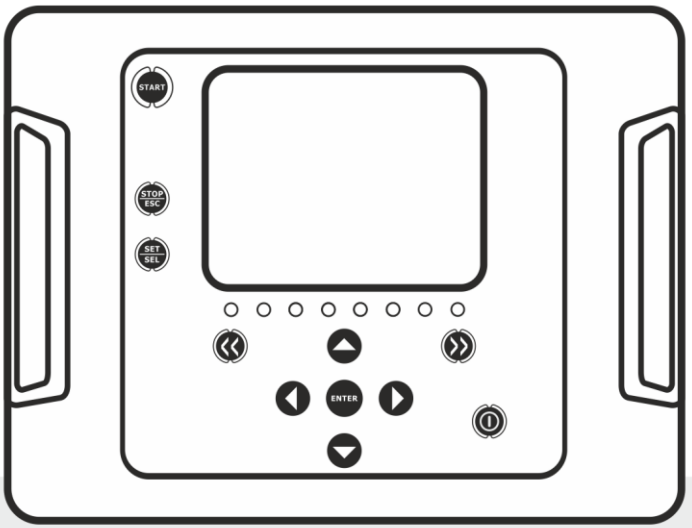
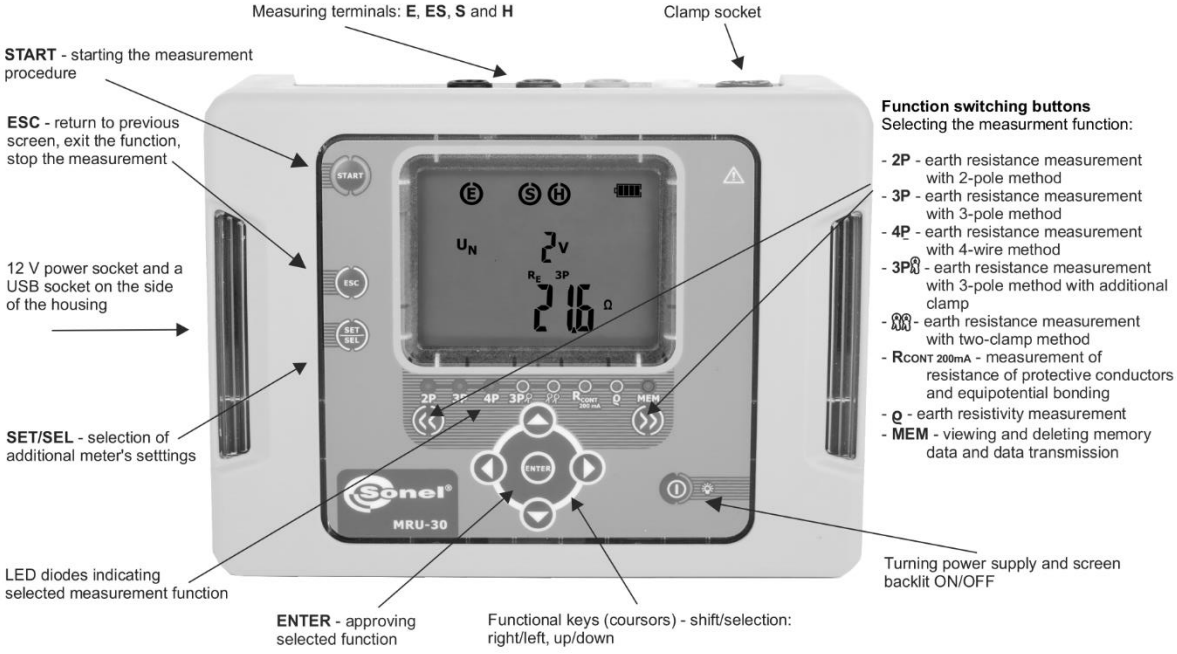


USER MANUAL

EARTH RESISTANCE METER

MRU-30

MRU-30


Measuring terminals: **E**, **ES**, **S** and **H**
Clamp socket
START - starting the measurement procedure
ESC - return to previous screen, exit the function, stop the measurement
12 V power socket and a USB socket on the side of the housing
SET/SEL - selection of additional meter's setttings
LED diodes indicating selected measurement function
ENTER - approving selected function
Functional keys (coursors) - shift/selection: right/left, up/down
Turning power supply and screen backlit ON/OFF
Function switching buttons
Selecting the measurment function:
- **2P** - earth resistance measurement with 2-pole method
- **3P** - earth resistance measurement with 3-pole method
- **4P** - earth resistance measurement with 4-wire method
- **3P** - earth resistance measurement with 3-pole method with additional clamp
- **MEM** - viewing and deleting memory data and data transmission
START
ESC
SET SEL
ENTER
MRU-30
2P
3P
4P
MEM

USER MANUAL

EARTH GROUND RESISTANCE METER MRU-30

SONEL S. A.
Świdnica, Poland

SONEL TEST & MEASUREMENT
Santa Clara, CA 95054

Version 1.05 26.07.2021

The Sonel MRU-30 meter is an easy-to-use instrument that is designed for the safe measurement of earth ground resistance.

The MRU-30 uses established methods of earth ground resistance measurements such as 3-pole, 4-pole, and 3-pole with auxiliary clamp. Additionally the MRU-30 employs the two clamp method of measurement without the use of auxiliary test rods when rods can't be used in some situations.

MRU-30 measurements include: soil resistivity, continuity measurement of protective and equipotential conductors, leakage currents, and interference voltages.

An integral screen clearly displays results. For safety, and to ensure successful studies, software will alert the user of possible dangers and irregularities.

The MRU-30 is highly portable, and engineered with a lightweight and compact case. The enclosure is robust and weatherproof (IP65) to prevent ingress of dust and moisture, making it ideal for all outdoor field work.

It contains a built-in rechargeable battery that can be recharged from a power adapter, or from a standard 12V vehicle socket.

Please acquaint yourself with this manual to avoid measuring errors and prevent possible problems related to operation of the meter.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

CAUTION:
Equipment changes or modifications not expressly approved by SONEL TEST & MEASUREMENT Inc., the party responsible for FCC compliance, could void the user's authority to operate the equipment, and could create a hazardous condition.

TABLE OF CONTENTS

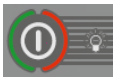
1 Safety

Electrical safety depends on the correct design and function of earth/ground systems. The MRU-30 meter has been designed to measure earth/ground installations. For correct operation and correct results, understand and follow these recommendations:

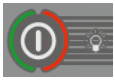
- Before you proceed to operate the meter acquaint yourself thoroughly with this manual and observe all safety regulations.
- The MRU-30 meter has been designed for measurements of earth/ground connections, equipotential bonding, and ground resistivity. Any application or use of the MRU-30 that differs from those specified in this manual may result in damage to the meter and constitute a source of danger to the user.
- The device must be operated by appropriately qualified personnel with relevant certification to carry out measurements of electric installations. Operation of the meter by unauthorized personnel may result in damage to the device and constitute a source of danger to the user.
- Using this manual does not exclude the need to comply with occupational health and safety regulations and other relevant fire regulations required during the execution of a particular type of work. Before starting work with the device in special environments, e.g. those with potential fire-risk or explosive environments, consult with the individual responsible for health and safety.
- Do not operate the meter in the following situations:
  - A meter that is damaged or completely or partially malfunctioning.
  - A meter with damaged test leads or insulation.
  - A meter stored for long periods in unfavorable conditions (e.g. excessive humidity or temperature extremes). **If the meter is transferred from a cold to a warm environment with a high level of relative humidity internal condensation can occur. Do not operate until the meter has reached the new ambient temperature (approximately 30 minutes).**
- Before operation make sure the test leads are securely connected to the appropriate measurement sockets.
- Do not power the meter from sources other than those described in this manual.
- The meter's inputs are electronically protected from power surges in case of accidental connection to live conductors: up to 276 V for 30 seconds.
- Manufacturer's calibration does not include test leads resistance. The displayed result is the sum of the measured object and the test leads resistance. The procedure for calibrating for test lead resistance is described in section 4.9.
- The device complies with the following standards: EN 61010-1 and EN 61557-1, -4, -5.

Note:
Due to continuous development the manufacturer reserves the right to change appearance, the accessories, and technical parameters of the meter. The display, in case of some of the functions, may also slightly differ from the display presented in this manual.

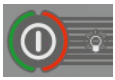
2 Turning the meter ON and activating the screen backlight.

1 

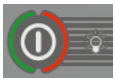
Turn on the meter with the button.

2 

Short press the button to turn the screen backlight on; press the button again to turn the backlight off.

3 

Switch off the meter by pressing and and holding the button for approx. 2 sec.

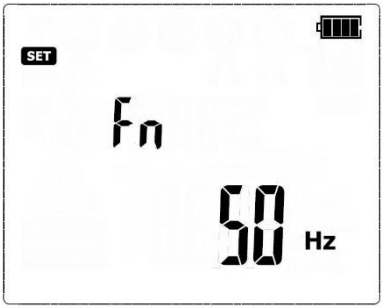
Emergency situations. 

Pressing the button for approx. 7 seconds will turn off the meter in case of emergency.

3 Meter configuration

1 

Turn on the meter by pressing the button and the **SET/SEL** button simultaneously.

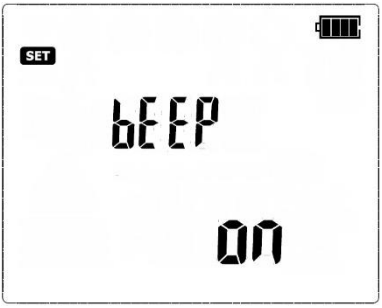


2 

When the **Fn** screen is displayed use the ▲ and ▼ buttons to set the local mains frequency – 50 Hz or 60 Hz (50 Hz is set as default).

③ 

Use the ◀ and ▶ buttons to show **bEEP** on the screen to allow turning audio sound on or off.

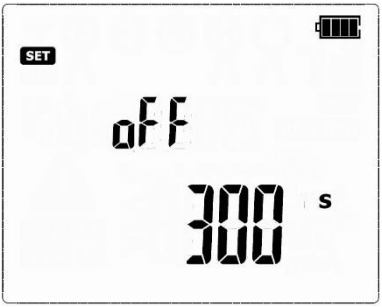


④ 

Use the ▲ and ▼ buttons to turn the audio sound ON (on) or OFF (oFF).

⑤ 

Press the ◀ and ▶ buttons to show the **oFF** screen to allow the setting of the auto-power off time (Auto-OFF):

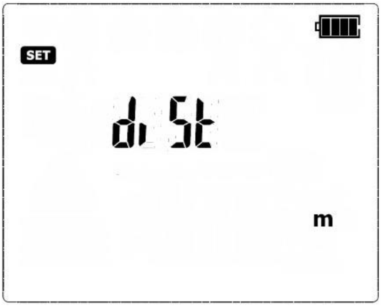


⑥ 

Use the ▲ and ▼ buttons to set the time to turn the meter off automatically (Auto-OFF): The choices are 300 s, 600 s, 900 s or none (dashes - Auto-OFF is disabled).

(7)

Use the ◄ and ► buttons to show the **diSt** screen to allow the unit of length to be selected:



(8)

Use the ▲ and ▼ buttons to set the unit of length: 'm' (meters) or 'ft' (feet) ('m' is set as default).

(9)

Use ◄ and ► buttons to show the **UPdt** screen to install new firmware updates**.**

(10)

Press **ENTER** to enter firmware update mode. The update process is described in section 7.

After changing the parameters, to exit the **SETUP** menu, either:

(11)

Press the **ENTER** button to memorize settings (not applicable for the Update screen)
Or: press the **ESC** button to go to the measurement screen without confirming changes.

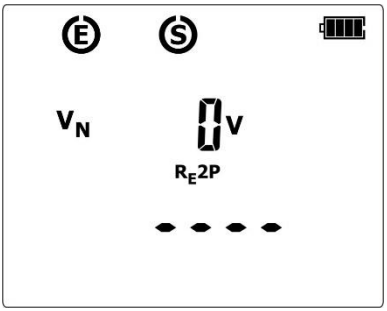
4 Measurements

Note:

During measurements the status bar is displayed.

4.1 Measurement of AC+DC interfering (noise) voltages

Note:
This measurement is active only when the meter is set for the following measurements, before starting them with the START button: R_E2P, R_E3P, R_E4P, R_E3P+C, R_{CONT}, ρ.



Before starting the measurement in these modes: **R_E2P, R_E3P, R_E4P, R_E3P+C, R_{CONT}** and **ρ,** and before pressing the **START** button the MRU-30 monitors the voltage present on the measurement terminals (between **E** and other sockets) and displays the value of the interfering voltage on the screen.

Additional information displayed by the meter

V_N >100V, **>100V** and a continuous tone, '**NOISE!**' and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>24V**, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 24 V, but < 40 V. The measurement cannot proceed.
'**NOISE!**'	The value of the interfering voltage is < 24 V, but has a high value. Results may be affected by additional uncertainty.

4.2 Earth resistance measurement with 2-pole method (R_E2P)

1. 

Use the **<<** or **>>** buttons to select the measurement mode: **2P**. The LED 

is illuminated. The meter is now in the state of measuring interfering noise voltage between the measurement terminals.

2. 

Press the **SET/SEL** button to select the measurement voltage**.**

3. 

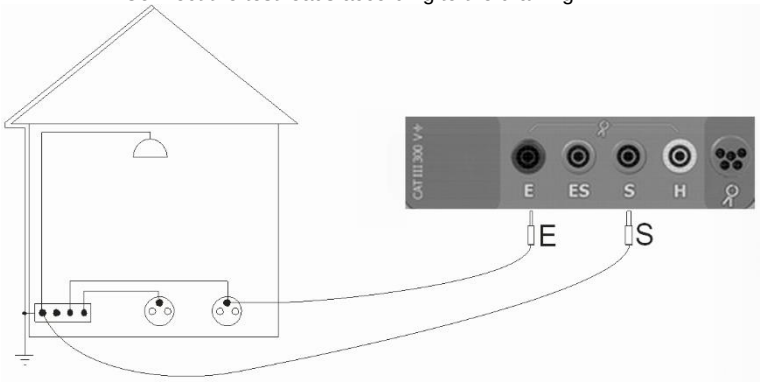
Use the ▲ and ▼ buttons to set the measurement voltage value to 25 V or 50 V.

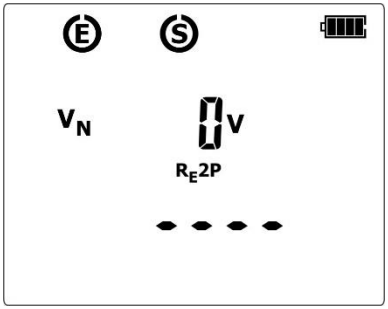
4. 

or 

Press **ENTER** to save the setting or press **ESC** to exit without saving.

5. Connect the test leads according to the drawing.



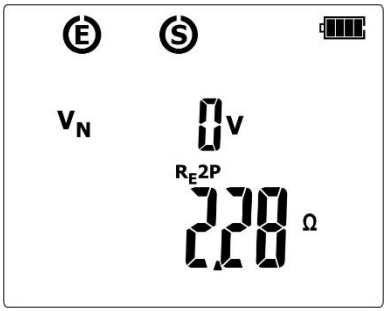
6. 

The meter is ready for measurement.

7. 

Press **START** to begin measurement.

8



After the measurement completes view the results on the screen.

The result is displayed for 20 seconds. Press **ENTER** to display again.

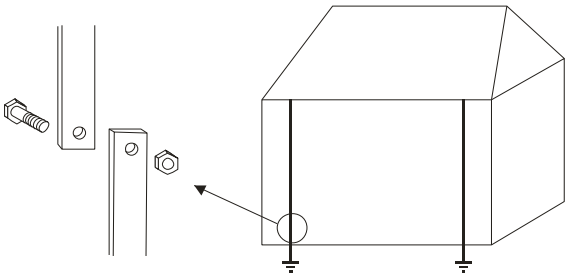
Additional information displayed by the meter

V_N >100V, **>100V** and a continuous tone, '**NOISE!**' and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>24V**, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 24 V, but < 40 V. The measurement cannot proceed.
'**NOISE!**'	The value of the interfering voltage is < 24 V, but has a high value. Results may be affected by additional uncertainty.

4.3 Earth resistance measurement with 3-pole method (R_E3P)

The basic type of earth ground resistance measurement is the 3-pole measurement.

1 Disconnect the earth electrode object of test.



2

Use the **<<** or **>>** buttons to select the measurement mode: **3P.** The LED 

is illuminated. The meter is now in the state of measuring the interfering noise voltage seen on the measurement terminals.

3

Press the **SET/SEL** button to select the measurement voltage.

4

Use the ▲ and ▼ button to set the measurement voltage value to 25 V or 50 V.

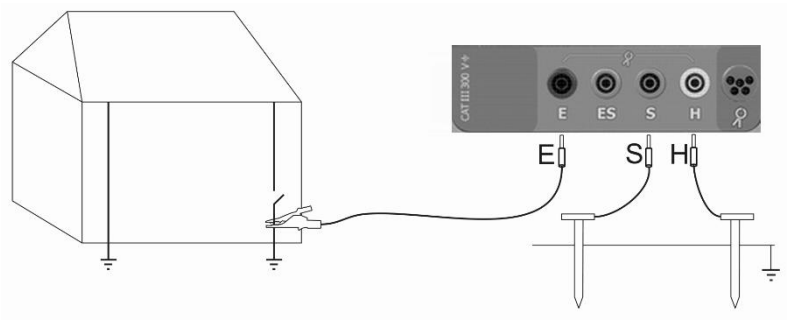
5

or

Press **ENTER** to save the setting or press **ESC** to exit without saving.

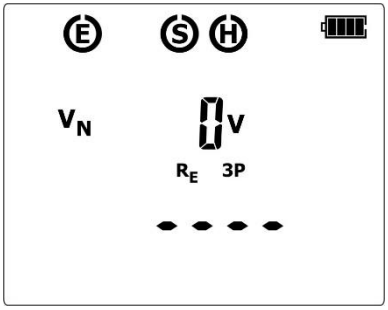
Connect the test leads according to this diagram:

6



Drive the current electrode into the ground and connect it to the **H** terminal of the meter.
Drive the voltage electrode into the ground and connect it to the **S** terminal of the meter.
Connect the earth electrode object of test to the **E** terminal of the meter.
All 3 electrodes should be aligned in a straight line.

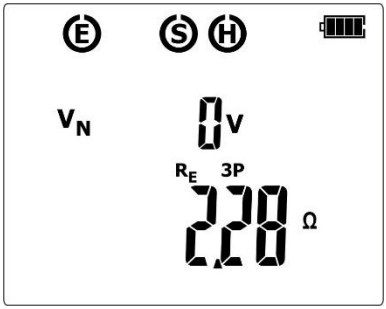
7



The meter is ready for measurement.

8 

Press **START** to begin measurement.

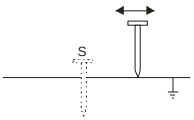
9 

After the measurement completes view the results on the screen.

10 

Use the ◀ and ▶ buttons to toggle between the measurement results:
R_H – resistance of current electrode
R_S - resistance of voltage electrode
ER – additional uncertainty caused by the resistance of the auxiliary electrodes
V_N – interfering (noise) voltage

The result is displayed for 20 seconds. Press **ENTER** to display again.

11 

Repeat the test two or more times by moving the voltage electrode a couple of meters or yards, alternately towards and away from the earth electrode object of test (E) and repeat steps 7, 8 and 9.
If the R_E test results differ by more than 3% it is necessary to significantly increase the distance between the current electrode and the earth electrode object of test (E) and repeat the measurements.

Note:

⚠
Earth resistance measurements are usually good if the interference voltage is < 24 V. The meter can measure in the presence of interference voltage up to 100 V. Over 40 V it is indicated as hazardous. Do not connect the meter to a voltage exceeding 100 V.

- Pay attention to the quality of the connection to the electrode object of test with the test leads – the contact area must be cleaned of paint, rust, corrosion etc.
- If the resistance of the auxiliary electrodes is too high, then the measurement of the R_E earth electrode will be distorted by additional uncertainty. A particularly high measurement uncertainty is generated if we measure a low value of the earth resistance with electrodes of a loose contact with the soil (such a situation occurs often if the earth electrode is properly made and the upper layer of the ground is dry and characterized by a low conductivity). Then the relation between the electrode resistance and the resistance of the measured earthing is

very high, and so is the case of the measurement uncertainty which depends on it. What may be done then is to perform, in accordance with the formulae specified in point 12.2, calculations, which will permit to evaluate the influence of the measurement conditions. It is also possible to improve the contact of the electrode with the ground, for example by means of moistening of the place when the electrode is driven, its driving into the ground in another place or using a 80 cm electrode. Check also the test leads and make sure the insulation is not damaged and the contacts: test lead – banana plug – electrode are not corroded or loosened. In most cases the achieved resolution of the measurement is sufficient, but it is necessary to be conscious of the uncertainty the measurement is burdened with.

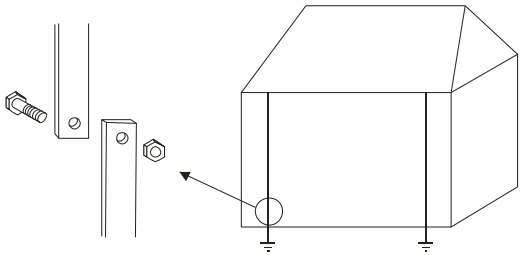
Additional information displayed by the meter

R_E>9999Ω	Measurement range exceeded.
V_N >100V, **>100V** and a continuous tone, '**NOISE!**' and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>24V**, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 24 V, but < 40 V. The measurement cannot proceed.
'**NOISE!**'	The value of the interfering voltage is < 24 V, but has a high value. Results may be affected by additional uncertainty.
LIMIT! and **ER** along with % value	The uncertainty caused by resistance of the electrodes is > 30%. (Uncertainties calculated on the basis of the measured values.)
LIMIT! and **R_H** or **R_S** along with Ω value	The resistance of H and S electrodes, or one of them exceeds 19.9 kΩ. The measurement is subject to error.
Flashing symbols: E, S, H	Flashing symbols E, H, S, indicate a test lead is disconnected from the measurement terminals.

4.4 Earth resistance measurement with 4-wire method (R_E4P

The 4-wire method is recommended in the case of measurements of earth ground resistance of very low values. It eliminates the influence of the test lead resistances. To evaluate the resistivity of the ground it is recommended to use the dedicated measurement function in section 4.9.

1. Disconnect the earth electrode object of test.



2. 
Use the **<<** or **>>** buttons to select the measurement mode: **4P.** The LED  is illuminated. The meter is now in the state of measuring interfering noise voltage between the measurement terminals.

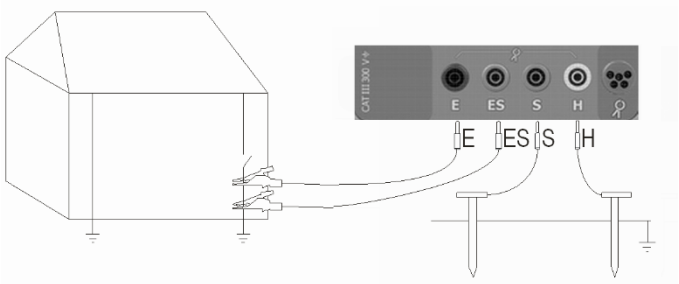
3. 
Press the **SET/SEL** button to select the measurement voltage.

4. 
Use the ▲ and ▼ buttons to select the measurement voltage of 25 V or 50 V.

5. 
or

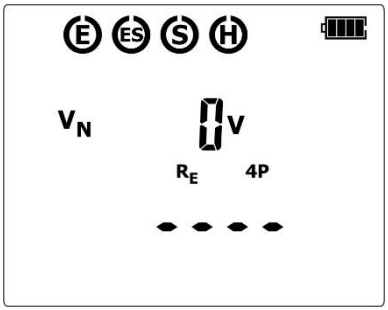
Press **ENTER** to save the setting or press **ESC** to exit without saving.

6. Connect the test leads according to this diagram:



Drive the current electrode into the ground and connect it to the **H** terminal of the meter.
Drive the voltage electrode into the ground and connect it to the **S** terminal of the meter,
Connect the earth electrode object of test to the **E** terminal of the meter.
Connect the **ES** terminal to the earth electrode object of test below the **E** connection.
All 3 electrodes should be aligned in a straight line.

7

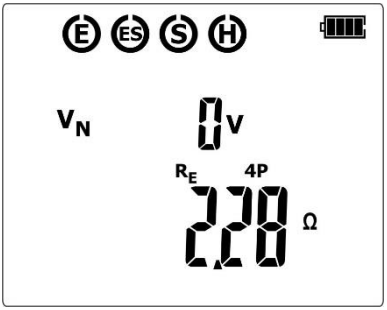


The meter is ready for measurement.

8

Press **START** to begin measurement.

9



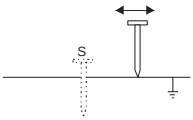
After the measurement completes view the results on the screen.

10

Use the ◀ and ▶ buttons to toggle between the measurement results:
R_H – resistance of current electrode
R_S - resistance of voltage electrode
ER – additional uncertainty caused by the resistance of the electrodes
V_N – interfering (noise) voltage.

The result is displayed for 20 seconds. Press **ENTER** to display again.

11



Repeat the test two or more times by moving the voltage electrode a couple of meters or yards, alternately towards and away from the earth electrode object of test (E) and repeat steps 7, 8 and 9.
If the R_E test results differ by more than 3% it is necessary to significantly increase the distance between the current electrode and the earth electrode object of test (E) and repeat the measurements.

Note:

Earth resistance measurements are usually good if the interference voltage is < 24 V. The meter can measure in the presence of interference voltage up to 100 V. Over 40 V it is indicated as hazardous. Do not connect the meter to a voltage exceeding 100 V.

- Pay attention to the quality of the connection to the electrode object of test with the test leads – the contact area must be cleaned of paint, rust, corrosion etc.
- If the resistance of the auxiliary electrodes is too high, then the measurement of the R_E earth electrode will be distorted by additional uncertainty. A particularly high measurement uncertainty is generated if we measure a low value of the earth resistance with electrodes of a loose contact with the soil (such a situation occurs often if the earth electrode is properly made and the upper layer of the ground is dry and characterized by a low conductivity). Then the relation between the electrode resistance and the resistance of the measured earthing is very high, and so is the case of the measurement uncertainty which depends on it. What may be done then is to perform, in accordance with the formulae specified in point 12.2, calculations, which will permit to evaluate the influence of the measurement conditions. It is also possible to improve the contact of the electrode with the ground, for example by means of moistening of the place when the electrode is driven, its driving into the ground in another place or using a 80 cm electrode. Check also the test leads and make sure the insulation is not damaged and the contacts: test lead – banana plug – electrode are not corroded or loosened. In most cases the achieved resolution of the measurement is sufficient, but it is necessary to be conscious of the uncertainty the measurement is burdened with.

Additional information displayed by the meter

R_E>9999Ω	Measurement range exceeded.
V_N >100V, **>100V** and a continuous tone, '**NOISE!**' and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>24V**, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 24 V, but < 40 V. The measurement cannot proceed.
'**NOISE!**'	The value of the interfering voltage is < 24 V, but has a high value. Results may be affected by additional uncertainty.
LIMIT! and **ER** along with % value	The uncertainty caused by resistance of the electrodes is > 30%. (Uncertainties calculated on the basis of the measured values.)
LIMIT! and **R_H** or **R_S** along with Ω value	The resistance of H and S electrodes, or one of them exceeds 19.9 kΩ. The measurement is subject to error.
Flashing symbols: E, ES, S, H	Flashing symbols E, Es, H, S, indicate a test lead is disconnected from the measurement terminals.

4.5 Earth resistance measurement with 3-pole method with additional clamp (R_E3P+C)

1

Use the **<<** or **>>** buttons to select the measurement mode: **3P+**. The LED  is illuminated. The meter is now in the state of measuring interfering noise voltage between the measurement terminals.

2

Press the **SET/SEL** button to select the measurement voltage.

3

Use the ▲ and ▼ buttons to set the measurement voltage value to 25 V or 50 V.

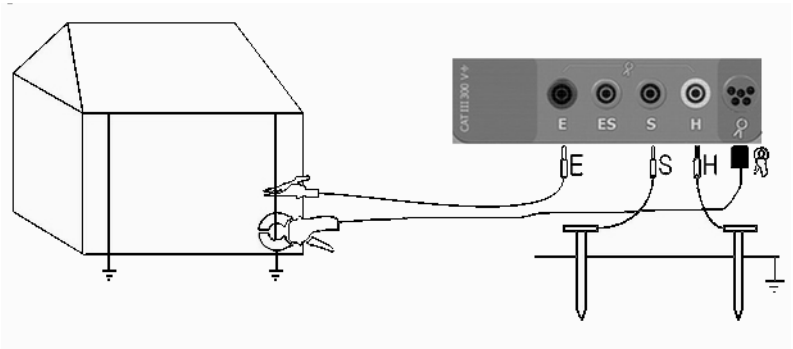
4

or

Press **ENTER** to save the setting or press **ESC** to exit without saving.

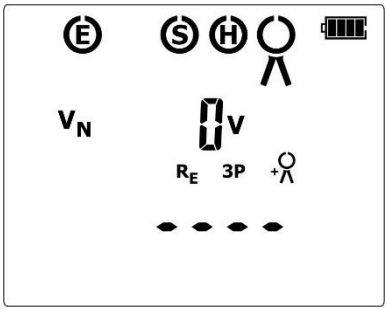
Connect test leads according to this diagram:

5



Drive the current electrode into the ground and connect it to the **H** terminal of the meter.
Drive the voltage electrode into the ground and connect it to the **S** terminal of the meter,
Connect the earth electrode object of test to the **E** terminal of the meter.
Attach the receiving clamp around the earth electrode object of test below the **E** cable connection.
All 3 electrodes should be aligned in a straight line.

6



The meter is ready for measurement.

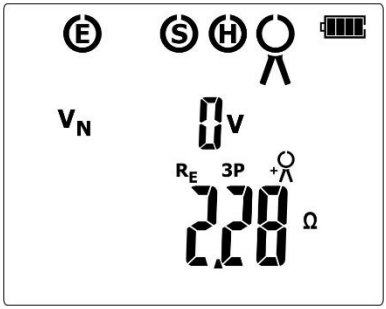
7

Use the ◀ and ▶ buttons to toggle between the measurements:
V_N – interfering (noise) voltage,
I_L – leakage current measured by the clamp

8

Press **START** to begin measurement.

9



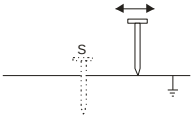
After the measurement completes view the results on the screen.

10

Use the ◀ and ▶ buttons to toggle between the measurement results:
R_H – resistance of current electrode
R_S - resistance of voltage electrode
ER – additional uncertainty caused by the resistance of the electrodes
V_N – interfering (noise) voltage
I_L – leakage current.

The result is displayed for 20 seconds. Press **ENTER** to display again.

(11)



Repeat the test two or more times by moving the voltage electrode a couple of meters or yards, alternately towards and away from the earth electrode object of test (E) and repeat steps 7, 8 and 9.
If the R_E test results differ by more than 3% it is necessary to significantly increase the distance between the current electrode and the earth electrode object of test (E) and repeat the measurements.

Note:

⚠

Earth resistance measurements are usually good if the interference voltage is < 24 V. The meter can measure in the presence of interference voltage up to 100 V. Over 40 V it is indicated as hazardous. Do not connect the meter to a voltage exceeding 100 V.

- Current clamps are must be purchased separately.
- The current clamp must be calibrated before it is used for the first time. It is recommended to periodically re-calibrate the current clamp. The clamp calibration option is described in section 4.7.
- If the resistance of the auxiliary electrodes is too high, then the measurement of the R_E earth electrode will be distorted by additional uncertainty. A particularly high measurement uncertainty is generated if we measure a low value of the earth resistance with electrodes of a loose contact with the soil (such a situation occurs often if the earth electrode is properly made and the upper layer of the ground is dry and characterized by a low conductivity). Then the relation between the electrode resistance and the resistance of the measured earthing is very high, and so is the case of the measurement uncertainty which depends on it. What may be done then is to perform, in accordance with the formulae specified in point 12.2, calculations, which will permit to evaluate the influence of the measurement conditions. It is also possible to improve the contact of the electrode with the ground, for example by means of moistening of the place when the electrode is driven, its driving into the ground in another place or using a 80 cm electrode. Check also the test leads and make sure the insulation is not damaged and the contacts: test lead – banana plug – electrode are not corroded or loosened. In most cases the achieved resolution of the measurement is sufficient, but it is necessary to be conscious of the uncertainty the measurement is burdened with.

Additional information displayed by the meter

R_E>9999Ω	Measurement range exceeded.
V_N >100V, **>100V** and a continuous tone, '**NOISE!'** and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!'** and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>24V**, '**NOISE!'** and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 24 V, but < 40 V. The measurement cannot proceed.
'**NOISE!'**	The value of the interfering voltage is < 24 V, but has a high value. Results may be affected by additional uncertainty.
LIMIT! and **ER** along with % value	The uncertainty caused by resistance of the electrodes is > 30%. (Uncertainties calculated on the basis of the measured values.)
LIMIT! and **R_H** or **R_S** along with Ω value	The resistance of H and S electrodes, or one of them exceeds 19.9 kΩ. The measurement is subject to error.
Flashing symbols: 	Flashing symbols E, H, S, indicate a test lead is disconnected from the measurement terminals.
Flashing clamp symbol 	Current clamp disconnected or the current value measured by the clamp is too low.
I_L xxA , I>3A, ⚠	Interfering current exceeds 3 A – the measurement is not possible.

4.6 Earth resistance measurement with two-clamp method (2C)

The two-clamp measurement is employed when there is no possibility of using auxiliary electrodes.

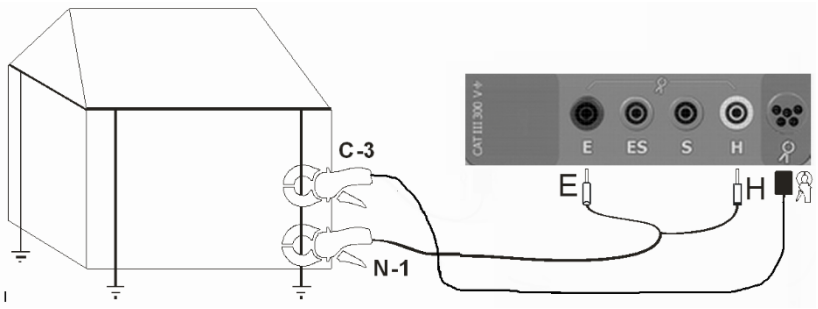
NOTE!
The two-clamp method is used specifically only in the case of multiple earth ground systems.

1

Use the **<<** or **>>** buttons to select the measurement mode: . The LED is illuminated. The meter is now in the state of measuring interfering noise voltage between the measurement terminals, and also measuring current sensed by the receiving current clamp.

Connect the test leads according to this diagram:

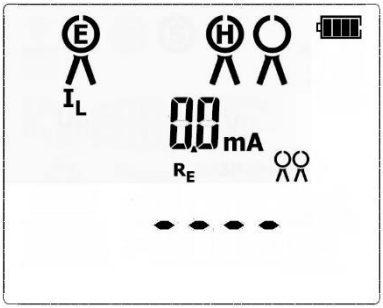
2



Connect the transmission clamp to terminals **H** and **E**.

The measurement current clamp should be connected to the clamp terminal .
Attach the transmission clamp and the measurement clamp around the tested earth electrode object of test at least 30 cm / 12 in from each other.

3

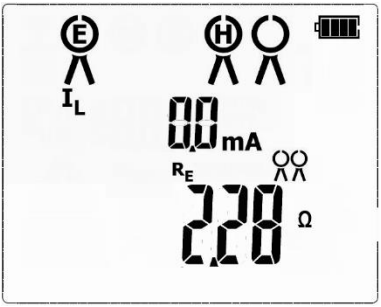


The meter is ready for measurement.

4

Press **START** to begin measurement.

5



After the measurement completes view the resistance value and the leakage current value on the screen.

The result is displayed for 20 seconds. Press **ENTER** to display again.

Note:

⚠

Measurements are usually good in the presence of interference current < 3 A and whose frequency complies with the value set in the MENU.

- Current clamps must be purchased separately.
- The current clamps must be calibrated before they are used for the first time. It is recommended to periodically re-calibrate current clamps. The clamp calibration option is described in section 4.7.

Additional information displayed by the meter

R_E>99.9Ω	Measurement range exceeded.
Flashing clamp symbols 	Transmitting clamp disconnected.
Flashing clamp symbol 	Receiving clamp disconnected, or the measured current value is too low.
I_L xxA , **I>3A**, ⚠	Interfering current is > 3 A. The measurement cannot proceed.

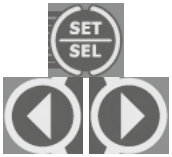
4.7 Calibration of the measurement clamp C-3

The current clamp C-3 must be calibrated before using for the first time. It is recommended to periodically re-calibrate the current clamp.

1

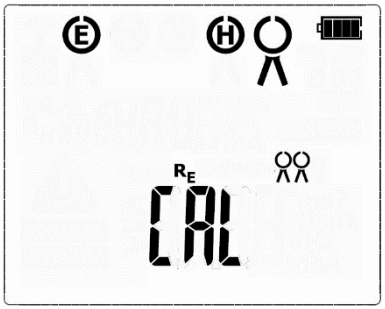
While in mode, the LED is illuminated, press the **SET/SEL** button to enter the clamp calibration screen.

or:



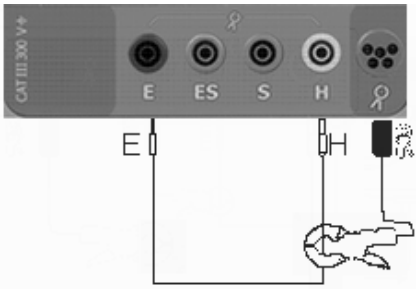
While is 3P+ mode , the LED 3P is on press the **SET/SEL** button to enter the screen where test voltage can be selected, then use ◀ and ▶ buttons to enter the screen where the measuring clamp calibration can be performed.

2



Flashing **CAL** message indicates meter is ready for the clamp calibration procedure.

3



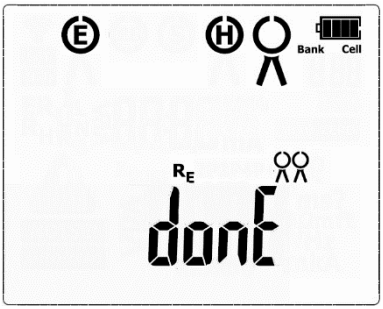
Connect the **'E'** and the **'H'** terminals together with a test lead and put the clamp around the lead.

4

Press **START** button.

The meter has determined the correction factor for connected clamp. The factor is saved in the memory also when the power supply of the meter is off until the following successful calibration of the clamp has been performed.

③



When **donE** is displayed on the screen the clamp calibration procedure is complete.

⑥

or

After 20 seconds the meter returns to the standby screen where a measurement can be started. Press **ESC** or **ENTER** to skip, and return to the standby screen immediately.

Note:

- Make sure the test lead passes centrally through the clamp.

Additional information displayed by the meter

Flashing symbols: E H and **oPEn**	Flashing symbols E, H, indicate a test lead is disconnected from the measurement terminals.
Flashing clamp symbol	Measurement clamp is disconnected.

4.8 Measurement of resistance of protective conductors and equipotential bonding (R_{CONT})

Note:
The measurement complies with the requirements specified in the standard: EN 61557-4 (V<24V, I>200mA and R≤10Ω).

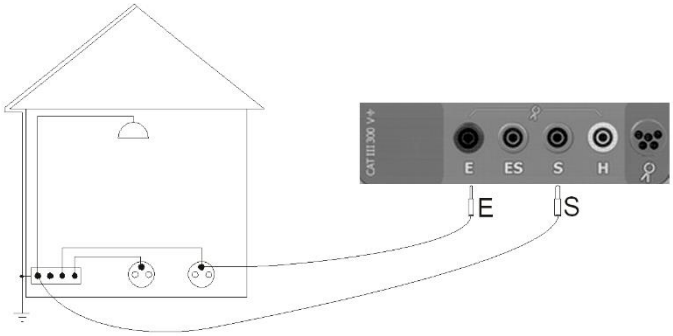
1

Use **<<** or **>>** buttons to select the measurement mode: $R_{CONT\ 200mA}$. The LED 

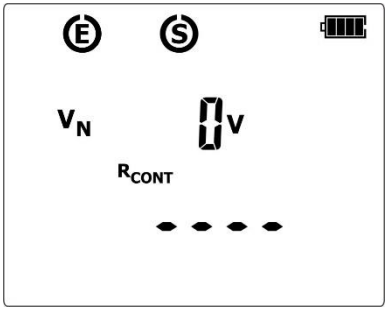
is illuminated. The meter is now in the state of measuring interfering noise voltage between the measurement terminals.

Connect the test leads according to this diagram:

2



3

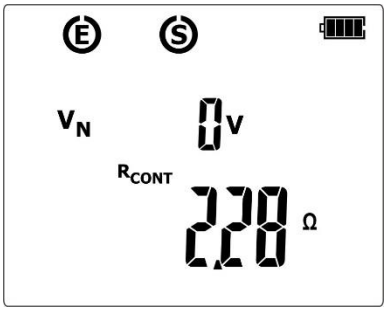


The meter is ready for measurement.

4

Press **START** to begin measurement.

5



After the measurement completes view the values of resistance and the interfering voltage on the screen.

The result is displayed for 20 seconds. Press **ENTER** to display again.

Additional information displayed by the meter

R>1999Ω	Measurement range exceeded.
V_N >100V, **>100V** and a continuous tone, '**NOISE!**' and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>3V**, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 3 V, but < 40V. The measurement cannot proceed.
'**NOISE!**'	The value of the interfering voltage is < 3 V, but has a high value. Results may be affected by additional uncertainty.

4.9 Calibration of the test leads for R_{CONT} measurement

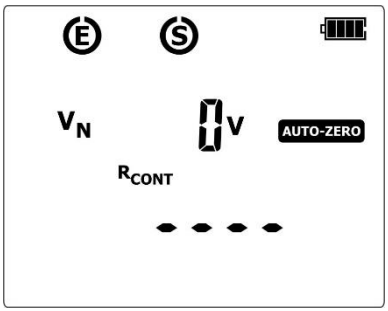
To eliminate the influence of the resistance of the test leads on the result of **R_{CONT}** measurement perform this compensation (auto-zeroing) procedure while in **R_{CONT}** measurement mode.

1

In **R_{CONT}** mode LED 

is illuminated press **SET/SEL** to switch into auto-zeroing mode.

2

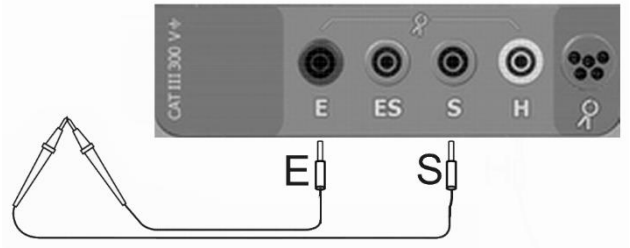


The flashing **AUTO-ZERO** message indicates the test leads calibration procedure is ready to begin.

Connect the test leads according to this diagram:

Short-circuit the test leads connected to the ‘E’ and ‘S’ terminals.

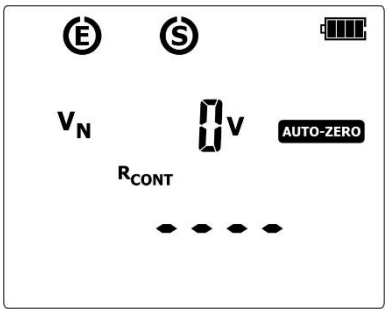
3



4

Press the **START** button.

5



When a steady **AUTO-ZERO** message is displayed on the screen, the test leads calibration procedure is complete.
The results now include the correction value for **R_{CONT}** and is indicated by **AUTO-ZERO** displayed on screen. This value is saved in memory and will be overwritten whenever the Auto-Zero procedure is performed

6 To delete the AUTO-ZERO correction and restore default calibration repeat the above steps with open (not shorted) test leads. An **oFF** message will appear and test lead compensation is now de-activated. When the procedure completes the **AUTO-ZERO** message will disappear from the screen.

7 

or 

After 20 seconds the meter returns to the standby screen where a measurement can be started. Press **ESC** or **ENTER** to skip, and return to the standby screen immediately.

4.10 Earth resistivity measurement (ρ)

The earth resistivity measurement mode ϱ is used to gather resistivity data for the design of a protective ground earthing system project, as well as for geology studies. The measurement method is identical to the four-pole earth ground resistance measurement, but includes the distance between the electrodes. The result is the resistance value calculated in accordance with the following formula: $\rho = 2\pi LR_E$, (Wenner's measurement method). The method assumes equal distances between electrodes.

1 
Use **<<** or **>>** buttons to select the earth resistivity measurement mode: ϱ The LED  is illuminated. The meter is now in the state of measuring interfering noise voltage between the measurement terminals, as well as measuring current with the receiving clamp.

2 

Press **SET/SEL** button to switch into mode of selecting the distance between the auxiliary electrodes.

3 
Use the ▲ and ▼ buttons to set the distance between the auxiliary electrodes. From 1 to 50 m, in 1 m steps, or from 1 to 150 ft, in 1 ft steps.

4 
Use the ▶ button to select the test voltage.

5 
Use the ▲ and ▼ buttons to select the measurement voltage value of 25 V or 50 V.

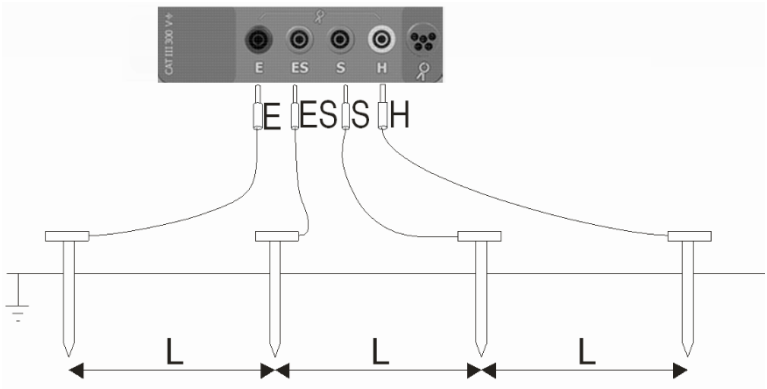
6 

or 

Press **ENTER** to save the setting or press **ESC** to exit without saving.

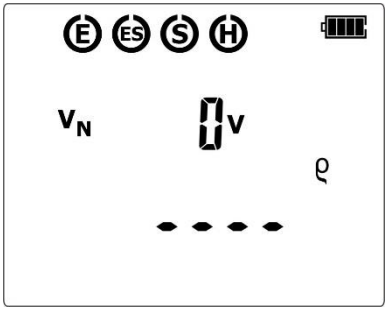
Connect test leads according to this diagram.

7



Align the four electrodes in a straight line, equally spaced, and drive them into the ground.
Connect the current electrode to the **H** socket of the meter,
Connect the voltage electrode to the **S** socket of the meter,
Connect the voltage electrode to the **ES** socket of the meter,
Connect the current electrode to the **E** socket of the meter.

8

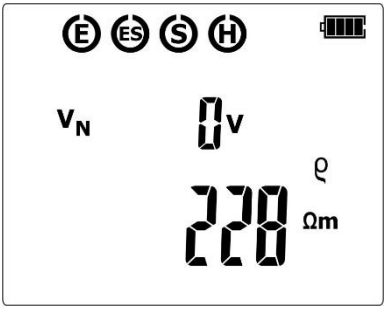


The meter is ready for measurement.

9

Press **START** to begin measurement.

10



After the measurement completes view the results on the screen.

⑪ 

Use the ◀ and ▶ buttons to toggle between the measurement results:
R_H – resistance of current electrode
R_S - resistance of voltage electrode
ER – additional uncertainty caused by the resistance of the electrodes
V_N – interfering (noise) voltage

The result is displayed for 20 seconds. Press **ENTER** to display again.

Note:

⚠

Earth resistance measurements are good if the interference voltage is not > 24 V. The meter can measure interference voltage up to 100 V. Over 40 V it is indicated as hazardous. Do not connect the meter to a voltage exceeding 100 V.

- Calculations are based upon the assumption that the distances between the measurement electrodes are equal (Wenner's method). If this is not the case the earthing resistance measurement must be carried out by means of the four-pole method and calculations must be performed individually.
- Pay attention to the quality of the connection to the electrode object of test with the test leads – the contact area must be cleaned of paint, rust, corrosion etc.
- If the resistance of the auxiliary electrodes is too high, then the measurement of the R_E earth electrode will be distorted by additional uncertainty. A particularly high measurement uncertainty is generated if we measure a low value of the earth resistance with electrodes of a loose contact with the soil (such a situation occurs often if the earth electrode is properly made and the upper layer of the ground is dry and characterized by a low conductivity). Then the relation between the electrode resistance and the resistance of the measured earthing is very high, and so is the case of the measurement uncertainty which depends on it. What may be done then is to perform, in accordance with the formulae specified in point 12.2, calculations, which will permit to evaluate the influence of the measurement conditions. It is also possible to improve the contact of the electrode with the ground, for example by means of moistening of the place when the electrode is driven, its driving into the ground in another place or using a 80 cm electrode. Check also the test leads and make sure the insulation is not damaged and the contacts: test lead – banana plug – electrode are not corroded or loosened. In most cases the achieved resolution of the measurement is sufficient, but it is necessary to be conscious of the uncertainty the measurement is burdened with.

Additional information displayed by the meter

>xxxkΩm or **>xxxkΩft**	Measurement range exceeded, where xxx is maximum value that can be measured for the selected settings.
V_N >100V, **>100V** and a continuous tone, '**NOISE!**' and ⚠	The voltage on the measurement terminals is > 100 V. The measurement cannot proceed.
V_N xxV, **>40V** and a continuous tone, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 40 V. The measurement cannot proceed.
V_N xxV, **>24V**, '**NOISE!**' and ⚠	Where xx is the value of the interfering voltage. The voltage on the measurement terminals is > 24 V, but < 40 V. The measurement cannot proceed.
'**NOISE!**'	The value of the interfering voltage is < 24 V, but has a high value. Results may be affected by additional uncertainty.
LIMIT! and **ER** along with % value	The uncertainty caused by resistance of the electrodes is > 30%. (Uncertainties calculated on the basis of the measured values.)
LIMIT! and **R_H** or **R_S** along with Ω value	The resistance of H and S electrodes, or one of them exceeds 19.9 kΩ. The measurement is subject to error.
Flashing symbols: E, ES, S, H	Flashing symbols E, ES, H, S, indicate a test lead is disconnected from the measurement terminals.

5 Memory of measurement results

Measurements can be stored in memory. The MRU-30 has a memory divided into 10 banks of 99 cells each. Each memory cell can store all measurement results of individual tests. Measurement results are stored in a memory cell with a selected number and selected memory bank. The user of the meter can optionally assign memory cell numbers to individual measurement points and the memory bank numbers to individual facilities.

The user may also perform measurements in any chosen sequence and repeat them without losing other data. Results stored in the memory can be recalled or downloaded to a computer.

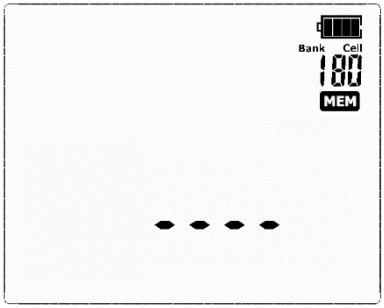
Results of single measurement can be stored in one memory cell. After entering the measurement result, the number of the cell, its ID number, is automatically increased.

It is a good practice before performing a new series of measurements to delete the memory contents of cells that are going to hold new measurement data.

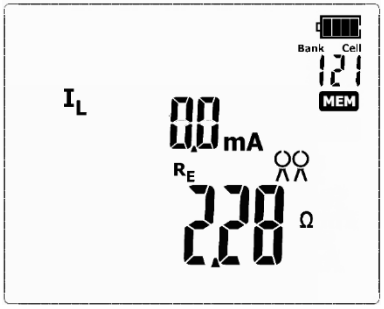
5.1 Storing the measurement results in the memory

1

After completing a measurement press **ENTER**. The meter will enter into the mode for storing test results.



If the destination cell is empty it is indicated by the blank spaces.



If the cell is occupied by the same type of results the screen will show measurement data.

② 

Use the ◀ and ▶ buttons to preview any results stored in the selected cell.

To change the cell number or bank number:

③ 

When the cell number is flashing, use the ▲ and ▼ buttons to select the desired number of the cell.

④ 

Press the **SET/SEL** button. The bank number will be flashing.

⑤ 

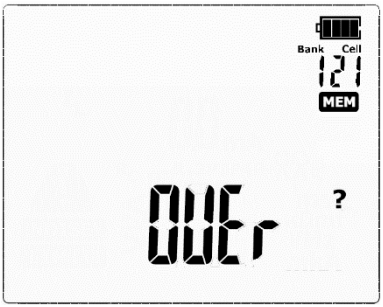
Use the ▲ and ▼ buttons to select the desired number of the bank.

⑥ 

After selecting the desired bank and cell press the **ENTER** button to save the result in the memory. A triple beep sound indicates data is being reorded.

To return to the measurement screen without saving Press **ESC**.

If you try to store data in an occupied memory cell, the **OVEr ?** warning message will appear:



⑦ 

or 

Press **ENTER** to overwrite the result and save the data, or **ESC** to cancel and select other cell or bank.

Note:

After the measurement, its result is shown on the display for 20 s or until:

- the measurement function is changed,
- Auto-OFF function is activated,
- the meter detects interference voltage > 50 V
- the **ESC** button is pressed to exit to the voltmeter display
- the next measurement is performed
- an entry into the memory is made

After exiting to the voltmeter display by pressing **ESC**, or after 20 s, or after the test results have been stored into memory the last result may be recalled by pressing **ENTER**.
All results for a given measuring function and preset measurement settings are stored in the memory.

5.2 Viewing memory data

1.  Use the **<<** or **>>** buttons to select the memory function: **MEM. the** LED MEM is Illuminated.

2.  Use the ◀ and ▶ buttons to preview any test results stored in a selected cell.

To change the cell number or bank number:

3.  When the cell number is flashing, use the ▲ and ▼ buttons to select the desired cell number.

4.  To select the bank number Press the **SET/SEL** button. The bank number will flash.

5.  Use the ▲ and ▼ buttons to select the desired number of the bank.

Viewing test results for $\mathbf{R_{CONT}}$ and $\mathbf{R_E2P}$ measurements is disabled.

5.3 Deleting memory data

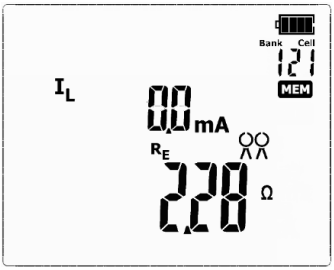
You can delete the entire memory or individual cells or banks.

5.3.1 Deleting cell data

1

Use the **<<** or **>>** buttons to select the memory function: **MEM.** The LED MEM is illuminated.

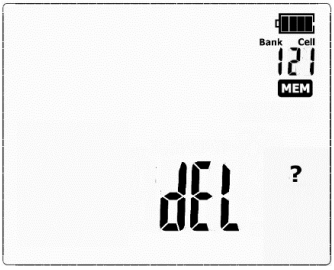
2



Set the cell number to be deleted by using the ◀ and ▶ buttons.

3

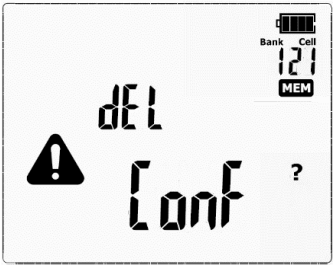
Press **ENTER**.



The message: **dEL ?** is displayed.

4

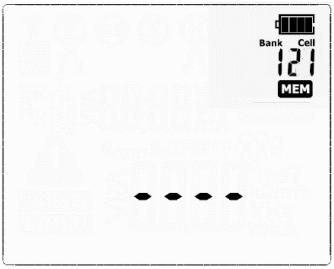
Press **ENTER**.



The ⚠ symbol and **dEL ConF ?** messages appear.

5

Press **ENTER** button again to delete the contents of the selected cell.
After deleting the cell, the meter beeps three times. Press **ESC** to cancel and return to memory browsing.



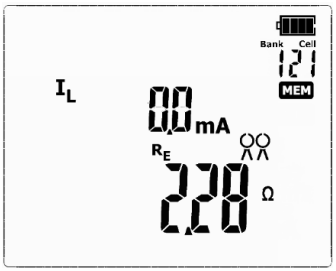
The contents of the cell have been deleted.

5.3.2 Deleting bank data

1

Use the **<<** or **>>** buttons to select the memory function: **MEM.** The LED MEM is illuminated

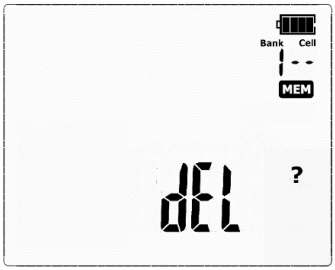
2



Set the bank number to be deleted by pressing the **SET/SEL** button until the bank number flashes.

Press the **SET/SEL** button again. The cell number will flash.

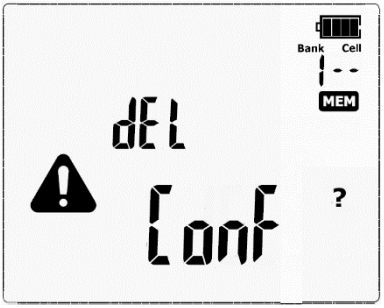
Set the **cell number** to '- -' (before 01) by pressing the ▼ button.



Then the dEL ? message is displayed.

③ 

Press **ENTER**.

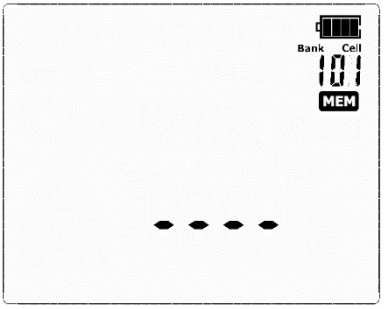


The ⚠ symbol and **dEL ConF ?** messages appear.

④ 

or

Press **ENTER** to delete the selected bank.
After deleting the bank the meter beeps three times. Press **ESC** to cancel and return to memory browsing**.**



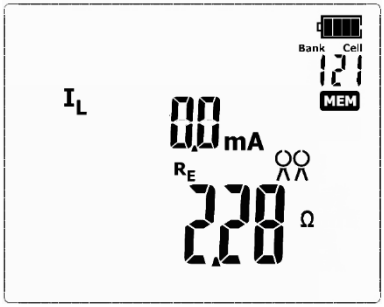
The contents of the bank have been deleted.

5.3.3 Deleting the whole memory

1

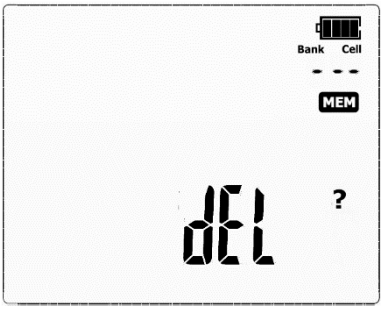
Use **<<** or **>>** to select the memory function: **MEM.** The LED MEM button is illuminated.

2



Press the **SET/SEL** button until the bank number flashes.

Set the bank number to '-' (before 0) by pressing the ▼ button.

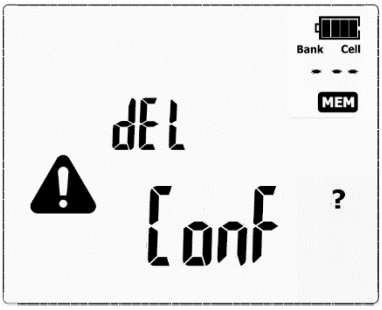


The bank number will change to '-'

Then the dEL ? message is displayed.

3

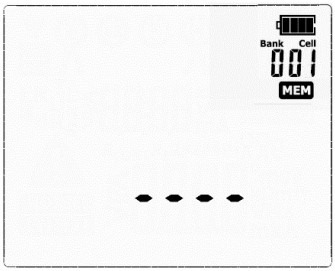
Press **ENTER**.



The ⚠ symbol and **dEL ConF ?** messages appear.

④ 

Press **ENTER** again.
After deleting the memory the meter beeps three times. Press **ESC** to cancel and return to memory browsing**.**



The entire contents of the memory have been deleted.

6 Data transmission

6.1 Computer connection accessories

To operate the meter with a computer, a USB cable and Sonel Reader software is required. If these accessories have not been purchased along with the meter they are available from the Sonel or an authorized Sonel distributor. These accessories may also be used with SONEL instruments equipped with a USB interface. Detailed information regarding software is available from Sonel or an authorized Sonel distributor.

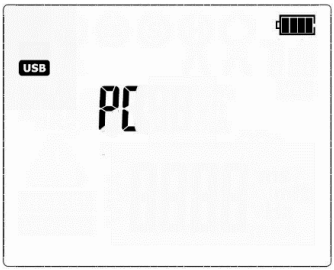
6.2 Data transmission through USB port

① 

Use the **<<** or **>>** buttons to select the memory function: **MEM.** The LED 

is illuminated

② Connect the USB cable from the USB meter socket to the USB port of the computer. The meter will display the message PC:

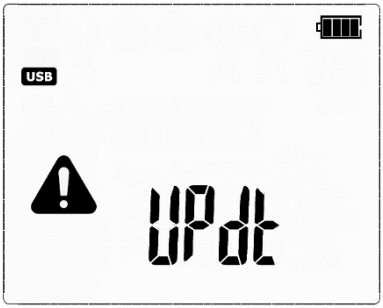


③ Start the Sonel Reader software for communicating with the meter.

7 Firmware update

1. In accordance with the guidelines of Section 3 of this manual, enter the meter's firmware update mode: **UPdt**.

2. Connect the cable to the USB port of the computer and the USB socket of the meter.

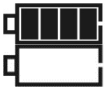


3. Run a program for updating the firmware and follow on-screen instructions.

8 Power supply of the meter

8.1 Monitoring the power supply voltage

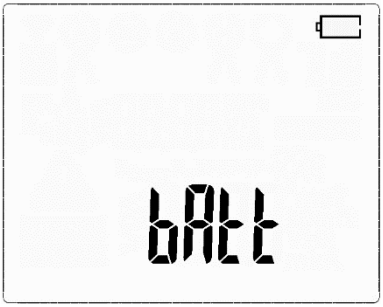
The charge level of the rechargeable batteries is indicated by the battery symbol in the right upper corner of the display:



Batteries are charged

Batteries are nearly discharged

No battery symbol on screen (with charger connected) indicates the battery is either disconnected or has malfunctioned.



The **bAtt** message indicates the batteries are completely discharged. The meter switches off automatically after 5 seconds.

8.2 Charging the rechargeable battery pack

CAUTION!
The MRU-30 meter is powered from a SONEL NiMH 9.6 V battery pack. It can only be replaced by Sonel or an authorized Sonel service center.

The internal battery charger is powered by an external 12 V Sonel AC power supply adapter. The device may be also powered from a 12 V car accessory socket.

Charging commences once the power supply adapter is connected to the meter regardless of whether the meter is on or off.

When the meter is switched off, charging is indicated on the screen by an animated battery symbol being charged, and indicated by the front panel function LED's cycling in red.

Charging modes:

When the meter is switched off the battery pack is charged in 'quick charging' mode. The charging process takes approx. 4 hours for full charge which is indicated by full battery symbol, the **FULL** message and beep. To fully turn the device off unplug the power adapter.

When the meter is switched on, the battery pack is charged in 'background charging' mode. Full charge is indicated by the **FULL** message and beep. If the charging time exceeds 10 hours the meter will automatically switch off for safety.

To fully turn the device off unplug the power charger and turn the meter off.

CAUTION!
Do not power the meter from sources other than those described in this manual.

Note:

Battery charging may finish prematurely due to interferences in the AC mains supply. If this occurs, turn the meter off and re-start charging again.

Additional information displayed by the meter

Message	Cause	Proceeding
Err ACU H°C	Battery is too high.	Wait for the batteries to cool down. Start the charging procedure again.
Err ACU L°C	Battery temperature is too low.	Wait for the batteries to warm up. Start the charging procedure again.
Err ACU X (where X is an error digit indicator)	Charging failure.	Re-start the charging procedure again. If charging from a 12 V car accessory socket verify 12 volts is present. If this error message returns contact Sonel service as the batteries may need replacing.
No battery symbol (with connected battery charger)	Disconnected or failed batteries.	Contact Sonel's service department.

8.3 General principles of using Ni-MH batteries

- Store Ni-MH batteries in a dry, cool and well-ventilated place and protect them from direct sunlight. The temperature of the environment in the case of prolonged storage should not exceed 30°C / 86°F. Long exposure to high temperature reduces their lifetime.
- Ni-MH batteries normally withstand 500-1000 charging cycles. The batteries reach their maximum capacity after 2-3 charge and discharge cycles. Battery life is affected by the depth of discharge; the deeper the discharge of the battery, the shorter its lifetime.
- The memory effect is low for Ni-MH batteries. They may be charged at any point with no serious consequences. However, it is recommended to fully discharge and re-charge them periodically.
- During storage, Ni-MH batteries discharge at the rate of approximately 20% per month. High temperatures will accelerate this process. To prevent excessive discharge of batteries, it is recommended to charge the batteries periodically, even if not in use.
- Modern fast chargers detect both too low and too high a temperature of batteries and react accordingly. Too low a temperature prevents charging, which might damage the battery irreparably. High temperature of the battery stops any further charging. Charging at a high temperature reduces battery lifetime and causes a further increase of the battery temperature, which will not allow charging to full capacity.
- With quick charging batteries are charged to approximately 80% of their capacity. Better results may be obtained if charging is continued. Charging will continue, but with a low current. After a couple of hours the batteries are charged to their full capacity.
- Do not charge or use batteries in extreme temperatures. Extreme temperatures reduce the lifetime of batteries. Avoid using devices powered from Ni-MH batteries in very hot environments. The nominal working temperature must be observed.

9 Cleaning and maintenance

NOTE!
Only use the maintenance methods described in this manual.

The outside of the MRU-30 meter may be cleaned with a soft, damp cloth using all-purpose detergents. Do not use any solvents or cleaning agents or abrasives which might scratch the case.

Clean the auxiliary electrode with water and dry it. Before the electrode is stored for a prolonged period of time it is recommended to grease it with any machine lubricant.

Cable reels and test leads should be cleaned with water and detergents and dried.

The electronic system of the meter does not require maintenance.

10 Storage

When storing the MRU-30:

- Disconnect all the test leads from the meter
- Clean the meter and all its accessories thoroughly
- Wind the long test leads onto the reels
- To prevent a total discharge of the batteries charge them periodically.

11 Dismantling and disposal

- Scrap and disused electric and electronic equipment should be disposed of selectively, i.e. not placed with waste of another kind.
- Scrap and disused electric and electronic equipment should be sent to a collection point in accordance with local regulations for the disposal of electric and electronic equipment.
- Before the equipment is sent to a collection point do not dismantle or disassemble any elements.
- Observe local regulations concerning the disposal of equipment, and depleted batteries.

12 Technical specifications

- The specified accuracy applies to meter terminals.
- The abbreviation 'm.v.' in the accuracy definition means the measured value.

12.1 Basic data

Interference voltage measurement V_N (RMS)

Range	Resolution	Accuracy
0 to 100 V	1 V	±(5% m.v. + 2 digits)

- measurement for f_N 45 to 65 Hz
- frequency of measurements – minimum two measurements/s

Measurement of earth resistance – 2-pole method (R_E2P)

Range	Resolution	Accuracy
0.01 Ω to 19,99 Ω	0.01 Ω	±(3% m.v. + 3 digits)
20.0 Ω to 199.9 Ω	0.1 Ω	
200 Ω to 1999 Ω	1 Ω	±5% m.v.
2000 Ω to 9999 Ω	1 Ω	±8% m.v.

Measurement of earth resistance – 3-pole method (R_E3P), 4-wire method (R_E4P)

The measurement method: 3-pole, in accordance with IEC 61557-5.
Range of measurement in acc. with IEC 61557-5: 0.53 Ω to 9999 Ω for 50 V test voltage.
Range of measurement in acc. with IEC 61557-5: 0.68 Ω to 9999 Ω for 25 V test voltage.

Range	Resolution	Accuracy
0.00 Ω to 19.99 Ω	0.01 Ω	±(3% m.v. + 3 digits)
20.0 Ω to 199.9 Ω	0.1 Ω	
200 Ω to 1999 Ω	1 Ω	±5% m.v.
2000 Ω to 9999 Ω	1 Ω	±8% m.v.

Measurement of resistance of auxiliary electrodes R_H and R_S

Range	Resolution	Accuracy
0 to 999 Ω	1Ω	±(5% (R_S+R_E+R_H) + 8 digits)
1.00 to 9.99 kΩ	0.01kΩ	
10.0 to 19.9 kΩ	0.1kΩ	

Measurement of multiple earth resistance – 3-wire with clamp method (R_E3P+C)

Range	Resolution	Accuracy
0.00 to 19.99 Ω	0.01Ω	±(3% m.v. + 3 digits)
20.0 to 199.9 Ω	0.1Ω	
200 to 1999 Ω	1 Ω	±5% m.v.
2000 to 9999 Ω	1 Ω	±8% m.v.

Measurement of multiple earth resistance – two-clamp method (2C)

Range	Resolution	Accuracy
0.00 to 19.99 Ω	0.01Ω	±(10% m.v. + 8 digits)
20.0 to 99.9 Ω	0.1Ω	±(20% m.v. + 3 digits)

Measurement of leakage current in functions utilizing C-3 clamp

Range	Resolution	Accuracy
0.1 to 99.9 mA	0.1 mA	±(8% m.v. + 5 digits)
100 to 999 mA	1 mA	±(8% m.v. + 3 digits)
1.00 to 5.00 A	0.01 A	±(5% m.v. + 5 digits)

- measurement for f_N 45 Hz to 65 Hz

Measurement of resistance of protective conductors and equipotential bonding (R_{CONT})
The measurement method: technical, in accordance with IEC 61557-4
Range of measurement in accordance with IEC 61557-4: 0.13 Ω to 1999 Ω

Range	Resolution	Accuracy
0.00 to 19.99 Ω	0.01 Ω	±(2% m.v. + 3 digits)
20.0 to 199.9 Ω	0.1 Ω	
200 to 1999 Ω	1 Ω	

Ground resistivity measurements (ρ)
The measurement method: Wenner's, $\rho = 2\pi LR_E$

Range	Resolution	Accuracy
0.0 to 199.9 Ωm	0.1 Ωm	Depends on the basic uncertainty of the R_E 4P measurement but not less than ±1 digit.
200 to 1999 Ωm	1 Ωm	
2.00 to 19.99 kΩm	0.01 kΩm	
20.0 to 99.9 kΩm	0.1 kΩm	
100 to 999 kΩm	1 kΩm	

- distance between measurement probes (L): 1 to 50 m, or 1 to 150 ft

Other technical data

a) type of insulation ..... double, in accordance with EN 61010-1 and IEC 61557
b) measurement category (for 2000 m a.s.l.) ..... CAT III 300 V acc. to EN 61010-1
c) protection class of enclosure in accordance with EN 60529 ..... IP65
d) maximum interference voltage AC + DC at which a measurement may be performed ..... 24 V
e) maximum measured interference voltage ..... 100 V
f) maximum interference current for measurement of earth ground resistance by means of the clamp method is performed ..... 3 A RMS
g) frequency of the measurement current ..... 125 Hz for 50 Hz mains
..... 150 Hz for 60 Hz mains
h) measurement voltage and current for R_{CONT} ..... V<24 V RMS, I>200 mA
i) measurement voltage for R_E2P, R_E3P, R_E4P ..... 25 or 50 V
j) measurement current (short-circuit current) for R_E3P, R_E4P ..... > 20 mA
k) maximum resistance of auxiliary electrodes ..... 20 kΩ
l) signaling of insufficient clamp current ..... ≤0.5 mA
m) power supply ..... rechargeable batteries type SONEL NiMH 9.6 V 2 Ah
n) AC adapter for the battery charger ..... 100 V to 240 V, 50/60 Hz
o) number of measurements for R_{CONT} ..... >3000 (1 Ω, 2 measurements/min)
p) number of measurements for R_E ..... >2000
..... (R_E=10 Ω, R_H=R_S=100 Ω, 25 V 50 Hz, 2 measurements/min)
q) R_{CONT} resistance measurement duration ..... <4 s
r) duration of a resistance and resistivity measurement by means of other methods ..... <8 s
s) dimensions ..... 200 x 150 x 73 mm / 7.9 x 5.9 x 2.9 in (without test leads)
t) weight with batteries ..... 1140 g / 2.5 lbs
u) working temperature ..... -10°C to +50°C / +14°F to +122°F
v) temperature range for battery charging ..... +10 °C to +40°C / + 50°F to +104°F
w) temperatures at which battery charging is prevented ..... < 0°C and ≥ +50°C / < 32°F and ≥ +122°F
x) reference temperature ..... 23 ±2°C / 73 ±4°F
y) storage temperature ..... -20 to +60°C / -4 to +140°F
z) relative humidity ..... 20 to 90%
aa) relative humidity nominal ..... 40 to 60%
bb) altitude ..... < 2000 m / 6560 ft*
cc) quality standard ..... design and production in accordance with ISO 9001
dd) the product meets EMC requirements according to the following standards .....
..... EN 61326-1 and EN 61326-2-2

NOTE
*** Information about the use of meter at altitude from 2000 m to 5000 m**

As for voltage inputs E, ES, S, H the instrument is to be considered downgraded to measurement category CAT III 150 V to ground (max 150 V between inputs) or CAT IV 100 V to ground (max 100 V between inputs). Markings and symbols indicated on the instrument are to be considered valid when using it at altitude lower than 2000 m.

12.2 Additional data

Data regarding additional uncertainties are useful mainly in the case the meter is used under non-standard conditions as well as for measurement laboratories for the purpose of calibration.

12.2.1 Influence of the serial interference voltage U_Z on earth resistance measurements for methods R_E3P, R_E4P, R_E3P+C, ρ

R_E	V_N	Additional uncertainty [Ω]
0.00 to 10,00 Ω	25V	$\pm(0.001R_E+0.01)V_z+0.007U_z^2$
	50V	$\pm(0.001R_E+0.01)V_z+0.004U_z^2$
10.01 to 2000 Ω	25V, 50V	$\pm(0.001R_E+0.01)V_z+0.001U_z^2$
2001 to 9999 Ω	25V, 50V	$\pm(0.003R_E + 0.4)V_z$

12.2.2 Influence of the auxiliary electrodes on earth resistance measurements for methods R_E3P, R_E4P, R_E3P+C, ρ

R_H,R_S	Additional uncertainty [%]
$R_H \leq 5$ kΩ and $R_S \leq 5$ kΩ	$\pm(\frac{R_S}{R_S+100000}\cdot 150+\frac{R_H\cdot 0.004}{R_E}+1.5\cdot 10^{-8}\cdot R_H^2)$
$R_H > 5$ kΩ or $R_S > 5$ kΩ or R_H and $R_S > 5$ kΩ	$\pm(7.5+\frac{R_H\cdot 0.004}{R_E}+1.5\cdot 10^{-8}\cdot R_H^2)$

R_E[Ω], R_S[Ω] and R_H[Ω] are values which are displayed by the device.

12.2.3 Influence of the interference current I_Z on the result of the earth resistance for method R_E3P+C

The MRU-30 meter may perform a measurement, if the value of the interference current does not exceed 3 A rms and the frequency complies with the value set in the MENU.

R_E	Additional uncertainty [Ω]
0.00 to 50,00 Ω	$\pm(0.03R_E\cdot I_Z^2)$
50.01 to 2000 Ω	$\pm(0.0009\cdot R_E\sqrt{R_E}\cdot I_Z^2)$
2001 to 9999 Ω	$\pm(9\cdot 10^{-7}\cdot R_E^2\cdot I_Z(I_Z+15))$

If the interference current exceeds 3 A the possibility of measurement is blocked.

12.2.4 Influence of interference current on the result of the earth resistance measurement for two-clamp method (2C)

The MRU-30 meter may perform a measurement, if the value of the interference current does not exceed 3 A rms and the frequency complies with the value set in the MENU.

R_E	Additional uncertainty [Ω]
0.00 to 10.00 Ω	$0.03R_E^2I_Z$
10.01 to 99.99 Ω	$0.0004R_E^2I_Z(I_Z+10)$

If the interference current exceeds 3 A the possibility of measurement is blocked.

12.2.5 Influence of the relation of the resistance measured with clamp for the multiple earthing branch to the resultant resistance (R_E3P+C)

R_C	Additional uncertainty [Ω]
$\leq 50\ \Omega$	$\pm(0.003\frac{R_C}{R_W^2})$
$> 50\ \Omega$	$\pm(0.5\frac{R_C}{\sqrt{R_W}})$

R_C[Ω] is the value of the resistance measured with clamps for the branch displayed by the device, and R_W[Ω] is the value of the resultant multiple earth resistance.

12.2.6 Additional uncertainties in accordance with IEC 61557-5 (R_E3P, R_E4P)

Influencing factor	Symbol	Additional uncertainty
Location	E_1	0%
Power supply voltage	E_2	0% (bAt not displayed)
Temperature	E_3	±0.2digits/°C for R<1 kΩ ±0.07%/°C ±0,digits/°C for R≥1 kΩ
Serial interference voltage	E_4	In accordance with formulas in 10.2.1 (V_N=3 V 50/60 Hz)
Resistance of electrodes and auxiliary earth electrodes	E_5	In accordance with formula in 10.2.3

13 Accessories

The current list of accessories can be found on the manufacturer's website.

13.1 Standard accessories

- Auxiliary electrode, 30 cm / 11.8 in (2 pcs.) – **WASONG30**,
- 1.2 m / 3.9 ft red test lead with banana plugs at both ends – **WAPRZ1X2REBB**,
- 2.2 m / 7.2 ft black test lead with banana plugs at both ends – **WAPRZ2X2BLBB**
- 25 m / 82 ft red test lead on reel with banana plugs at both ends - **WAPRZ025REBBSZ**
- 50 m / 164 ft yellow test lead on reel with banana plugs at both ends – **WAPRZ050YEBBSZ**
- Black crocodile clip – **WAKROBL20K01**
- Pin probe with banana connector, red – **WASONREOGB1**,
- Cramp with banana socket – **WAZACIMA1,**
- Soft carrying case for the meter and accessories – **WAFUTM9**
- Carrying case for the meter and accessories – **WAFUTL10**
- USB cable – **WAPRZUSB**
- Power supply adaptor Z7 – **WAZASZ7,**
- Calibration certificate issued by an accredited laboratory,
- User manual.

13.2 Optional accessories

Optional items available from Sonel or authorized Sonel distributors:

WASONG80

- Auxiliary electrode, 80 cm

WACEGC3OKR

- Receiving clamp C-3

WAFUTL3

- *case L-3 (for auxiliary electrodes 80 cm)*

WACEGN1BB

- *Transmitting clamp N-1*

WAPRZLAD12SAM

- 12 V car cigarette lighter plug for charging batteries

14 Manufacturer

Contact the manufacturer for warranty and post-warranty service:

SONEL S.A.
58-100 Świdnica
Poland
tel. +48 74 858 38 60
fax +48 74 858 38 09
E-mail: export@sonel.pl
Web page: www.sonel.pl

SONEL Test & Measurement
Santa Clara, Ca 95054 USA
tel. +1 (408) 898 2215
fax +1 (408) 988 4869
E-mail: testsupport@soneltest.com
Web: www.soneltest.com

Attention:
Service and repairs must be carried out only by Sonel or an authorized Sonel service center.

15 Laboratory services

SONEL Testing and Calibration Laboratory has been accredited by the Polish Center for Accreditation (PCA) - certificate no. AP 173.

AP 173

Laboratory offers calibration for the following instruments that are used for measuring electrical and non-electrical parameters.

- **METERS FOR MEASUREMENTS OF ELECTRICAL PARAMETERS**
  - voltage meters,
  - current meters (including clamp meters),
  - resistance meters,
  - insulation resistance meters,
  - earth resistance and resistivity meters,
  - RCD meters,
  - short-circuit loop impedance meters,
  - power quality analyzers,
  - portable appliance testers (PAT),
  - power meters,
  - multimeters,
  - multifunction meters covering the functions of the above-mentioned instruments,
- **ELECTRICAL STANDARDS**
  - calibrators,
  - resistance standards,
- **METERS FOR MEASUREMENTS OF NON-ELECTRICAL PARAMETERS**
  - pyrometers,
  - thermal imagers,
  - luxmeters.

The **Calibration Certificate** is a document that presents a relation between the calibration standard of known accuracy and meter indications with associated measurement uncertainties. The calibration standards are normally traceable to the national standard held by the National Metrological Institute.

According to ILAC-G24 „Guidelines for determination of calibration intervals of measuring instruments", SONEL S.A. recommends periodical metrological inspection of the instruments it manufactures no less frequently than once every **12 months**.

For new instruments provided with the Calibration Certificate or Validation Certificate at the factory, re-calibration should be performed within **12 months** from the date of purchase, however, no later than **24 months** from the date of purchase.

ATTENTION !
The person performing the measurements should be absolutely sure about the efficiency of the device being used. Measurements made with an inefficient meter can contribute to an incorrect assessment of the effectiveness of health protection and even human life.

NOTES

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