 Hz)
- Alternative 50/60 Hz mode for pinpointing cable faults on live low-voltage cables.

Scope of delivery The scope of delivery includes the following:

- DPP-CU indicator unit with carrying strap
- 2 x earth spike
- 2 x cable for connecting the earth spikes, 1,50 m
- 2 x contacting sponge
- 6 x AA battery, type IEC R6 (alkaline manganese)
- Transport bag
- Manual

Check contents Check the contents of the package for completeness and visible damage right after receipt. In the case of visible damage, the device must under no circumstances be taken into operation. If something is missing or damaged, please contact your local sales representative.

Optional accessories The following optional accessories can also be ordered from Megger Sales:

Accessory	Description	Item number
Accumulator pack	Rechargeable battery pack with 2 Li-ion batteries (9V/650 mAh), suitable battery compartment and charger	2013006

2.2 Technical data

Indicator unit The indicator unit is defined by the following technical parameters:

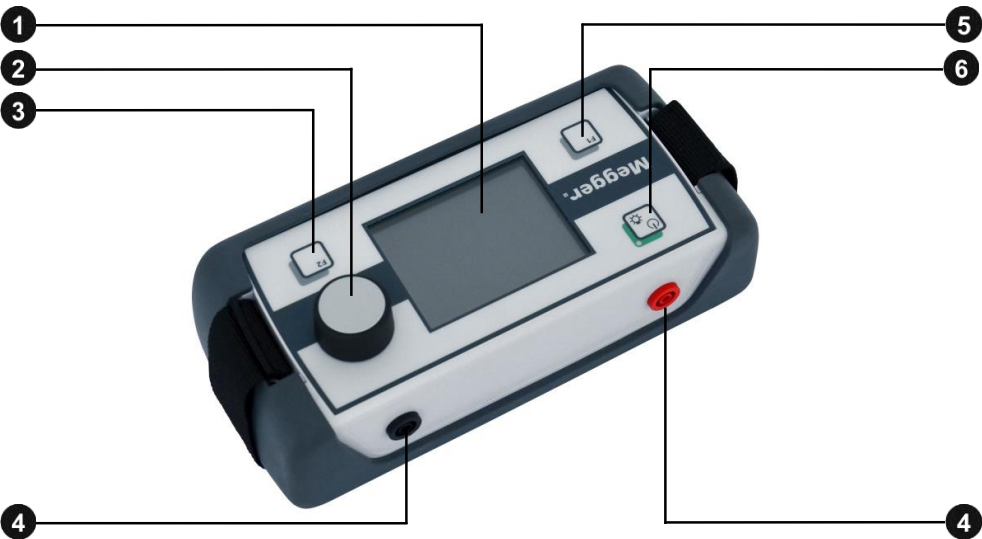
Parameter	Value
Power supply	6 x AA batteries, type IEC R6 (alkaline manganese)
Operating time	>15 hours
Voltmeter • Input resistance • Sensitivity	650 kΩ <5 µV
Operating temperature	-20 °C – 55 °C
Operating humidity	Max. relative humidity 93% at 30 °C
Storage temperature	-30 °C – 70 °C
Display	TFT colour display with 320 x 240 pixels
Weight	<0.9 kg
Dimensions	225 mm x 65 mm x 100 mm (W x H x D)
IP protection class (in accordance with IEC 60529 (DIN VDE 0470-1))	IP 54

ESG earth spikes The earth spikes are defined by the following parameters:

Parameter	Value
Weight	750 g
Length	1.02 m

2.3 Connections and controls on the indicator unit

The following illustration shows the connections and controls on the indicator unit:



Element	Description
1	Display
2	Knob
3	Function key 2
4	Earth spike connection sockets Maximum input voltage: 60 VDC/42 VAC _{peak}
5	Function key 1
6	Indicator unit on/off (when pressed and held), Backlighting on/off (when pressed briefly), LED indicates the device is switched on (green) and low batteries (red)

3 Basic operation of the indicator unit

Switching on the indicator unit The indicator unit can be switched on by briefly pressing the  button. The device is ready for use after just a few seconds.



If the device is not used for 10 minutes, it switches off automatically.

Battery test After switching on the device, you should check the battery status immediately using the charging bar in the top right corner of the display.

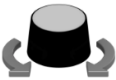


If the bar is barely filled, it is advisable to carry replacement batteries. As of a residual capacity of about 20%, both the battery status indicator and the LED in the  button illuminate in red.

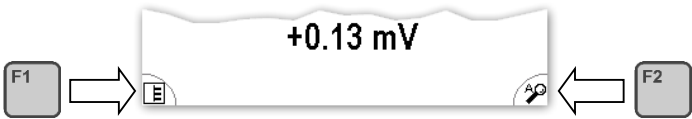
Back-light The display backlighting is automatically activated immediately after the indicator unit is switched on. Because the indicator unit is equipped with a transreflective display, the background illumination must be switched off by **briefly pressing** the  push-button if sufficient strong sunlight is available. This extends the operating time of the indicator unit.

The backlight can be switched back on at any time by briefly pressing the button again.

Operation using the knob With the exception of a few functions, the indicator unit is operated exclusively using the knob. The functions available vary according to the respective current view:

Action	Function in the <u>measurement screen</u>	Function in the <u>menu screen</u>
	Opens the <u>menu screen</u>	Opens the currently selected menu item
	Adaptation of the measurement range	Selects the menu item

Function keys The indicator unit is equipped with the two  and  function keys, which can be used to call up the important functions directly from the measurement screen without first having to call up the menu screen. The current function key assignments are permanently displayed in the bottom corners of the measurement screen.



The function key assignments can be adapted in the basic settings of the respective software mode if necessary.

4 Pinpointing Sheath Faults

4.1 Preparatory Measures

4.1.1 Tracing the Line

Trace the route of the faulty cable as exactly as possible in the pre-located area using a line location device. Knowledge of the exact cable route makes it far easier to pinpoint the sheath fault.

4.1.2 Starting Up the DC Impulse Generator



To pinpoint a sheath fault, a DC impulse generator is needed. When equipment creating such high voltages is used, certain safety regulations must be complied with. It is essential to read the manual for the DC impulse generator!

For a DC impulse generator, any equipment and system can be used which can be prepared for pulsed DC voltage to locate sheath faults. This particularly includes equipment from the MFM series, but also various other testing and fault location systems.

Connect the DC impulse generator to the screen of the faulty cable and generate a pulsed DC voltage permissible for the type of sheath.

For more details about starting up the device, please read the accompanying instructions.

4.1.3 Connecting the Earth Spikes



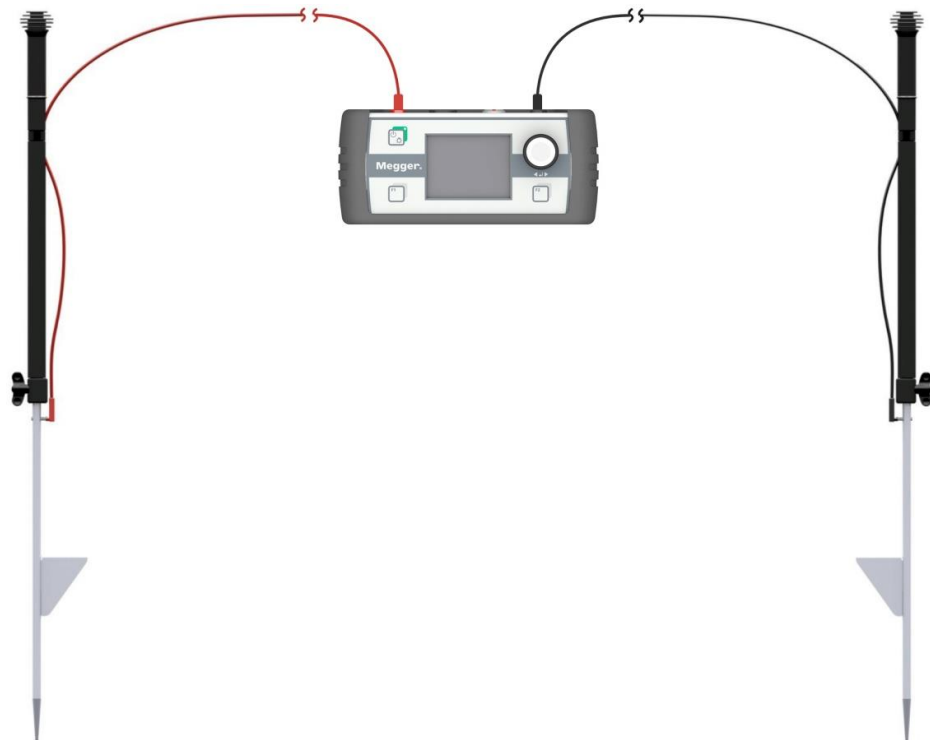
The cables supplied with the unit may only be used in accordance with their intended purpose, which is to connect the earth spikes to the indicator unit!



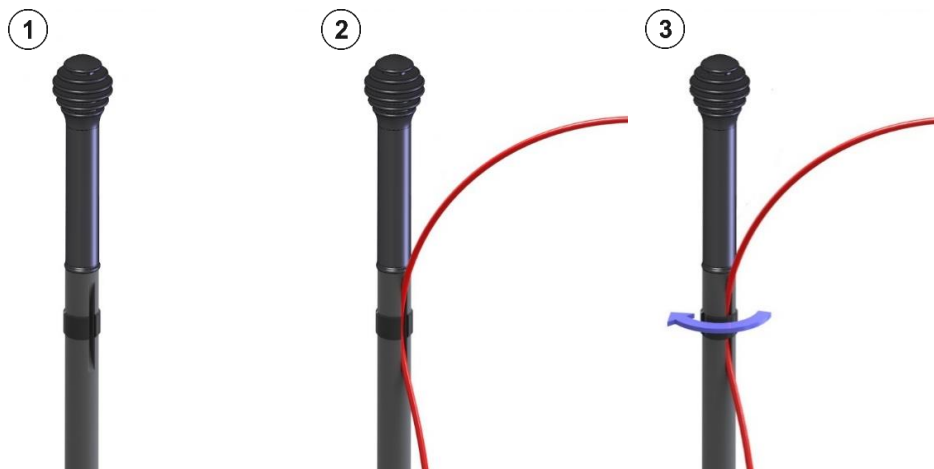
Hold the earth spikes by the insulated handles only

In the immediate vicinity of the potential gradient dangerous voltages may occur at the surface. The displayed voltage values are not suitable to draw a conclusion about the actual risk.

When connecting the earth spikes, observe the designated colours of the connection cable and connection socket!



To avoid switching back and forth or even accidentally pulling out the cable while operating, it is advisable to attach the cable to the earth spike as shown in the diagram:



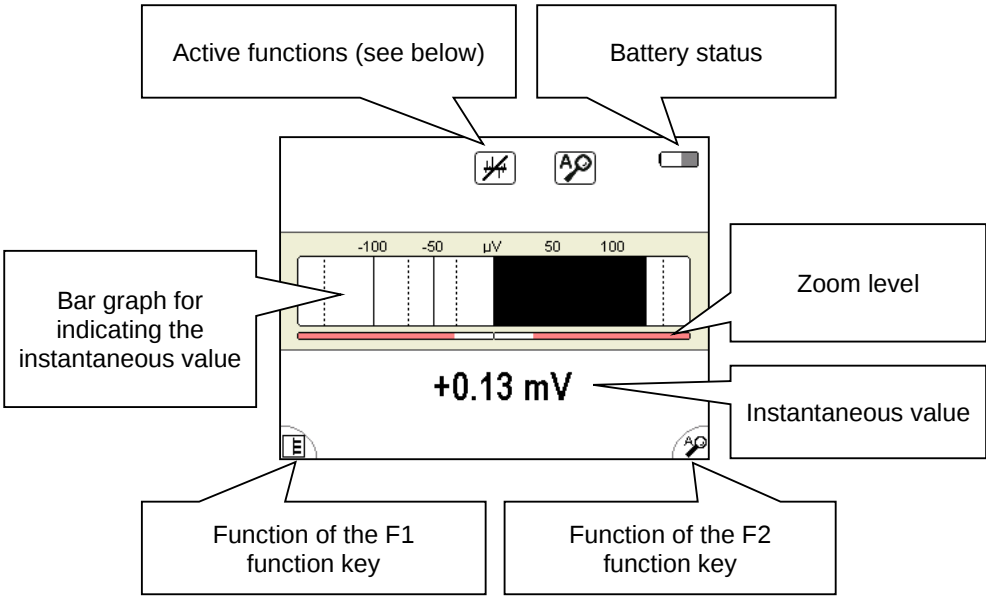
In applications in which it was only possible to pre-locate the fault position very vaguely, or even where it was not possible at all, you will have to approach the position from a greater distance. However, to be able to measure the smaller step voltage, the earth spikes need to be placed at larger intervals from one another (see page 22). For this purpose, customised connection cables of 15 metres in length are available as accessories.

4.1.4 Turning On the Indicator Unit

Turning on Once the earth spikes are connected to the indicator unit, press the  button briefly to switch on.

Shortly after switching on, the **measurement screen** appears. The device is now ready to measure.

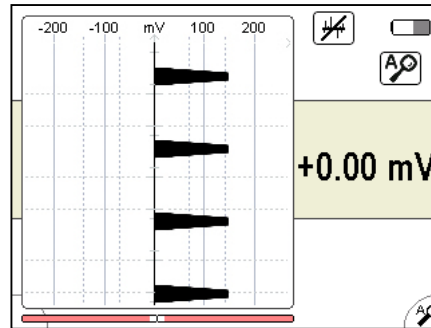
Layout of the measurement screen While you are pinpointing, the **measurement screen** displays all the relevant information which could be useful when approaching the sheath fault:



Active functions and modes The symbols at the top right of the measurement screen indicate the following functions and measurement modes:

Symbol	Description
	High pass filtering is active (see page 19)
	Smoothing filter is active (see page 19)
	Automatic zoom is active (see page 19)
	50/60 Hz location mode is active (see page 19)

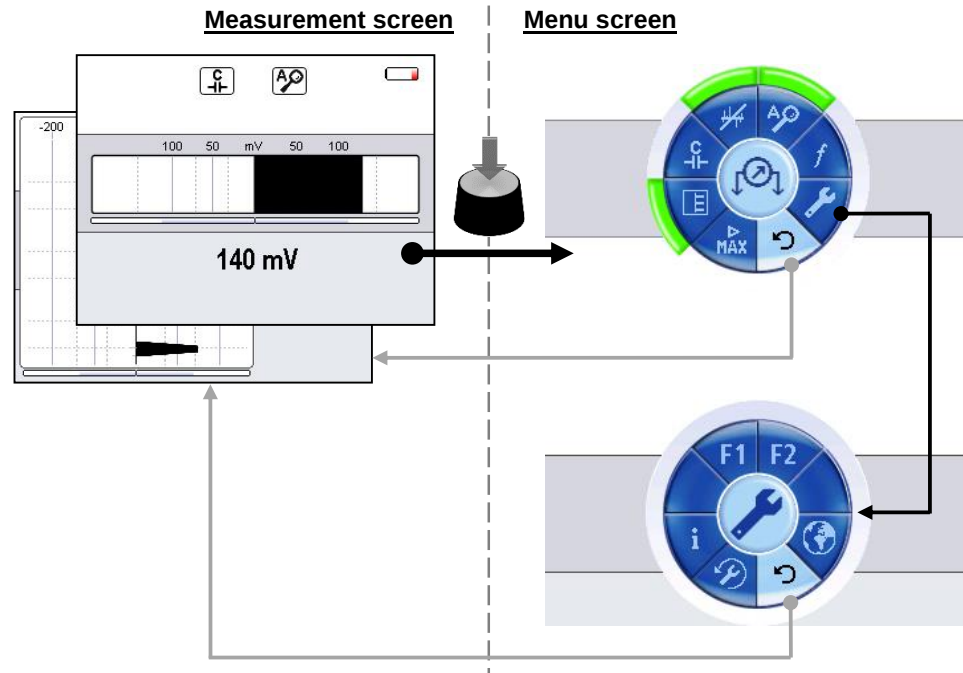
Alternative view In addition to the standard view, the device offers an alternative view for showing the time progress of the step voltage over 16 seconds.



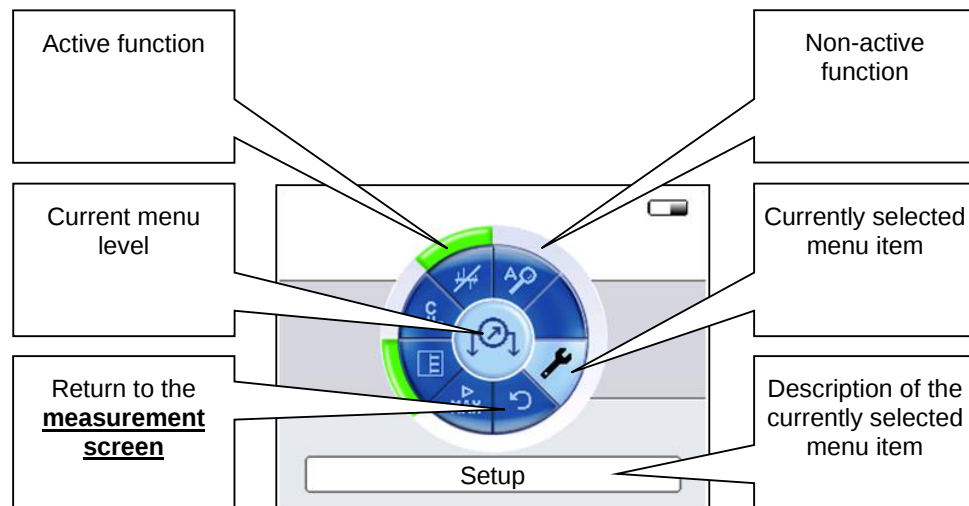
This alternative display can be activated or deactivated at any time via the **E** menu item (see page 19).

4.1.5 Adjusting the Settings

Menu structure You can switch from the **measurement screen** to the **menu screen** at any time and change any settings in two steps at most:



Layout of the menu screens Each **menu screen** is made up as follows:



4.1.5.1 Adjusting the Basic Settings

After the indicator unit has been switched on, you can adjust the basic settings. To do so, switch to the **menu screen** by pressing the knob and selecting the menu item . The following menu then appears in the display:



In this menu you can perform the following basic settings:

Menu item	Description
F1 F2	Using this menu item, the following functions can be assigned to the two function keys of the indicator unit:  Each press of the function key switches between the two measurement screens.  The high pass filtering (see next section) can be activated/deactivated by pressing the function key.  The smoothing filter (see next section) can be activated/deactivated by pressing the function key.  The automatic zoom (see next section) can be activated/deactivated by pressing the function key.
	Sets the display language.
	Restores the factory settings.
i	Shows the current software version of the indicator unit.

4.1.5.2 Adjusting the Measurement Settings

By pressing the knob, you can at any time switch from the measurement screen to the menu screen with the most important measurement settings:



In this menu you can perform the following measurement settings:

Menu item	Description
	Activating/deactivating the alternative measurement screen (see page 15) with a display for the time progress of the voltage.
	Activating/deactivating the automatic zoom. If this function is active, the scale of the voltage display automatically adapts to the current measurements all the time. The knob does not have a function in this case. If the function is deactivated, the scale needs to be adjusted manually by turning the knob. The currently set zoom level is permanently displayed in a small bar below the bar graph or diagram (see page 15).
	Switch between the available measurement modes. Pre-set and preferred mode for pinpointing sheath faults in combination with a DC voltage generator that feeds a pulsed DC voltage into the faulty cable. 50/60 Alternative mode for pinpointing cable faults on live low-voltage cables. Depending on the mains frequency, the appropriate setting must be selected. This mode can be particularly useful, for example, when the building junction boxes are inaccessible and the consumers cannot be easily disconnected from the mains.

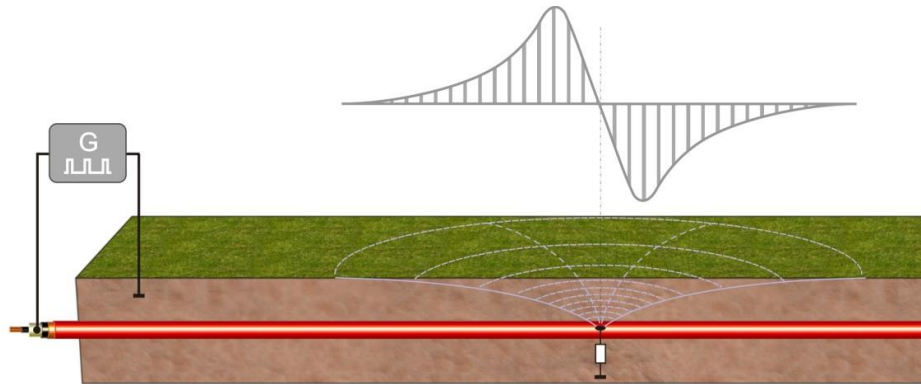
Menu item	Description
	Activating/deactivating the high pass filtering. Select this function if severe interference affects the measurements (such as in the vicinity of tram installations). The high pass filter suppresses any constant components, whereby only the edges are displayed but not the impulse itself. This is why the device has different indications with active high pass filtering. Each DC pulse causes two deflections at different polarity, where the first indicates the start of the impulse and the second indicates the end. The first deflection indicates the direction of the fault position. without high pass filtering with high pass filtering
	Activates/deactivates the smoothing filter. When the smoothing filter is activated, sudden signal peaks which are not part of the actual signal are suppressed.
	Activates/deactivates the maximum sensitivity. By default, the sensitivity of the volt meter is limited to measurement values >1 mV. In this way, low interference signals are ignored by the system and unnecessary adjustments of scaling are avoided. If it becomes necessary to begin fault location at a greater distance from the sheath fault, the useful signal in certain circumstances is barely above noise level. In these situations the maximum sensitivity should be activated and the measurement range be expanded downwards to 5 µV.

4.2 Approaching the Fault

4.2.1 General Notes

Technical principles With each coupled DC pulse, current flows into the ground at the position of the fault, which forms voltage gradients around the fault position.

The step voltage, which can be measured on the surface, increases at the fault position and changes polarity directly above the location.



This particular effect is most beneficial for pinpointing sheath faults, by measuring the value as well as the polarity of the step voltage using two earth spikes and approaching the deflection direction following the fault position.

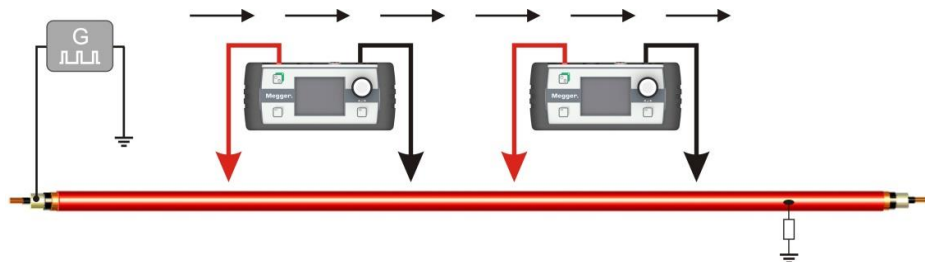


The sheath fault is located in the direction of the earth spike which is connected with the black measuring lead

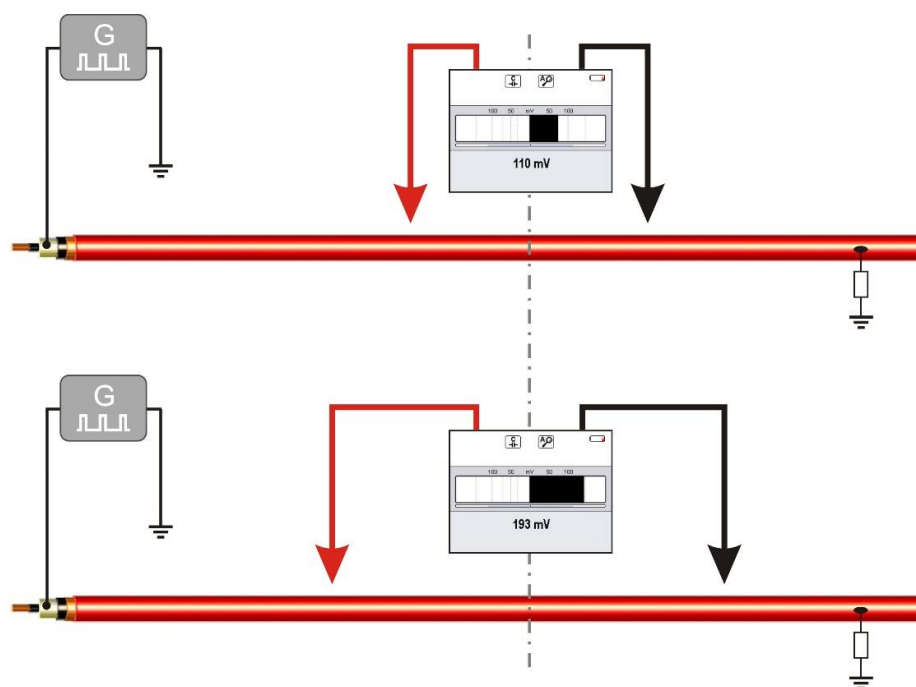
The sheath fault is located in the direction of the earth spike which is connected with the red measuring lead

Orientation To ensure a reliable indication of the direction, note the following guidelines for basic handling:

- The earth spikes should be placed along the suspected cable route if possible.
- The indicator unit must be kept in a horizontal position along the cable run.
- **While approaching the fault location, the earth spikes must not get mixed up and the alignment of the indicator unit must not change.**



Distance between the earth spikes The distance between the earth spikes directly affects the step voltage reading. If the distance increases, the potential difference between the two earth spikes rises and therefore the voltage reading shown on the indicator unit as well.



Particularly when you start pinpointing, it is advisable to place the earth spikes at larger distances from each other so that the generator impulse can be identified as clearly as possible, even at greater distances to the fault location.



If, for example, precise pre-location was not possible due to multiple faults, the maximum possible distance is sometimes not enough to measure the impulses due to the connection cables. In this case, a connection cable (or both, in extreme cases) can be replaced with a longer one. This would require a second person to speed up the work!

Impact of ground conditions The ground conditions have a huge effect on the electrical coupling and the precision of the system.

Changing coupling behaviour while pinpointing can, for instance, cause the measured voltage to drop even when approaching the fault position.

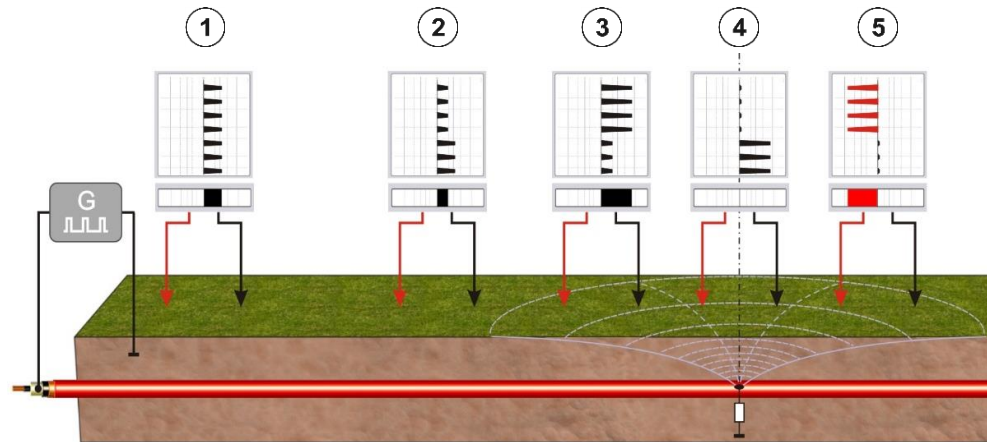
Dry asphalt ground acts as an insulator and does not provide sufficient earth contact for the earth spikes. In this case pinpointing can also be performed in parallel to the cable route on more suitable ground, as the voltage gradients do also spread to the side.

In densely built-up urban areas, the gaps between the ground and paving stones can also be used to attach the earth spikes.

If none of the above alternatives is feasible, the earth contact may be improved by means of the included sponge. For this, the sponge have to be moistened first and then stuck to the pointy end of the earth spikes.

4.2.2 Procedure

Diagram In the following picture you can see several points of an ideal signal route from the feeding point to the fault position and beyond:



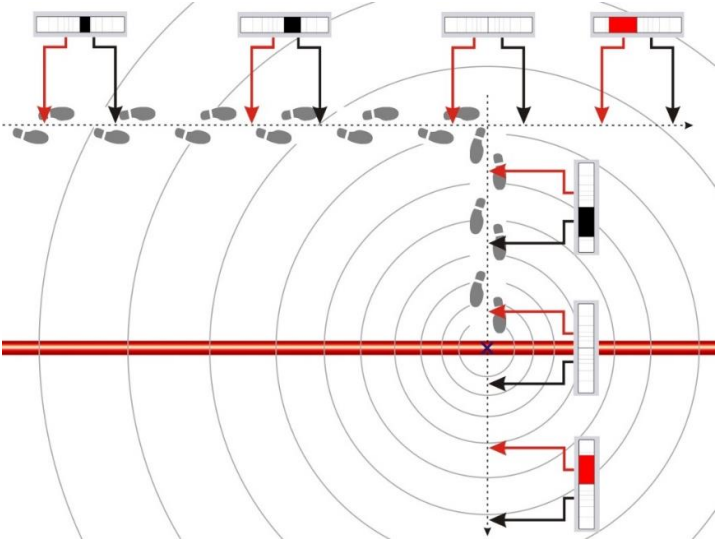
As voltage gradients induced by the current flowing back from the fault position exist around the earthing point of the generator, the measurement values near this point might be elevated (position ①). However, the deflection direction (polarity) also indicates the direction of the fault position at this point.

At half-way point between the generator and the fault position, the signal strength reaches a minimum (position ②). On moving nearer to the fault (position ③), the signal strength increases again. The maximum signal strength is measured when one of the earth spikes is directly above the fault.

If the fault is exactly between the two earth spikes or exactly to the side (position ④), the indicator unit does not display a reading.

If the fault position is passed by, the polarity changes (position ⑤). The signal on the indicator unit points to the other direction.

Procedure This is what to do when approaching the fault:

Step	Action
1	Find a suitable place to start on the ground directly above the traced cable route or to the side. Insert the two earth spikes in the correct alignment positions (see page 21) into the ground.
2	Observe the signals on the indicator unit and try to identify the impulse signal of the generator. - Adjust the scale of the display to the signal level by turning the knob or activate the automatic scaling (see page 19). - If necessary, increase the distance between the earth spikes to receive a stronger signal level. - If the DC impulse of the generator is masked by interference, try to counter the interference by using some of the available filter functions (see page 20). - Switching to the alternative view which shows the voltage curve over the last 16 seconds (see page 19) could make identifying the periodical DC voltage impulses easier.
3	Follow the cable route in the direction of the signal without changing your orientation. Take some more measurements every few metres. When approaching the fault position, the distance between the earth spikes can be gradually decreased by up to about one metre with increasing signal levels. Continue approaching until the signal suddenly changes its polarity and indicates the opposite direction.
4	Go back slightly and measure the signal level at smaller intervals. Determine the position at which the opposing currents compensate each other and at which there is no signal level indicated.
5	To correct any possible lateral offset, insert the two earth spikes at an angle of 90° to the cable route and determine the zero point for the second coordinate by further measurements. 

Step	Action
6	Place the black earth spike on the suspected position of the fault and the red earth spike about one metre away. The signal must now point in the direction of the black earth spike. Repeat this control measurement at several other positions in a circle around the black earth spike. If the signal level indicates towards the black earth spike at each control measurement, the fault position has been successfully verified.
7	Repair the damaged section and test the sheath again for any further damage.

4.3 Completing the Work

After the sheath fault has been successfully pinpointed, the indicator unit can be turned off by pressing the  button **for 3 seconds**.

Afterwards, the DC impulse generator can be switched off and disconnected from the cable under test while making sure that all applicable safety regulations are followed.

5 Storage and Transport

Long periods out of use and storage If you do not expect to use the unit for over a month, you must remove the batteries and store them separately.

You should store the device in a dry and sheltered environment which provides adequate protection against mechanical damage and dirt. The storage temperatures shown in the technical data must be adhered to.

Transport Only use the carry-bag supplied to transport the device. Please note that the ambient conditions along the entire transport route must comply with the technical data.

During transport, never hold the device by the connection cables only!

6 Maintenance and Care

Changing the batteries To change the 6 x 1.5 V AA batteries, you must undo the two screws on the underside of the indicator unit by a quarter of a turn (e.g. using a coin) and then take off the battery compartment cover.

NiMH rechargeable batteries (AA type) can also be placed in the battery compartment. However, they must be charged using an external charger.

Caring for the display Do not clean the display with aggressive products such as solvents or spirits.

Instead, use lukewarm water and a soft, lint-free cloth for wet wiping, or a microfibre cloth for dry wiping.

