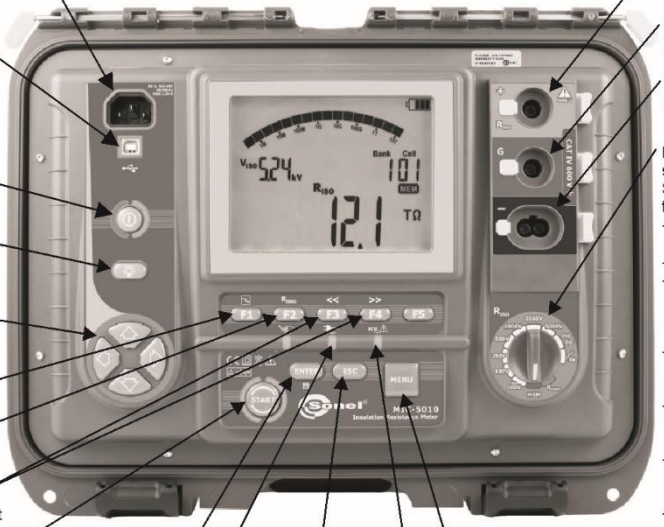
USER MANUAL

INSULATION RESISTANCE METERS

MIC-5010 • MIC-5005

MIC-5010


Power supply input
USB slot
Power on/off After the meter is turned ON, the display shows all digits and symbols (display test).
Turning the display backlight on/off.
Shift/selection: right / left, up / down
Filter button
Button for test leads' calibration
Viewing components of the measurement result
Starting the measurement procedure
Approving selected function
LED indicating battery charging status or voltage on the tested object
ESC - return to previous function, exit the function
LED indicating the presence of high voltage at the terminals
MENU - selection of additional meter's settings
R_{ISO}+ terminal: measurement of R_{ISO} and R_{CONT}
Shielding conductor input: three-lead measurement of R_{ISO}
R_{ISO}- terminal: measurement of R_{ISO} and R_{CONT}
Rotary switch of function selection
Selecting the measurement function:
- R_{CONT} - measurement of circuit continuity,
- MEM - viewing memory data,
- 50...2500V - measurement of insulation resistance with test voltage adjusted within the range of 50 V...5000 V,
- 100V - measurement of insulation resistance using test voltage of 100 V,
- 250V - measurement of insulation resistance using test voltage of 250 V,
- 500V - measurement of insulation resistance using test voltage of 500 V,
- 1000V - measurement of insulation resistance using test voltage of 1000 V,
- 2500V - measurement of insulation resistance using test voltage of 2500 V,
- 5000V - measurement of insulation resistance using test voltage of 5000 V,
- DD - dielectric discharge indicator
- SV - measurement with increasing voltage

USER MANUAL

INSULATION RESISTANCE METERS
MIC-5010 • MIC-5005

SONEL S.A.
Wokulskiego 11
58-100 Świdnica
Poland

Version 1.21 13.09.2023

Thank you for purchasing the MIC-5010 / 5005 insulation meter. Please acquaint yourself with this manual to ensure safe operation, and avoid operational errors that can affect measurement results.

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 A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

CONTENTS

1 Safety

The MIC-5010 / 5005 insulation meter is designed to test the safety of electrical installations, for protection against electric shock and fires. For correct operation and accuracy of obtained results observe the following recommendations:

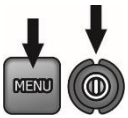
- Before operation of the meter acquaint yourself thoroughly with this manual and pay close attention to the safety regulations and instructions provided by Sonel.
- Any application that differs from those described in this manual may result in a damage to the device and constitute a source of danger to the user.
- The meter must be operated only by qualified personnel authorised to perform work on electrical systems. Operating the meter by unauthorised personnel may result in damage to the device and constitute a source of danger to the user.
- During measurements of insulation resistance dangerous voltages up to 5 kV occur at the ends of the test leads of the meter.
- Before measurement of insulation resistance ensure that the tested object is not live, and disconnected from the mains power supply.
- Do not disconnect test leads from the tested object before the measurement is completed (see par. 3.1.1.) otherwise the electrical charge on the object will not be discharged leaving a high voltage present on the object under test, creating a serious risk of electric shock.
- Compliance with occupational health and safety regulations and relevant fire regulations must be adhered to. Before starting work in special environments, e.g. potential of fire-risk or explosive environments, consult with the person responsible for health and safety.
- Do not operate the meter:
  - ⇒ Which is damaged, completely or partially malfunctioning
  - ⇒ With incorrect, or damaged test leads with damaged insulation
  - ⇒ When stored for an excessive period of time in adverse conditions (e.g. excessive humidity). If the meter is transferred from a cool to a warm environment with a high relative humidity do not use it for 30 minutes until the meter has warmed up to the new ambient temperature.
- The LOW BATT message indicates insufficient voltage of the internal power supply. The battery must be recharged.
- The error message **Err*X***, where ***X*** is a number between 0 to 9, indicates incorrect operation or malfunction of the meter. If after restarting the device this situation continues, the meter needs servicing by Sonel or an authorized Sonel service center.
- Before starting measurements choose the correct measurement function and make sure that test leads are connected securely to the measuring terminals.
- Do not power the meter from sources other than those described in this manual.
- **The R_{ISO}** measurement terminals of the meter are protected electronically from overload, or from connection to a live circuit up to 660V rms for 60 seconds.
- Repairs must be performed by Sonel or an authorised Sonel service center.

Note:
Due to continuous development the actual appearance of the display may slightly differ from the information presented in this operating manual.

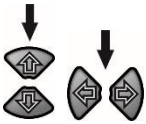
ATTENTION!
To display the correct battery discharge status first completely discharge and then fully recharge the battery.

Note:
Installing drivers in 64-bit Windows 8 and Windows 10 may result in displaying an "Installation failed" message. Windows 8 and Windows 10 by default block drivers without a digital signature. Disable the driver signature enforcement in Windows.

2 Meter configuration

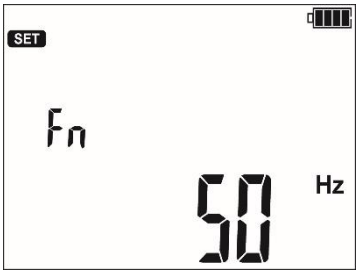
1. 

Turn on the meter holding the **MENU** button pressed.

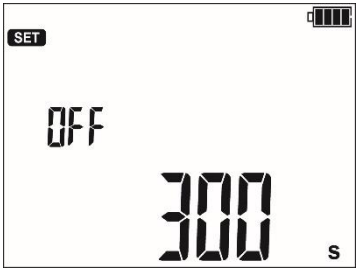
2. 
The ↑ and ↓ buttons are used to set parameter values. The ← and → buttons move to the next parameter.

The setting sequence is as follows:

3. Rated grid frequency (50 Hz and 60 Hz).

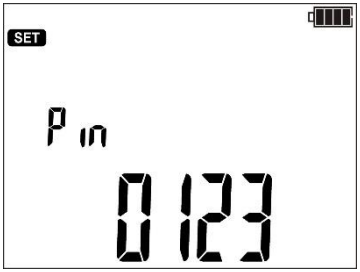


4. Auto-off time (300 s, 600 s, 900 s) or none (---).

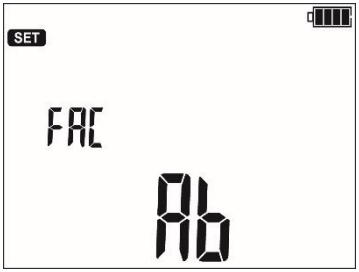


⑤ Pin: Select or hange the flashing digit. Moving to the next digit with the **F3** and **F4** buttons and set the desired pin #.

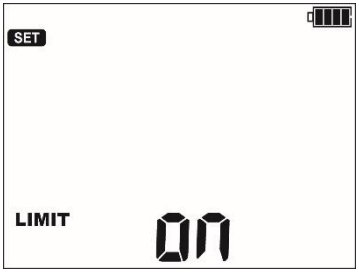
The corresponding PIN code is required for wireless transmission to computer software, and to prevent unauthorized access to the meter.



⑥ Absorption coefficients for R_{ISO}: Ab1, Ab2 (Ab) or PI, DAR (PI). Each change sets the t1, t2 and t3 to their default values: for **Ab1/Ab2** t1=15s, t2=60, t3=0, and for **PI/DAR** t1=30, t2=60, t3=0).

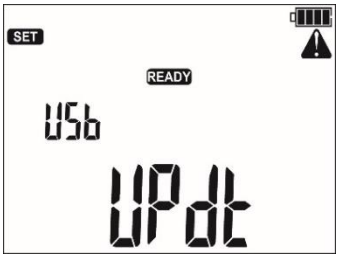


⑦ MIC-5010 Enabling (on) and disabling (oFF) the limit settings.

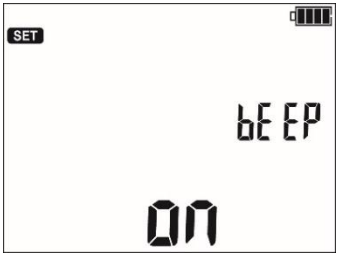


8 Software updates**.**

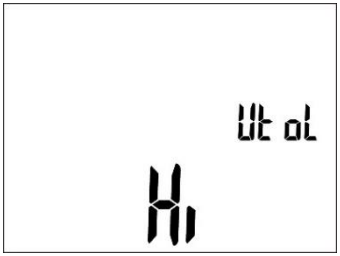
This topic is discussed in section 6.



9 Enabling (on) and disabling (oFF) the buzzer.



10 Test voltage accuracy: **Hi** – 0…5%, **Lo** – 0…10%



11

Press **ENTER** to confirm and go to the measurement screen.

Press **ESC** to go to the measurement screen without approving the changes.

Note:
To restore factory settings, press and hold the ON/OFF button for more than 5 seconds.

3 Measurements

Notes:

The last measurement is retained by the meter until a new measurement is started or the measuring function is changed by the rotary switch. The measurement result displays for 20 s. It may be recalled by pressing **ENTER**, also after the meter is turned off and then on again.

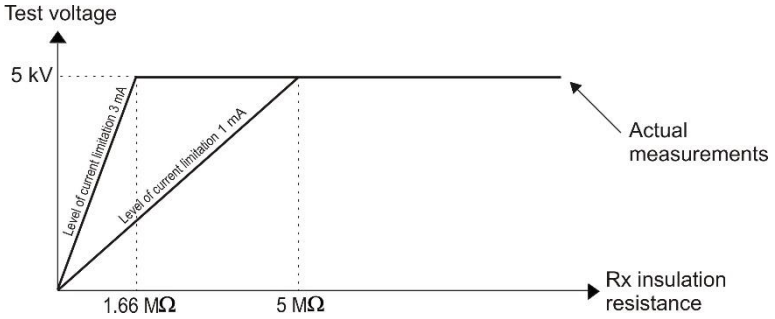
WARNING:
Do not change the range switch during a measurement to prevent damage the meter and threaten user safety.

3.1 Measurement of insulation resistance

WARNING:
De-energize the object under test. The tested object must not be live.

Note:
During measurement make sure the test leads do not touch each other, or that the probes or crocodile clips come into contact with each other, otherwise surface currents will result in additional errors.

The meter output current is limited at of 1.2 mA or 3 mA. Current limiting is indicated with a continuous audio tone. Measurement results are correct, but the test voltage on the terminals will be lower than the selected voltage of test. Current limit occurs in the first stage of a measurement due to the object's capacitance becoming charged.



Actual measurement voltage as a function of the measured insulation resistance R_X (for the maximum measurement voltage)

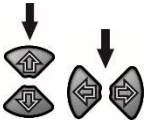
3.1.1 Double-lead measurement

1

Set the rotary function switch in one of the R_{ISO} positions. Each position is marked with the measurement voltage. The position **50 - 5000 V** allows selection of a custom test voltage, in steps of 10 V from 50 V - 1 kV and in steps of 25 V from 1 kV and 5 kV. The meter is in the voltage measurement mode.

2

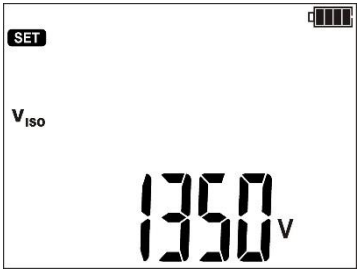
Press the **MENU** button to select
- the time intervals for calculating the absorption coefficients - (t1, t2, t3) and
- MIC-5010 the length of the entire measurement time t, the current I_{ISO} and limit.
For the **50...5000 V** position the test voltage V_n can be selected.



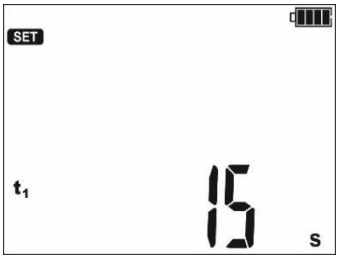
The ▲ and ▼ buttons are used to set the parameter value. The ◄ and ► buttons move to the next parameter.

The setting sequence is as follows:

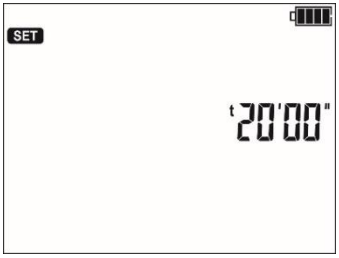
3 Test voltage V_n,



④ Time intervals: - t1 (1 to 600 s), t2 (1 to 600 s, but >t1) and t3 (1 to 600 s, but >t2) and t (independent of t1, t2 and t3: 1 s to 99 min 59 s)

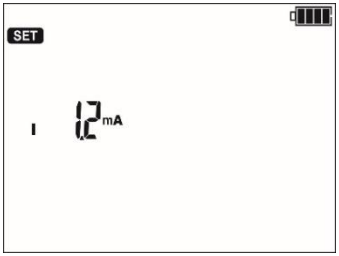


Setting of the times t1 to t3.

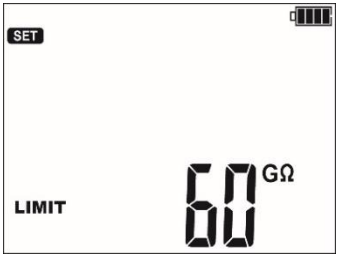


Setting of the time t.

⑤ Short-circuit current I_{SC}: 1.2 mA or 3 mA



⑥ MIC-5010 Limit.

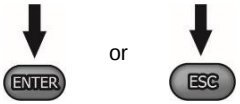


For R_{ISO} the limit is the minimum value. The limit range is from 1 kΩ to 15 TΩ.

The limit value is set using the ▲ and ▼ buttons. Hold down the value key to change it more rapidly. The resolution of the set limit is related to the sub-range.

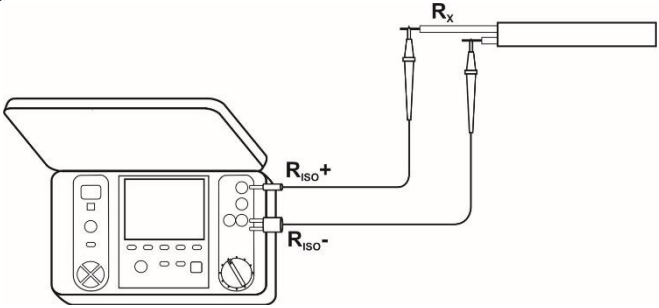
To deactivate the limit press the ▼ button while in the 1 kΩ position or the ▲ button while in the 15 TΩ position. The displayed shows **---** when limit is deactivated.

7



Press **ENTER** to confirm settings, confirmed by a beep, or press **ESC** to exit without saving the changed settings.

8 Connect the test leads according to the following diagram:

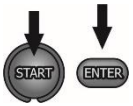


9

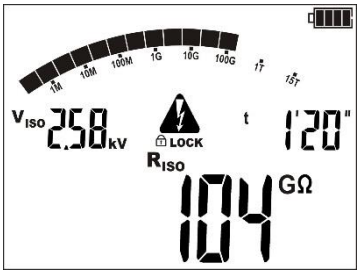
The meter is ready for measurement.

10

Press and hold the **START** button.
The measurement is performed continuously until the button is released or the pre-set time is reached.



To latch the measurement process, first hold down **START,** then **ENTER** holding down both buttons simultaneously. When the **LOCK** symbol displays release the buttons. To cancel the measurement, press **START** or press **ESC**.

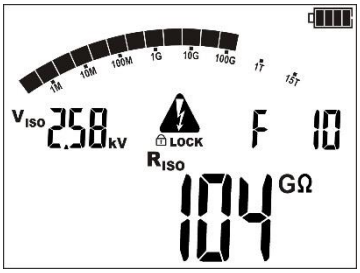


View of the screen during measurement.

During measurements using the ◄ and ► buttons displays either the test voltage U_{ISO} or I_L leacage current.

The meter is equipped with an advanced digital filter for result stabilization in difficult and unstable measurement conditions. When the **F1** button is pressed before or during the measurement the meter will make calculations to stabilize the fluctuations of the measurement results. The meter displays a filtered value of measurements for a specified time period. The filter is selected by pressing the **F1** button i.e. after the first press the result shall be displayed as a filtered value from the last 10 s, after the second press from the last 30 s, then for 60 s and finally the filter is turned off "- -". The last filter setting is erased when the meter is turned off or when the rotary function switch is changed.

The ability to set the filter depends on the set t measurement time, for example when t=20 s it is only possible to set the filter for 10 s.



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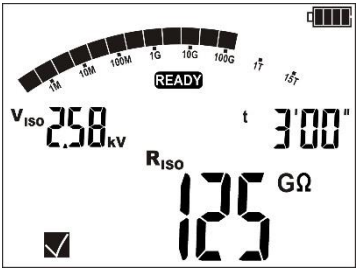
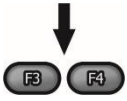


After the measurement completes view the result.

12



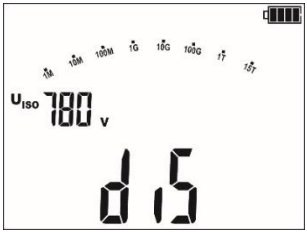
Use the **F3** and **F4** buttons (**SCREEN**) to view the individual components in the following order: R_{ISO}→I_L and C→ Rt1 and It1→Rt2 and It2→Rt3 and It3→Ab1 (DAR)→Ab2(PI)→R_{ISO}→limit(only MIC-5010), where C – is the capacitance of the tested object.

Note:

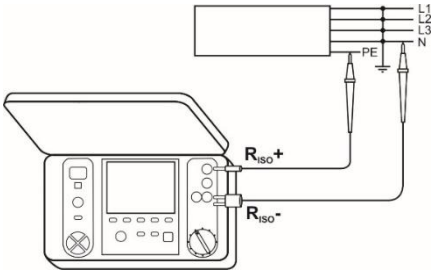
During measurements dangerous voltages up to 5 kV occur at the ends of the test leads of the meter.

Do not disconnect test leads from the tested object before the measurement is completed otherwise the electrical charge on the object will not be discharged leaving a high voltage on the object under test, creating a serious risk of electric shock.

- Disabling t2 will also disable t3.
- Measurement time starts when the test volatge V_{ISO} voltage stabilizes.
- The message LIMIT !! indicates limited inverter power. If this condition persists for 20 seconds the measurement is cancelled.
- A short beep occurs every 5 seconds during the measurement. Key time intervals (t1, t2, t3) are indicated with a long beep.
- If the values of resistances measured at the moments t1, t2, t3 are out of range, the absorption coefficient is not displayed and the display shows dashes.
- During measurement the yellow LED illuminates.
- After the measurement completes the charge on the object under test is discharged by shorting the **R_{ISO}+** and **R_{ISO}-** terminals through a 100 kΩ resistance.



- Capacitance measurement is carried out only while the capacitance of the tested object is being discharged. If the R_{ISO} measurement is interrupted before the R_{ISO} value stabilizes, the discharge will start too early, so the capacitance measurement result may not be correct.
- For the measurement of power cables with multiple conductors short and ground those conductors not being tested as in the diagram below:



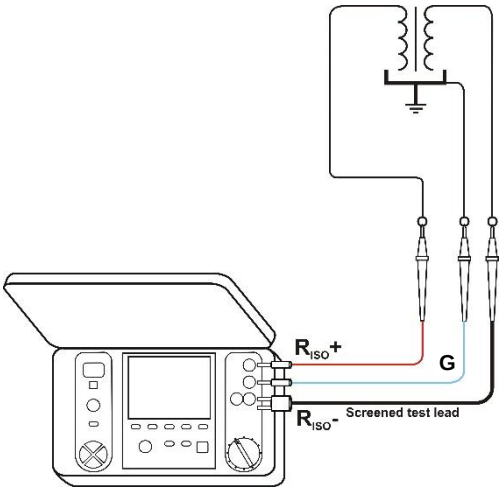
Additional information displayed by the meter

	Test voltage is present on terminals of the meter**.**
NOISE!	Interference voltage lower than 50 V DC or 500 V AC is present on the tested object. Measurement may be burdened with additional uncertainty.
LIMIT !! + continuous tone	Activation of current limit.
HiLE	Breakdown of the tested object insulation, the measurement is cancelled. The message appears after LIMIT !! displays for 20 s during the measurement when the voltage reaches the nominal value.
V_n>50 V (for DC) or **V_n~>500 V** (for AC) + continuous two-tone beep + and red LED	During the measurement AC voltage appeared on the object under test or the object cannot be discharged for 30 seconds. After a further 5 seconds the meter returns to voltmeter mode

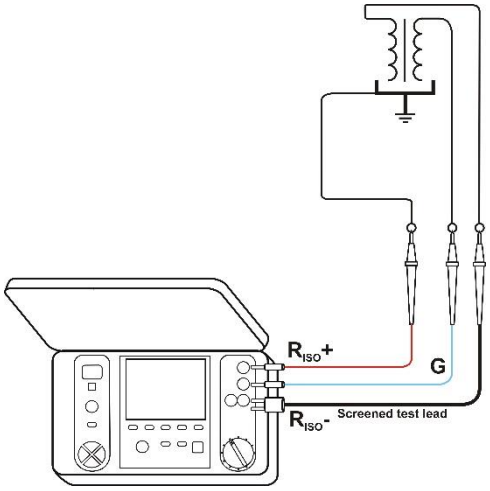
3.1.2 Three-lead measurement

To eliminate the influence of surface resistance in transformers, cables, etc. the three-lead measurement is used. In this mode do not connect the current measuring test lead **R_{ISO}-** to large ground conductors. For example:

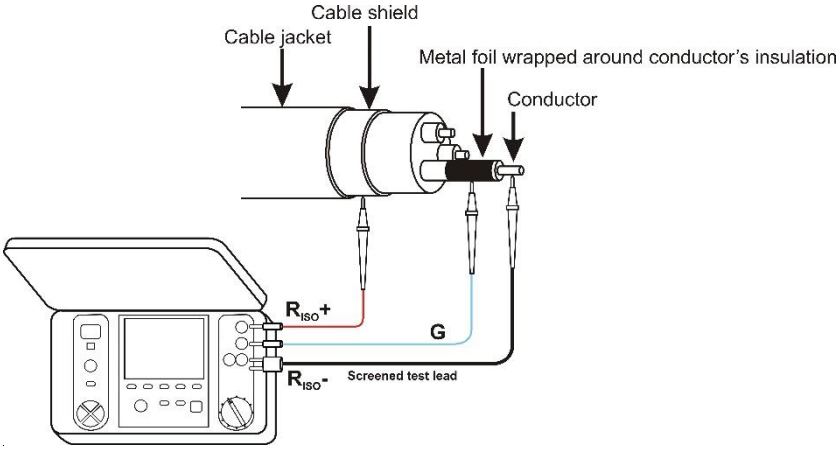
- At the measurement of inter-winding resistance of a transformer, the **G** terminal of the meter should be connected to the transformer enclosure.



- When measuring the insulation resistance between one of the windings and the transformer's enclosure, connect the G terminal of the meter to the second winding:

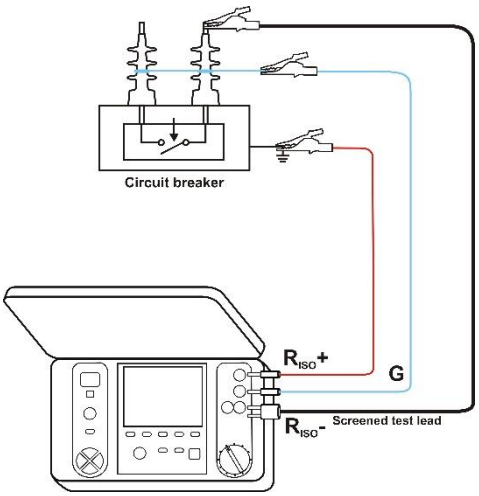


- To eliminate the effect of surface resistances when measuring the insulation resistance between a cable conductor and the cable shield, (important in difficult weather conditions) wrap a piece of metal foil around the insulation the tested conductor and connect the foil to the **G** terminal of the meter, as in the following diagram:



The same technique should apply when measuring the resistance between two conductors of a multiple conductor cable, attaching the **G** terminal to other conductors that are not included in the measurement.

- When measuring the insulation resistance of a high voltage circuit breaker, the **G** terminal of the meter should be connected to the terminal insulator body of the breaker as in the following diagram:



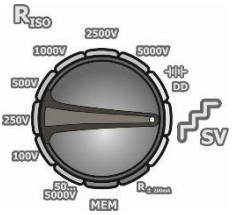
3.1.3 Measurements with increasing voltage - SV

In this mode the meter performs a series of 5 measurements in increasing voltage steps. The voltage steps depend on the set maximum voltage as follows:

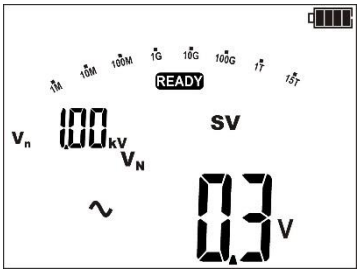
- **1 kV:** 200 V, 400 V, 600 V, 800 V, 1000 V,
- **2.5 kV:** 500 V, 1 kV, 1.5 kV, 2 kV, 2.5 kV,
- **5 kV:** 1 kV, 2 kV, 3 kV, 4 kV, 5 kV.

The results of each of the 5 measurements is saved and indicated by a beep and an icon.

1

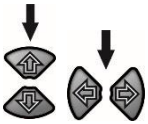


Set the rotary function switch to the **SV** position. The meter is in the voltage measurement mode.



2

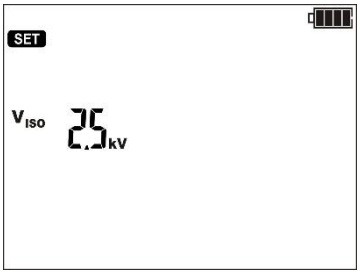
Press the **MENU** button to select the maximum measurement voltage, the duration for individual measurements, and the I_{ISO} current.



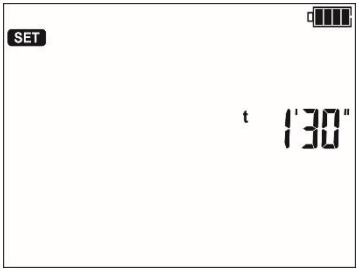
The ↑ and ↓ buttons are used to set the parameter value, while the ← and → buttons move to the next parameter.

The setting sequence is as follows:

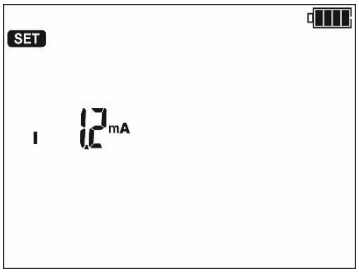
3 Maximum measurement voltage: 1 kV, 2.5 kV and 5 kV



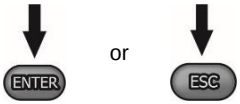
4 Set the duration of individual measurements between 30 seconds to 5 minutes.



5 short-circuit current I_{SC}: 1.2 mA or 3 mA

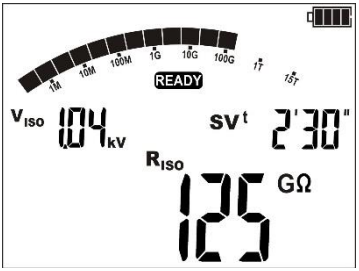


⑥



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

⑦



Press **START** to make the measurement.

After the measurement completes view the result.

⑧

Use **F3** and **F4** (**SCREEN**) to see individual components of the result in the following order: R_{ISO}, U_{ISO}, t → I_L and C → $U_{ISO}1$ and t1 alternatively with $R_{ISO}1$ and I_L1 → $U_{ISO}2$ and t2 alternatively with $R_{ISO}2$ and I_L2 → ..., where C - the capacity of the tested object.

Note:

- Further information, starting the measurement, displayed symbols, result readout and component view operate identically as in the case of R_{ISO} measurement.

3.1.4 Dielectric Discharge Indicator - DD

The Dielectric Discharge value characterises the insulation quality independent of test voltage. In this test the discharge current is measured after 60 seconds from the end of measurement of the insulation.

The measurement operates as follows: first the insulation is charged with a voltage for a set period. If the charging voltage does not achieve the set voltage the object is not charged and the meter cancels the measurement after 20 seconds. If charging (and polarization) is successful the only current flowing through the insulation is leakage current. The object is discharged and a dielectric discharge current flows. Initially this current is the sum of the discharge current resulting from the charge that was accumulated on the object's capacitance, which fades quickly, plus the absorption current. The leakage current is negligible because there is no voltage present during discharge; the meter's measurement terminals are shorted.

1 minute after shorting the terminals the current is measured. The DD value is calculated using the formula:

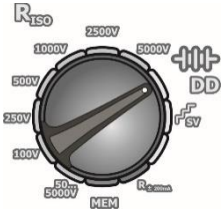
$$DD = \frac{I_{1\min}}{V_{pr} \cdot C}$$

where:
I_{1min} – current measured 1 minute after closing the circuit [nA],
V_{pr} – test voltage [V],
C – capacitance [μF].

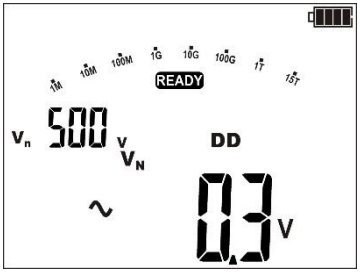
The measurement indicates the insulation condition. See the table below:

DD value	Insulation condition
>7	Bad
4-7	Poor
2-4	Between poor and good
<2	Good

1

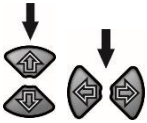


Set the rotary function switch to the **DD** position. The meter is in the voltage measurement mode.



2

Press the **MENU** button to select the test current and load time.



The ↑ and ↓ buttons are used to set the parameter value, while the ← and → buttons move to the next parameter.

The setting sequence is as follows:

3 Set the charge time: 1 min to 60 min,

4 Set the charge voltage: 100 V, 250 V, 500 V 1 kV, 2.5 kV, 5 kV.

5 Set the maximum charging current: 1.2 mA or 3 mA.

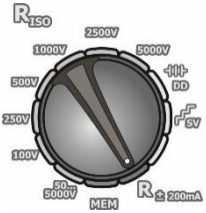
Note:

In environments with strong interference the measurement may be affected by additional uncertainty.

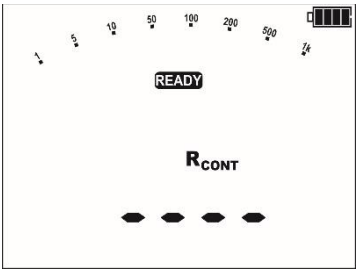
3.2 Low-voltage measurement of resistance

3.2.1 MIC-5010 Measurement of resistance of protective conductors and equipotential bonding with ±200 mA current

1



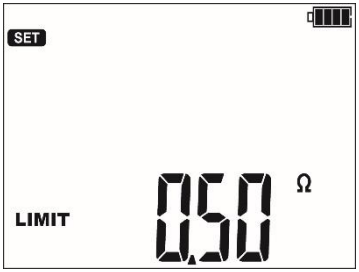
Set the rotary function switch to the R_{CONT} position.



The meter is ready for measurement.

2

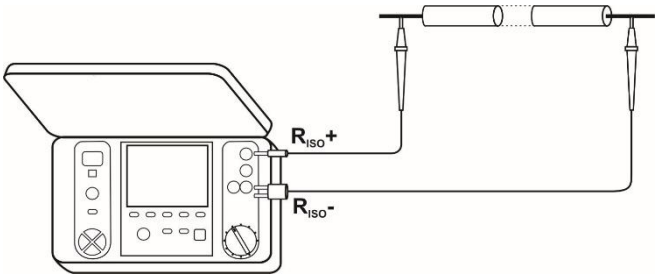
Press the **MENU** button to select the limit setting.

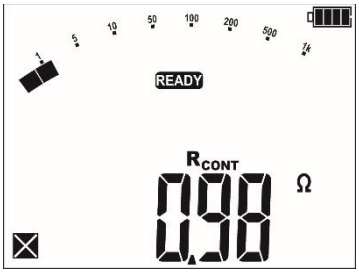


For R_{CONT} the limit is the minimum value. The setting limit is in the range from 0.01 Ω to 999 Ω. The value of the limit is set in the same way as for R_{ISO}.

To deactivate the limit press the ▼ button while in the 1 kΩ position or the ▲ button while in the 999 Ω position. The display displays blank spaces **---**.

③ Connect the meter to the object under test as in the diagram below. Press the **START** button to make the measurement.



④ 

View the result.

Additional information displayed by the meter

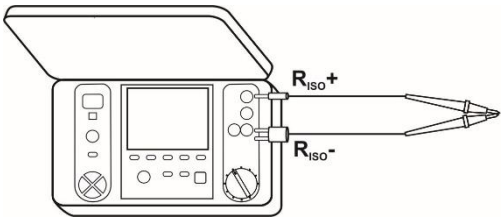
NOISE!	Interference voltage is present on the tested object. The measurement will be burdened with additional uncertainty that is specified in the technical data.
V_n>10 V + continuous two-tone, beep + red LED	Interference voltage exceeds the allowable value. The measurement cannot proceed.

3.2.2 Calibration of test leads

To eliminate the contribution of the resistance of the test leads from the measurement result the autozero function will compensate for the test leads' resistance.

1. 

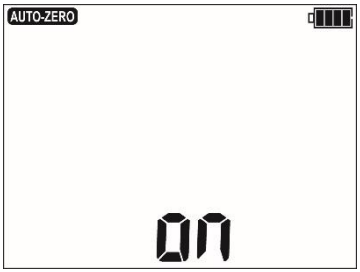
Press the **F2** button (R_{ZERO}).

2. 

Short the test leads.

3. 

Press **START**.

4. 

The message AUTO-ZERO on appears confirming that test lead calibration has been performed. The meter enters the measurement mode. AUTO-ZERO remains visible during measurements.
The compensation values are retained when the meter is switched off.

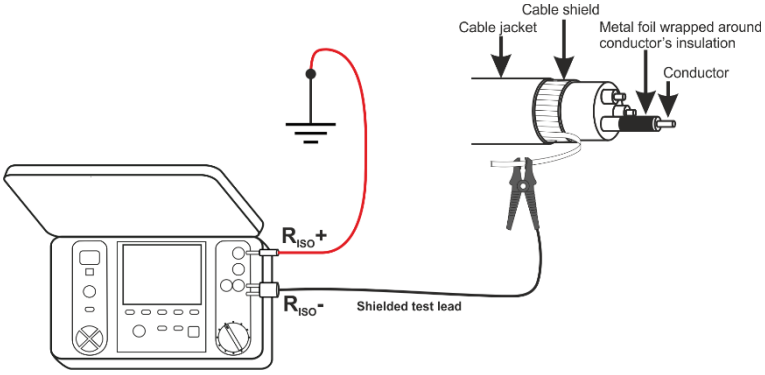
5. To remove the autozero compensation and return to the default calibration perform the same procedure without shorting the test leads together. The message off appears.

3.3 Tightness test of MV cable jacket

Tightness test of MV cable jacket consists of applying a test voltage between its metal sheath or its return conductor and the ground. During the measurement, pay attention to the value of I_L current.

The test voltage and the measurement time depend on the type of the tested object and test guidelines. For example, for a cable with polyethylene insulation:

- test voltage according to standard HD 620 S1: ≤5 kV,
- measurement time after voltage stabilization: 1-10 min,
- positive result according to HD 620 S1: when no ground fault has occurred.



4 Memory of measurement results

The meter is equipped with memory for storing 11880 single test results. The memory is organized into 10 memory banks with 99 cells in each bank. Each measurement result can be stored in a numbered memory cell in a selected memory bank. Each cell may contain the entire set of measurements of R_{ISO} and R_{CONT}. The user can assign memory cell numbers to individual measurement points, and the memory bank numbers to individual facilities, for example. Memory of measurement result data is retained when the meter is switched off. The data can be later viewed again on screen or sent to a computer.

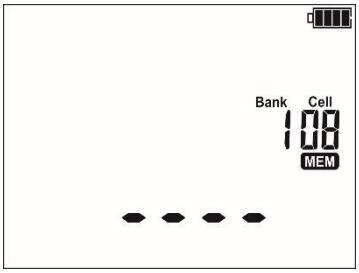
Note:

- Each cell may contain either a R_{ISO} 2(3)p measurement result, or a R_{ISO} SV, or a DD value.
- After saving measurement results the ID number of the cell is automatically increased with each new save.
- A recommended practice is to delete all memory contents before beginning a new series of measurements. Before deletion the memory contents can be saved to a computer if needed.

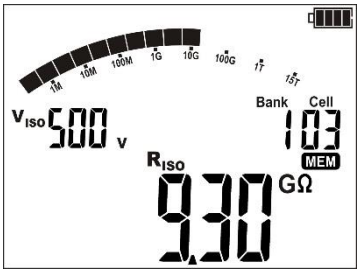
4.1 Storing the measurement results in the memory

1

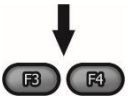
After the measurement completes press **ENTER**. The meter enters the data saving mode.



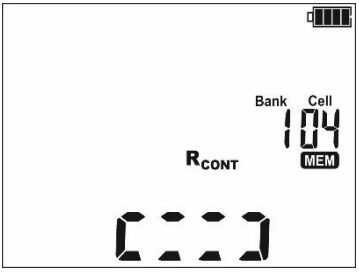
The display will indicate if the cell is empty with blank spaces.



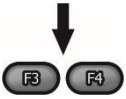
Or the display will show cell data if the cell has data of the same type.



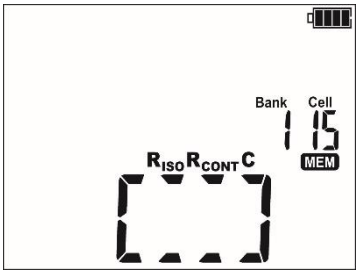
(Use the **F3** and **F4** buttons (**SCREEN**) to see individual components of the result.)



The cell may be partially occupied with a different type of data and displays a blank rectangle.



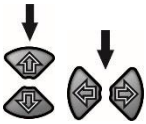
(Use the **F3** and **F4** buttons (**SCREEN**) to see individual components of the result.)



The cell may be fully occupied with a different type of data and displays a large blank rectangle.

(Use the **F3** and **F4** buttons (**SCREEN**) to see individual components of the result.)

2



Change the cell ID # using the ↑ and ↓ buttons. Change the bank ID # using the ← and → buttons.

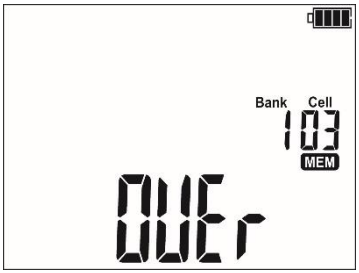
3

Press **ENTER** to save the result. A triple beep and a rectangle displayed on the screen confirms the result data has been saved.

Or press **ESC** to return to the last displayed result without saving.

4

If the cell is occupied the following warning message appears:



5

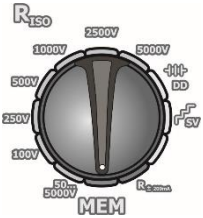
or

Press **ENTER** to overwrite the cell data with the new result. Or press **ESC** to cancel saving.

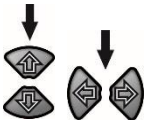
Note:

- Complete set of results (main result and supplementary results) for a given measuring function and preset measurement settings are stored in the memory.

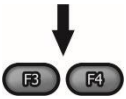
4.2 Viewing memory data



Set the rotary function switch of to the **MEM** position.



The cell ID is changed using the ↑ and ↓ buttons. The bank ID is changed using the ← and → buttons.



Use the **F3** and **F4** buttons (**SCREEN**) to see individual components of the result.

Note:

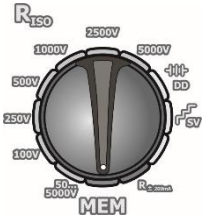
- For R_{ISO} results, the display alternates between showing the bank + cell numbers, and then the time the result was entered into memory. This applies to all R_{ISO} and I_L measurements.

4.3 Deleting memory data

The entire memory or individual banks of memory may be deleted.

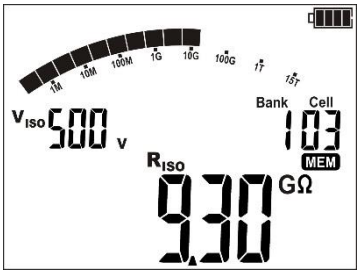
4.3.1 Deleting bank data

1

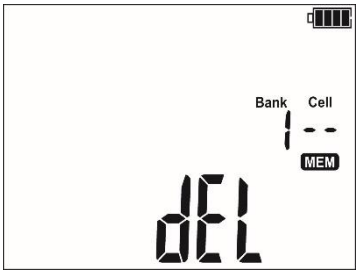


Set the rotary function switch selection at the **MEM** position.

2



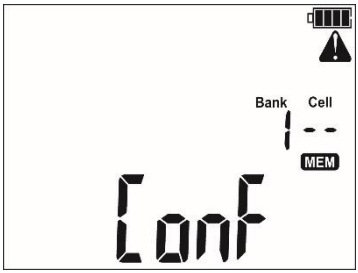
Select the bank number to be deleted using the ⬅ and ➡ buttons. Use the ⬇ button to decrement the cell ID below “01” until blank spaces appear.



The dEL message indicates the bank is ready to be deleted.

3

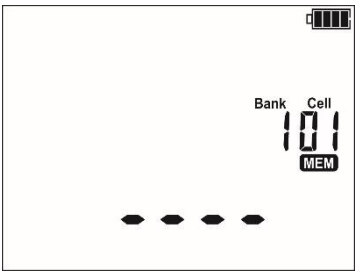
Press the **ENTER** button.



The ⚠ symbol and ConF message display asking to confirm deletion.

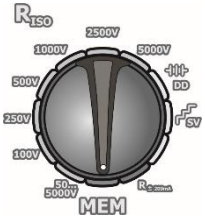
4

Press **ENTER**.
The meter beeps three times and sets the cell number as "01" to confirm the bank has been deleted.



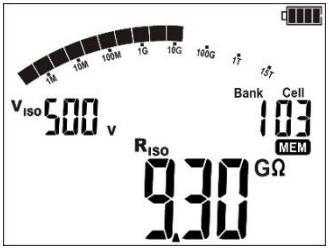
4.3.2 Deleting the whole memory

1

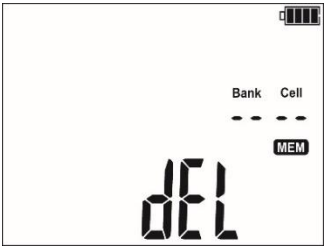


Set the rotary function switch to the **MEM** position.

2



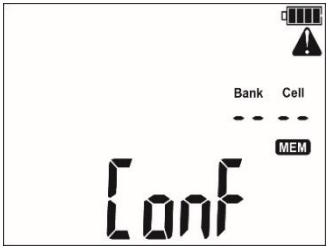
Use the ⬅ button to decrement the bank # until the bank and cell ID #'s display blank spaces.



The message dEL displays indicating the memory is ready to be deleted.

3

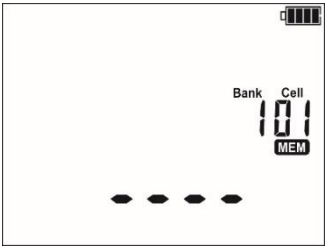
Press the **ENTER** button.



The ⚠ symbol and CONF message display asking to confirm deletion.

④

Press **ENTER**.
The meter beeps three times and sets the bank number as “1” and the cell number as "01" to confirm the memory has been deleted.



5 Data transmission

Note:

- Data transmission to a PC is not possible during battery charging.

Support for wireless data transmission

Meter name	Bluetooth	OR-1
	Serial number / prefix	
MIC-5010	DP ≥ B20469	B20001 ... B20468
MIC-5005	≥ B11082	B10001 … B11081

5.1 Set of accessories to connect the meter to a PC

To communicate with a computer a USB cable or Bluetooth wireless module and **Sonel Reader** PC software is required. It allows users to read and display the measurement data stored in the meter memory. This program may be downloaded free from the manufacturer's website.

The software is compatible with other instruments manufactured by SONEL S.A. equipped with a USB interface and/or wireless module / Bluetooth. Detailed information regarding software is available from Sonel or an authorised Sonel distributor.

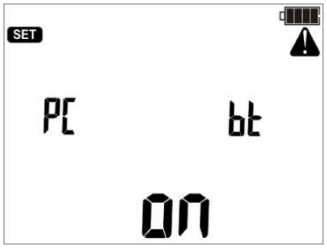
5.2 Data transmission through USB port

1. Set the rotary function switch to the **MEM** position.
2. Connect the cable to the USB port of the computer and the USB port of the meter.

3. Start the Sonel Reader software on the PC.Data transmission with Bluetooth module

Firmware ≤1.30

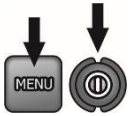
1. Set the rotary switch to **MEM**, press the **MENU** button.



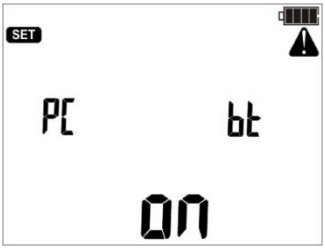
2. Press **ENTER** to start the transmission.

Firmware 1.31+

1. While holding down the **MENU** button, turn on the meter.



2. After the configuration menu screen is displayed (chapter 2, step (3)), use the ◄ ► buttons to go to the **bt** screen. Activate transmission with the ▲ ▼ buttons.



3. Connect Bluetooth module to the USB socket of the PC, unless it is integrated into the PC.
4. During the process of pairing the meter with a PC enter PIN code compatible with the PIN code of the meter defined in main settings..
5. On the computer start data storing programme.

Firmware ≤1.30

The data transmission may be interrupted using the **ESC** button.

Firmware 1.31+

Exit from transmission mode - setting **oFF** according to step 2.

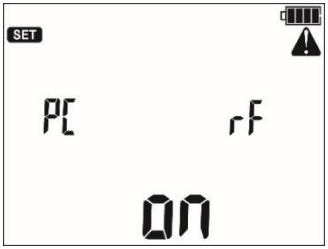
⚠

Standard pin for Bluetooth is "0123".

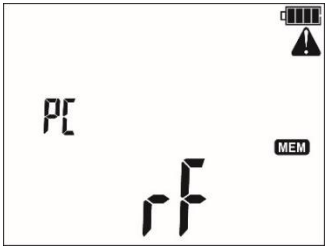
- With the USB cable active the wireless transmission is not possible.

5.3 Data transmission with OR-1 wireless module

1. Set the rotary switch to **MEM**, press the **MENU** button.



2. Connect the OR-1 module to the USB socket of the PC and press **ENTER**.



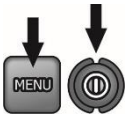
3. If necessary, change the PIN code (par.2).
4. Start the data storing programme.

Note:

The standard pin for OR-1 is "123".

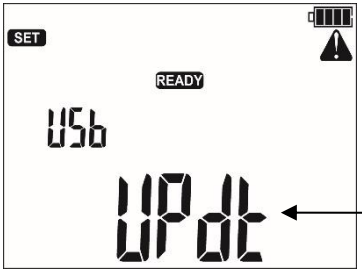
- The data transmission may be interrupted using the **ESC** button - the meter then enters the memory viewing mode.
- With the USB cable active the wireless transmission is not possible.

6 Software updates

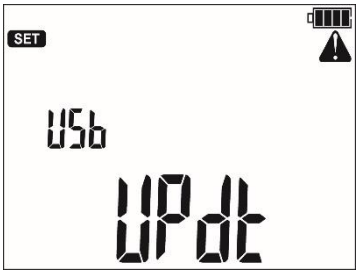


Turn on the meter by pressing and holding the **MENU** button.

Using the ◄ and ► buttons display the following screen.



Connect the meter to the computer using an USB cable and press **ENTER**.



Follow the instructions of the software.

7 Power supply of the meter

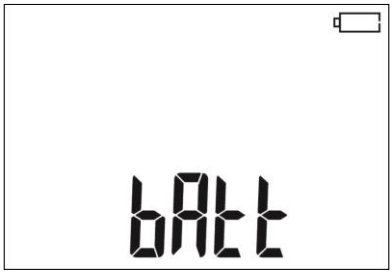
7.1 Monitoring the power supply voltage

ATTENTION!
To display the correct battery discharge status, first completely discharge and then fully recharge the battery.

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

Batteries charged

Batteries almost discharged.



Batteries are fully discharged.
The meter switches off automatically.

7.2 Battery power

The meter is powered with a Li-Ion battery which may only be replaced by Sonel or an authorized Sonel service center.

NOTE:
In MIC-5010 up to SN: B20319 and MIC-5005 up to SN: B10644 gel batteries are used.

The internal charger is powered from a 120/240 V AC mains supply with supplied power cord. It is also possible to power the unit from a car accessory socket using an optional 12 V / 120-240 VAC converter.

ATTENTION!
Do not power the meter from sources other than those listed in this manual.

7.3 Charging rechargeable battery

To charge the battery simply connect the power cord or 12V car accessory socket adapter. The charging status is indicated by the battery symbol. A complete charge takes approx. 7 hours. Full charge is indicated by a full battery symbol, and a green LED. Once charge is complete turn the device off, and unplug the meter from the power cord or adapter.

Note:

- Mains interferences can prevent full charging of batteries. If charging time is too short turn the meter off and start charging again.

Additional information displayed by the meter

Indication	Condition
Green LED flashing once per second, + the battery symbol displayed on the screen.	Charging in progress.
GreenLED on continuously, + the full battery symbol displayed on the screen.	Charging finished.
Green LED flashing twice per second.	Charging error.
Green LED and flashing battery symbol twice per second, + the OL symbol displayed on the screen.	Battery temperature too high. Measurements are stopped.

7.4 Mains power

It is possible to make measurements during the charging process: in charge mode, press the **ESC** button - the meter enters the measurement mode while continuing the charging process.

When the meter is turned off by  button or by Auto-OFF, the charging process continues provided the power cord or adapter is connected to power.

Additional information displayed by the meter

Indication	Condition
All the segments off the battery symbol flashing once per second.	Charging finished.
Green LED and battery symbol flashing twice per second, + the OL and LOW BATT symbols are displayed on the screen.	Battery temperature too high. Measurements are stopped.

7.5 General principles for using Li-Ion rechargeable batteries

- Store the half-charged battery pack in a plastic container placed in a dry, cool and well ventilated place and protect them from direct sunlight. The battery pack may be damaged if stored when fully discharged. The ambient temperature for prolonged storage should be maintained within the range of 5°C…25°C.
- Charge the batteries in a cool, well-ventilated place at a temperature of 10°C ... 28°C. Modern fast chargers detect both too low and too high temperature of rechargeable batteries and react to the situation adequately. Too low temperature should prevent starting the process of charging, which might irreparably damage rechargeable batteries. The increase in temperature of the battery pack may cause electrolyte leakage and even its ignition or explosion.
- Do not exceed the charging current, as it may result in ignition or "swelling" of the battery pack. "Swollen" battery pack must not be used.
- Do not charge or use the batteries in extreme temperatures. Extreme temperatures reduce the lifetime of rechargeable batteries. Always observe the rated operating temperature. Do not dispose the battery pack into fire.
- Li-Ion cells are sensitive to mechanical damage. This kind of damage may cause its permanent damage and thus - ignition or explosion. Any interference in the structure of Li-ion battery pack may cause its damage. This may result in the ignition or explosion. A short-circuit of the battery poles "+" and "-" may permanently damage the battery pack or even cause its fire or explosion.
- Do not immerse Li-Ion battery in liquids and do not store in humid conditions.
- If the electrolyte contained in the Lithium-Ion battery pack, contacts eyes or skin, immediately rinse the affected place with plenty of water and consult a doctor. Protect the battery against unauthorised persons and children.
- When you notice any changes in the Lithium-Ion battery pack (e.g. changes in colour, swelling, excessive temperature), stop using the battery pack. Li-Ion batteries that are mechanically damaged, overcharged or excessively discharged are not suitable for use.
- Any misuse of the battery may cause its permanent damage. This may result in the ignition. The seller and the manufacturer shall not be liable for any damages resulting from improper handling Li-Ion battery pack.

7.6 General principles for using gel (lead) rechargeable batteries

- Store the rechargeable batteries in a dry, cool and well ventilated place and protect them from direct sunlight. Do not install them in a tightly closed container. While charging the batteries may produce flammable gases, which may be the cause of explosion if proper ventilation is not available. The best temperature for battery storage and operation is between 15°C and 25°C.
- Do not place batteries near equipment generating sparks, or store them in dusty areas.
- Do not connect the battery to any plastic elements or housing elements containing solvents. This may cause the battery body to unseal or crack.
- During storage of lead batteries they are self-discharged. The storage time without charging is dependent on ambient temperature: from 6 months at 20 °C to 2 months at 40 °C. In order to prevent excessive battery discharge, resulting in a significant reduction of their capacity and durability it is required to recharge them in specified intervals.
- Do not discharge the battery to a voltage below that, specified by its manufacturer. An attempt to recharge an over-discharged battery may cause a thermal hazard, which results in battery deformation or in change of the structure and distribution of the electrolyte in the battery as some of the water evaporates. This worsens the battery parameters similar to prolonged overcharging. Always recharge the battery immediately after discharging, even if it was not discharged to the recommended cut off voltage. Leaving a discharged battery for a couple of hours (sometimes even less than that if the discharge was very deep) will cause sulphating.
- Charging may only be performed using a charger with specific parameters and under the conditions set by their manufacturers. Failure to meet these conditions can lead to leakage, overheating or even an explosion.

8 Cleaning and maintenance

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

The outside of the 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 probes with water and dry them. Before storing probes for long periods it is recommended to coat it with any machine lubricant to prevent corrosion.

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

The electronic system of the meter does not require maintenance.

9 Storage

When storing the meter:

- 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.
- If meter is to be stored for a prolonged periods, remove the batteries.

10 Dismantling and utilisation

- 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.

11 Technical specifications

11.1 Basic data

⇒ The abbreviation "m.v." used in the specification of accuracy denotes a standard measured value

AC / DC voltage measurement

Display range	Resolution	Accuracy
0.0 V to 29.9 V	0.1 V	±(2 % m.v. + 20 digits)
30.0 V to 299.9 V	0.1 V	±(2 % m.v. + 6 digits)
300 V to 600 V	1 V	±(2 % m.v. + 2 digits)

- Frequency range: 45 to 65Hz

Measurement of insulation resistance

Test voltage accuracy (R_{obc} [Ω] ≥ 1000*V_N [V]): 0…+5% or 0…+10% of the set value
Measuring range according to IEC 61557-2: 50 kΩ to 15.0 TΩ (I_{ISOnom} = 1.2 mA or 3 mA)

DC and increasing voltage measurement (SV) for V_{ISO} = 5 kV

Display range	Resolution	Accuracy
000 kΩ to 999 kΩ	1 kΩ	± (3 % m.v. + 10 digits)
1.00 MΩ to 9.99 MΩ	0.01 MΩ	
10.0 MΩ to 99.9 MΩ	0.1 MΩ	
100 MΩ to 999 MΩ	1 MΩ	
1.00 GΩ to 9.99 GΩ	0.01 GΩ	
10.0 GΩ to 99.9 GΩ	0.1 GΩ	
100 GΩ to 999 GΩ	1 GΩ	± (3.5 % m.v. + 10 digits)
1.00 TΩ to 9.99 TΩ	0.01 TΩ	± (7.5 % m.v. + 10 digits)
10.0 TΩ to 15.0 TΩ	0.1 TΩ	± (10 % m.v. + 10 digits)

- The accuracies shown above are the “worst” values calculated for the top range values. The lower the reading, the higher the accuracy.
- Accuracy for any measuring voltage and each result can be calculated from the following formula:

$$\delta_R = \pm(3\ \% + (V_{ISO}/(V_{ISO} - R_{zm} \cdot 21 \cdot 10^{-12}) - 1) \cdot 100\ \%) \pm 10 \text{ digits}$$

where:

V_{ISO} – voltage at which the measurement is conducted [V]
R_{zm} – measured resistance [Ω]

Approximate maximum values of the measured resistance, depending on the test voltage, are presented in the table below.

Voltage	Test range
250 V	500 GΩ
500 V	1 TΩ
1000 V	2.00 TΩ
2500 V	5.00 TΩ
5000 V	15.0 TΩ

⇒ **Note:** For insulation resistance below R_{ISOmin} there is no accuracy specified because the meter works with an adjustable current limit in accordance with the following formula:

$$R_{ISO\,\min} = \frac{V_{ISOnom}}{I_{ISOnom}}$$

where:

R_{ISOmin} - minimum insulation resistance measured without limiting the converter current
V_{ISOnom} - nominal test voltage
I_{ISOnom} - nominal converter current (1.2 mA or 3 mA)

- Additional error in the three-lead measurement (impact of G terminal): 0.05% with reduced current leakage incurred by 250 kΩ resistance during 100 MΩ measurement with 50 V measurement voltage.
- Max. short-circuit current I_{ISO}: 3.6 mA ±15 %.
- I_{SC} current in the remaining load range shall be selected from the following values: 1.2 mA, 3 mA.

Measurement of leakage current

Display range	Resolution	Accuracy
0.01 nA to 9.99 nA	0.01 nA	± (1.5% m.v. + 2 digits)
10.0 nA to 99.9 nA	0.1 nA	
100 nA to 999 nA	1 nA	
1.00 uA to 9.99 uA	0.01 uA	
10.0 uA to 99.9 uA	0.1 uA	
100 uA to 999 uA	1 uA	
1.00 mA to 9.99 mA	0.01 mA	

Measurement of capacitance

Display range	Resolution	Accuracy
0 nF to 999 nF	1 nF	± (5% m.v. + 5 digits)
1.00 µF to 49.99 µF	0.01 µF	

- Measurement of capacitance is available only during R_{ISO} measurement (when discharging the object).
- Accuracy of measurement is met for the tested capacitance connected in parallel with a resistance greater than 10 MΩ.
- For measurement voltages below 100 V the measurement error is not specified.

MIC-5010 **Measurement of continuity of protective conductors and equipotential bondings with ±200 mA current**

Measuring range according to IEC 61557-4: 0.12 Ω…999 Ω

Display 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 999 Ω	1 Ω	±(4 % m.v. + 3 digits)

- Voltage at open terminals: 4 V to 24 V
- Output current at R<15 Ω: min. 200 mA (I = 200 mA...250 mA)
- Current flowing bidirectionally, average resistance is displayed on the screen
- Compensation of test leads resistance, autozeroing

11.2 Other technical data

a) type of insulation acc. to EN 61010-1 and IEC 61557 ..... double
b) measurement category acc. to EN 61010-1 ..... IV 600 V (III 1000 V)
c) ingress protection acc. to EN 60529
- open enclosure IP40
- closed enclosure IP67

d) power supply of the meter
- mains ..... 90 V ÷ 260 V 50 Hz/60 Hz
- MIC-5005 up to serial number B10644 ..... gel rechargeable battery 12 V
- MIC-5005 serial number prefix B1 (from B10645) ..... Li-Ion rechargeable battery 14.8 V 5.3 Ah
- MIC-5005 serial number prefix LX ..... akumulator LiFePO4 13.2 V 5.0 Ah
- MIC-5010 up to serial number B20319 ..... gel rechargeable battery 12 V
- MIC-5010 serial number prefix B2 (from B20320) ..... Li-Ion rechargeable battery 14.8 V 5.3 Ah
- MIC-5010 serial number prefix LY ..... akumulator LiFePO4 13.2 V 5.0 Ah

e) dimensions ..... 390 x 308 x 172 mm / 15.4 x 12.1 x 6.8 in
f) meter weight .....
- with gel battery ..... approx. 7 kg / 15.4 lbs
- with Li-Ion battery ..... approx. 5.6 kg / 12.3 lbs
- with LiFePO4 battery ..... approx. 6 kg / 13.2 lbs

g) storage temperature ..... -25°C...+70°C / -13°F to +158°F
h) operating temperature ..... -20°C...+50°C / -4°F to +122°F
i) humidity ..... 20%...90%
j) altitude (above sea level) ..... ≤3000 m / 9842 ft
k) reference temperature ..... +23°C ± 2°C / +73°F ± 4°
l) reference humidity ..... 40%...60%
m) display ..... LCD, segment-type
n) number of R_{ISO} measurements, acc. to EN 61557-2 with battery power supply ..... min. 1000
o) time of operation on a single battery charge
- for R_{ISO}=5 MΩ, U_{ISO}=5 kV, T=(23±5)°C ..... up to 6 h*

p) memory of measurement results ..... 990 cells
q) data transmission ..... USB connection or wireless (Bluetooth / OR-1 receiver)
r) quality standard ..... design, construction and manufacturing are ISO 9001 compliant
s) the device meets the requirements of ..... EN 61010-1 and IEC 61557 standards
t) the product meets EMC requirements (immunity for industrial environment) according to the following standards ..... EN 61326-1 and EN 61326-2-2

*Depends on the temperature and condition of the battery.

ATTENTION!

MIC-5010 / 5005 meters are classified in terms of Electromagnetic Compatibility (EMC) as instruments of Class A (for use in industrial environments - according to EN 50011). Interferences, impacting the operation of other devices must be taken into account when the meters are used in other environments (e.g. domestic).

Note:

SONEL S.A. hereby declares that the radio device type MIC-5010/5005 complies with Directive 2014/53/EU. The full text of the EU Declaration of Conformity is available at the following website address: https://sonel.pl/en/download/declaration-of-conformity/

11.3 Additional data

Data on additional uncertainties are useful mainly when the meter is used in non-standard conditions and for metrological laboratories for the purpose of calibration.

11.3.1 Additional uncertainties according to IEC 61557-2 (R_{ISO})

Significant parameter	Designation	Additional uncertainty
Position	E_1	0 %
Supply voltage	E_2	2% (**BAT**is not lit)
Temperature 0°C...35°C	E_3	6 %

11.3.2 MIC-5010 Additional uncertainties according to IEC 61557-4 (R_{CONT})

Significant parameter	Designation	Additional uncertainty
Position	E_1	0 %
Supply voltage	E_2	0.2% (**BAT**is not lit)
Temperature 0...35°C	E_3	1 %

12 Manufacturer

Contact the manufacturer for warranty and post-warranty service:

SONEL S.A.
Wokulskiego 11
58-100 Świdnica
Poland
tel. +48 74 884 10 53 (Customer Service)
e-mail: customerservice@sonel.com
web page: www.sonel.com

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

WARNINGS AND GENERAL INFORMATION DISPLAYED BY THE METER

ATTENTION!

Connecting voltage higher then 600 V, between any of the test terminals may damage the meter and cause a hazard to the user.

	Test voltage is present on terminals of the meter.
	You must consult the manual.
READY	The meter is ready for measurement.
NOISE!	This message displayed during or after the measurement indicates major noise in the system during the measurement. The measurement result may be affected by additional uncertainty.
Vn>50V (for DC voltage) or **Vn~>500V** (for AC voltage) + continuous two-tone beep + red LED flashing	During the measurement, a voltage appeared or the object cannot be discharged for 30 seconds. After 5 seconds the meter returns to its default state - voltmeter.
LIMIT I!	Activation of current limit. The symbol displayed is accompanied by a continuous beep.
HiLE	Breakdown of the tested object insulation, the measurement is interrupted. The message appears after displaying **LIMIT I!** for 20 s during the measurement, when voltage previously reached the nominal value.
AUTO-ZERO	Resistance compensation completed for test leads.
 bAtt	Battery Status: Fully charged Battery discharged Battery discharged Charge battery.

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