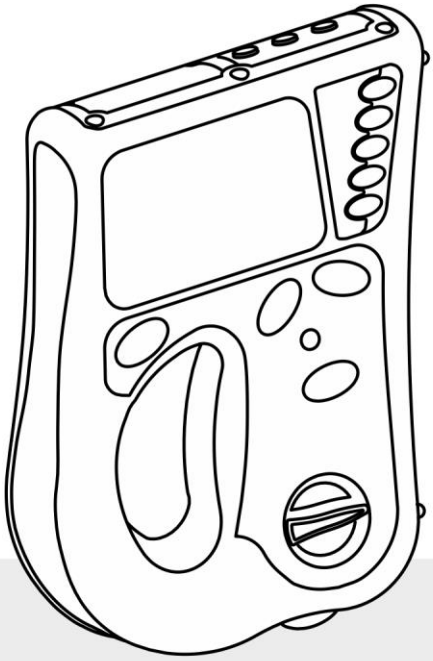
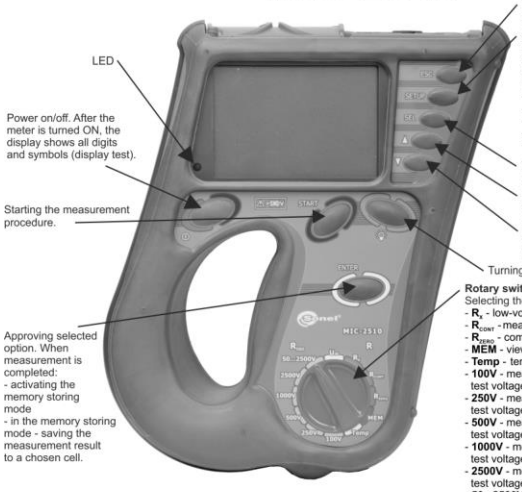


USER MANUAL

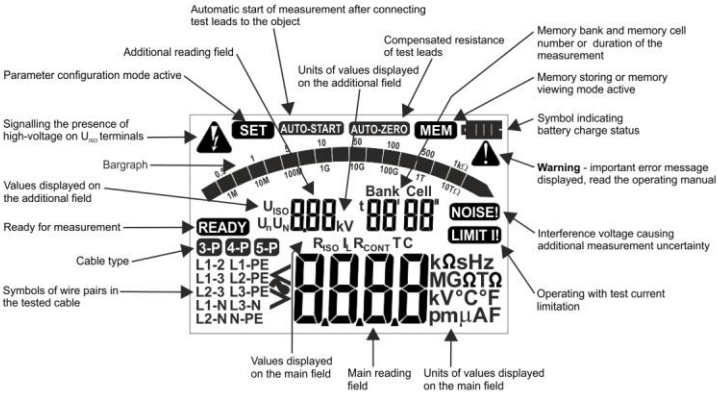
INSULATION RESISTANCE METER

MIC-2510

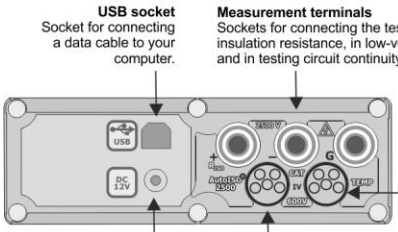
MIC-2510



DISPLAY



VIEW FROM THE TERMINALS



USER MANUAL

INSULATION RESISTANCE METER
MIC-2510

SONEL S.A.
Wokulskiego 11
58-100 Świdnica

Version 1.13 14.10.2021

MIC-2510 meter is a modern, easy and safe measuring device. Please acquaint yourself with the present manual in order to avoid measuring errors and prevent possible problems related to operation of the meter.

CONTENTS

1 Safety

MIC-2510 meter is designed for performing check tests of protection against electric shock in mains systems. The meter is used for making measurements and providing results to determine safety of electrical installations. Therefore, in order to provide conditions for correct operation and the correctness of the obtained results, the following recommendations must be observed:

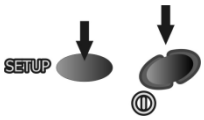
- Before you proceed to operate the meter, acquaint yourself thoroughly with the present manual and observe the safety regulations and specifications determined by the producer.
- Any application that differs from those specified in the present manual may result in a damage to the device and constitute a source of danger for the user.
- MIC-2510 meters must be operated only by appropriately qualified personnel with relevant certificates authorizing the personnel to perform works on electric systems. Operating the meter by unauthorized personnel may result in damage to the device and constitute a source of danger for the user.
- During measurements of insulation resistance, dangerous voltage up to 2.5 kV occurs at the ends of test leads of the meter.
- Before the measurement of insulation resistance you must be sure that tested object is disconnected from the power supply.
- During the measurement of insulation resistance do not disconnect test leads from the tested object before the measurement is completed (see par. 3.1); otherwise the capacitance of the object will not be discharged, creating the risk of electric shock.
- Using this manual does not exclude the need to comply with occupational health and safety regulations and with other relevant fire regulations required during the performance of a particular type of work. Before starting the work with the device in special environments, e.g. potentially fire-risk/explosive environment, it is necessary to consult it with the person responsible for health and safety.
- It is unacceptable to operate the following:
  - ⇒ a damaged meter which is completely or partially out of order,
  - ⇒ a meter with damaged test leads insulation,
  - ⇒ a meter stored for an excessive period of time in disadvantageous conditions (e.g. excessive humidity). If the meter has been transferred from a cool to a warm environment with a high level of relative humidity, do not start measurements until the meter is warmed up to the ambient temperature (approximately 30 minutes).
- Displayed **BATT** symbol indicates insufficient voltage of power supply and the need to charge the accumulator or replace batteries.
- Symbols **Err*X***, where ***X*** is a number 1…9, indicate incorrect operation of the meter. If after restarting the device this situation is repeated - it indicates that the meter is damaged.
- If after switching ON and displaying software version, message dAtE is displayed and the meter switches OFF - send the meter for servicing. When dAtE is displayed every time after the meter is switched ON, but the meter enters the measurement mode – update its software.
- Before measurement, choose a correct measurement function and make sure that test leads are connected to respective measuring terminals.
- Do not operate a meter with an open or incorrectly closed battery (accumulator) compartment or power it from other sources than those specified in the present manual.
- $\mathbf{R_{ISO}}$ inputs are electronically protected against overloads (caused by e.g. connecting the meter to a live circuit) up to 600 V for 60 sec.
- Repairs may be carried out only by an authorized service point.

Note:
Due to continuous development of the meter's software, the actual appearance of the display, in case of some of the functions, may slightly differ from the display presented in this operating manual.

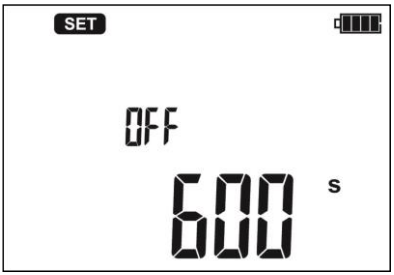
Note:
An attempt to install drivers in 64-bit Windows 8 may result in displaying "Installation failed" message.
Cause: Windows 8 by default blocks drivers without a digital signature.
Solution: Disable the driver signature enforcement in Windows.

2 Meter Configuration

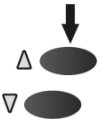
1



Turn on the meter keeping **SETUP** button pressed.

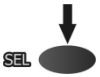


2

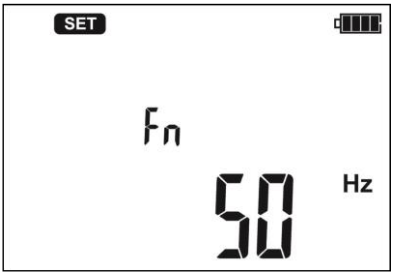


Use △ and ▽ buttons to set the auto-off time or to inactivate this function (horizontal lines – Auto-OFF function is inactive). Auto-OFF function is used to turn-off inactive meter after a preselected time.

3



Press **SEL** button to enter the setting of nominal network frequency.



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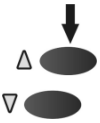
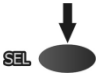
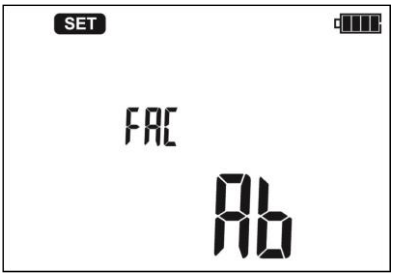


Use Δ and ∇ buttons to set the frequency value.

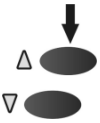
5



Press **SEL** button to enter the setting the type of absorption coefficients.

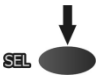


6

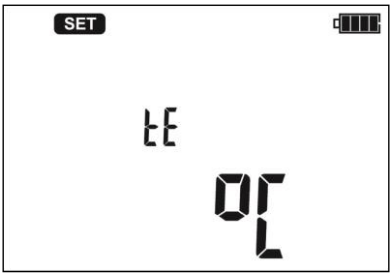


Use Δ and ∇ sto set Ab1, Ab2 parameters (Ab) or PI, DAR (PI).

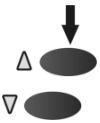
7



Press **SEL** button to enter the setting of the temperature unit.

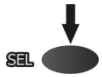


8

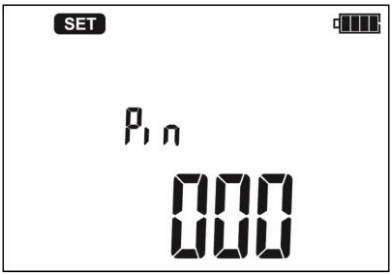


Use Δ and ∇ buttons to set the temperature unit (°C or °F).

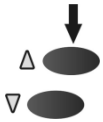
9



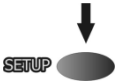
Press **SEL** button to enter the setting of PIN code.



10



Use Δ and ∇ buttons to set the value of each digit.

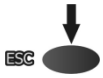


Use **SETUP** button to move between digits.

The same code must be entered in the computer programme for wireless transmission. It is used to prevent access of unauthorized persons to the meter via wireless connections (external entities).

11

Press **ENTER** to display the measurement screen, approving introduced changes (additionally t1, t2 and t3 times will be modified for $\mathbf{R_{Iso}}$: for **Ab1/Ab2** t1=15s, t2=60, t3=0, while for **PI/DAR** t1=30, t2=60, t3=0) or…



…press **ESC** to go to the measurement screen without validating the changes.

3 Measurements

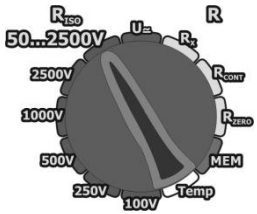
3.1 Measurement of insulation resistance

WARNING:
The object tested must not be live.

Attention:
During measurement, especially of high resistances, make sure that test leads do not touch each other and the probe (crocodile clips), because such a contact may cause the flow of surface currents resulting in additional error in measurement results.

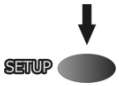
3.1.1 Double-lead measurement

1



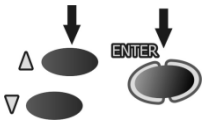
Set the rotary switch of function selection at one of $\mathbf{R_{ISO}}$, choosing measurement voltage (on position **50...2500V** selected with 10V step). The meter is in the voltage measurement mode.

2

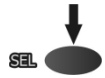


Press **SETUP** button to select time used for calculating the absorption coefficients t1, t2, t3 and the interval between the characteristic points.
For the position **50...2500V** of the selector an additional option is available to select the measuring voltage U_N.

3

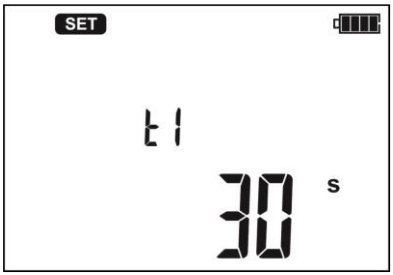


Use △ and ▽ set U_N value and confirm by pressing **ENTER** or

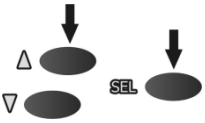


use **SEL** button to enter the setting of times for calculating the absorption coefficients.

4

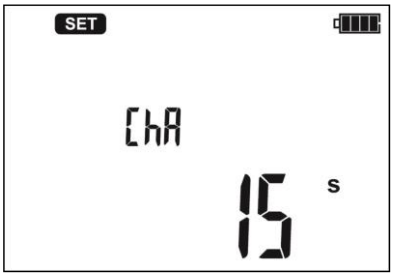


5

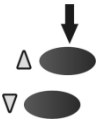


Use △ and ▽ to set the value of t1, press **SEL** button to start setting of t2, and then t3. Press **SEL** again to enter the setting of time interval of recording $\mathbf{R_{ISO}}$ characteristics.

6

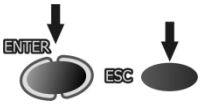


7



Use △ and ▽ to set the interval (15, 30 or 60 sec.). Horizontal lines indicate unavailability of recording characteristics.

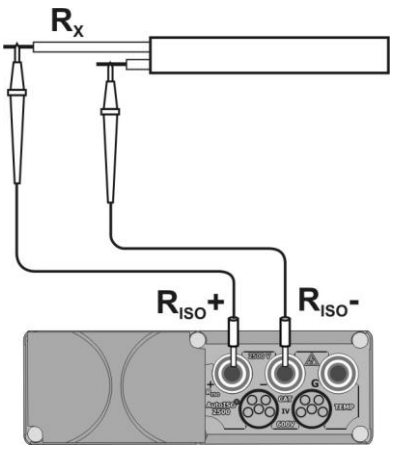
8



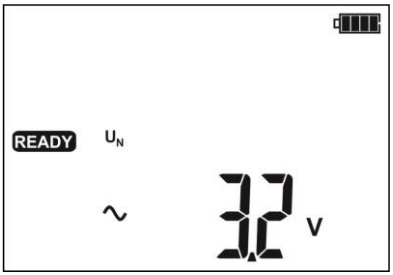
Press **ENTER** to confirm settings (confirmed by beep) or press **ESC** to leave without saving the changes.

Connect test leads according to the drawing.

9



10

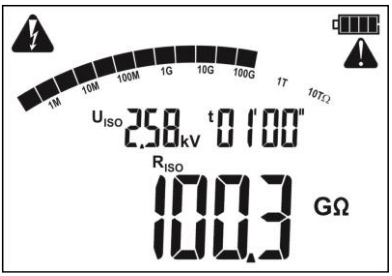


The meter is ready for measurement.

11

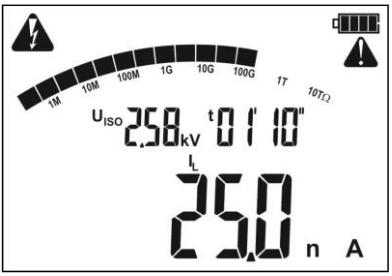
Press and hold **START** push-button. The measurement is performed continuously until you release the button or the pre-set time is reached.

In order to maintain (block) the measurement press **ENTER** while holding **START** button pressed - a triangle with an exclamation mark will be displayed indicating about automatic measurement, now the buttons may be released. In order to interrupt the measurement, press **START** or **ESC**.

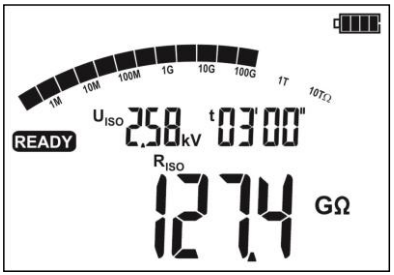


View of the screen during measurement. The triangle displayed on the right side means that the measurement was started with **ENTER** button.

Using **SEL** you may display the leakage current I_L.

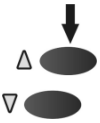


(12)



After the measurement is completed or stopped, read the result. The results of all completed measurements will be displayed (even when the measurement was interrupted/stopped e.g. after 60 seconds).

(13)



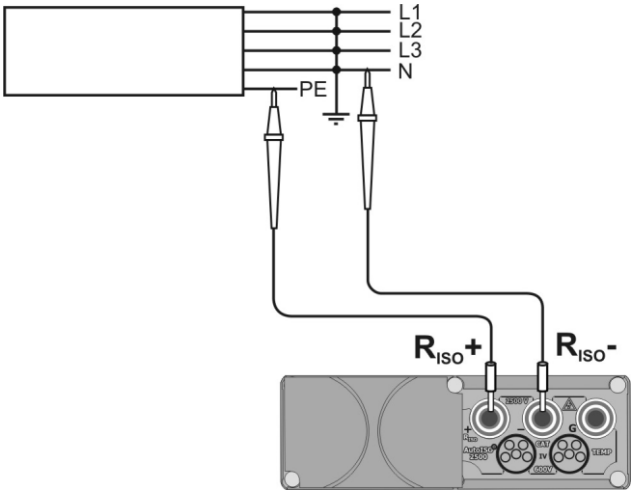
Use Δ and ∇ to see individual components of the result in the following order: R_{ISO}→I_L→Ab2→Ab1→ Rt3→It3→Rt2→It2→Rt1→It1→C→R_{ISO}, where C - the capacity of the tested object.
If the measurement is stopped, the displayed values will present the results of partial measurements that have been completed and "---" will represent uncompleted partial measurements.
If the characteristic was measured, then the measurement results may be read between the It1 and C.

Note:

During measurements of insulation resistance, dangerous voltage up to 2.5 kV occurs at the ends of test leads of MIC-2510 meter.

It is forbidden to disconnect test leads before the measurement is completed. Failure to obey the above instruction will lead to high voltage electric shock and make it impossible to discharge the tested object.

- Disabling t2 will also disable t3.
- Timer measuring the measurement time is started when U_{ISO} voltage is stabilized.
- Symbol **LIMIT** means operation with limited converter current. If this condition persists for 20 seconds the measurement is interrupted.
- If the timer reaches characteristic points (tx times or characteristic times), then for 1s instead U_{ISO} a symbol of this point is displayed which is accompanied by a long beep.
- If any of the measured values of partial resistance is out of range, the value of the absorption coefficient is not displayed – the display shows dashes.
- During the measurement LED is lit in yellow.
- After completion of measurement, the capacitance of the tested object is discharged by shorting **R_{ISO}+** and **R_{ISO}-** terminals with resistance of 100 kΩ.
- If while viewing the results, voltage is applied to **R_{ISO}** terminals, then LED will light up red.
- In case of power cables measure the insulation resistance between each conductor and other conductors shorted and grounded (figure below).



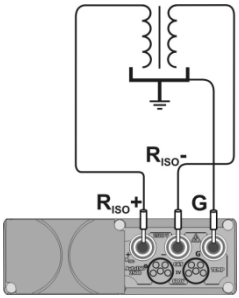
Additional information displayed by the meter

	Test voltage is present on terminals of the meter**.**
NOISE!	Interference voltage higher than 25V but lower than 50V, is present on the tested object. Measurement is possible but may be burdened with additional uncertainty.
READY disappears, LED lights red, two-tone beep	Interference voltage higher than 50V is present on the tested object. The measurement is blocked.
LIMIT I!	Activation of current limit. The symbol displayed is accompanied by a continuous beep.
ErrHiLE	Breakdown of the tested object insulation, the measurement is interrupted. The message appears after displaying **LIMIT I!** for 20s during the measurement, when voltage previously reached the nominal value.
ErrUdEt LED is lit in red, two-tone acoustic signal	During the measurement, AC voltage appeared or the object cannot be discharged for 30 seconds. After 5 seconds the meter returns to its default state - voltmeter.

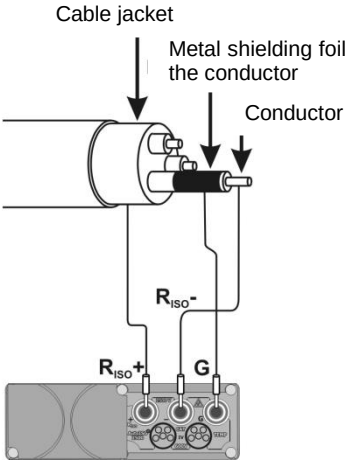
3.1.2 Three-lead measurement

In order to eliminate the influence of surface resistance in transformers, cables, etc. a three-lead measurement is used. For example:

- at the measurement of inter-winding resistance of a transformer, **G** socket of the meter should be connected to the transformer tank;



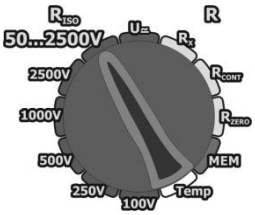
- when measuring insulation resistance between one of the cable conductors and the cable jacket, the effect of surface resistances (important in difficult weather conditions) is eliminated by connecting a piece of metal foil wounded around the insulation of the tested conductor with **G** socket of the meter;



The same shall apply when measuring the resistance between two conductors of the cable, attaching to **G** terminal other conductors that do not take part in the measurement.

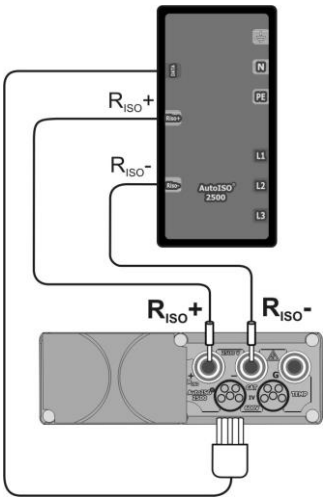
3.1.3 Measurement with AutoISO-2500 adapter

1



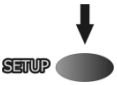
Set the rotary switch of function selection at one of **R_{ISO}** position, choosing measurement voltage (on position **50...2500V** selected with 10V step). The meter is in the voltage measurement mode.

2



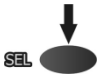
Connect AutoISO-2500 adapter. The meter automatically detects this state, adding to the configuration menu an additional option for choosing the cable type. But the option of recording characteristics is removed.

3



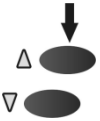
With switch in **50...2500V** position go to selecting the test voltage U_N by pressing **SETUP**.

4

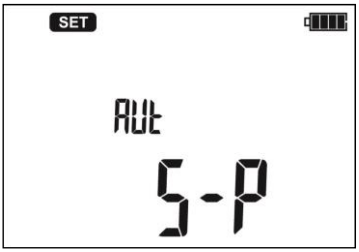


After setting U_N as in double-lead measurement, press **SEL** button to set the type of the cable.

5



Use Δ and ∇ to set the type of cable: 3-P, 4-P, 5-P (for objects up to 1kV) or H3-P, H4-P, H5-P (for power cables). The figure means the number of cable conductors.

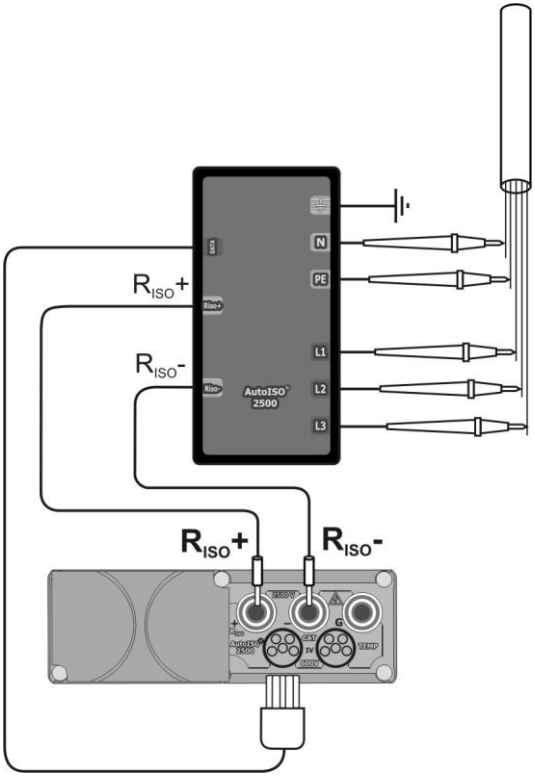


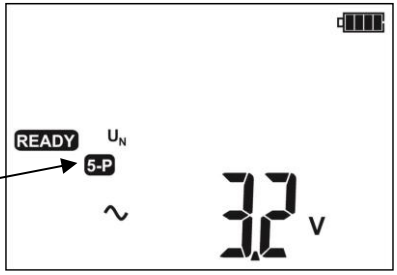
6 Set times for calculating the absorption coefficients as in double-lead measurement.

7 

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

8 Connect AutoISO-2500 adapter to the tested cable.



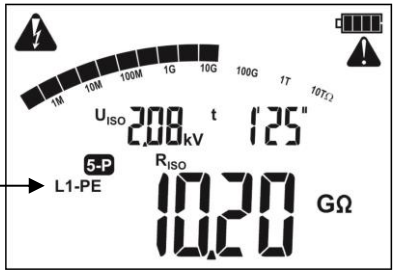
9 

The meter is ready for measurement.

For H3-P, H4-P and H5-P-P the symbol flashes every 0.5 seconds

(10)

Press **START** button to initiate the measurement (no need to hold it, the measurement is done automatically). First, checking of voltages on particular pairs of conductors is performed. If any of the voltages exceeds the permissible value, then it is displayed on the display, LED lights red and the measurement is cancelled (exceeding U_{L1-N} voltage prevents commencing the measurement).
The measurement is performed continuously until the meter reaches the preset time for the last pair of conductors.



View of the screen during measurement.

Symbol (mnemonic) of currently measured pair of conductors

Note:

- The meter detects AutoISO connection for approx. 1 sec.
- After connecting AutoISO, a default voltage measurement is performed on a pair of conductors L1-N, for all types of conductors
- For power cables PE means earthing cable.
- In case of measurements on power cables the adapter shorts the remaining wires to E line, e.g. 5-P measurement for a power cable and indication of L1-PE pairs, means that the adapter connects line L1 to one of the meter's ISO inputs, while the contained lines L2, L3, N, PE, E are connected to the second ISO input.

Due to the fact that AutoISO-2500 adapter shorts a few input lines during measurements on power cables, it is essential to ensure that the tested cable is disconnected from external power sources. The meter checks for the presence of voltage before measurement, but it does not prevent connection of voltage during the measurement. When voltage is applied in this situation, it will cause a short circuit and will damage AutoISO-2500 module.

- Other messages, displayed symbols, results and scrolling through result components as in case of double-lead measurement, additionally - switching between results of individual pairs with **SEL** button.
- In cases of errors HiLE, **LIMIT !** the measurement is interrupted only for the current pair of conductors. Error UdEt tops the measurement.

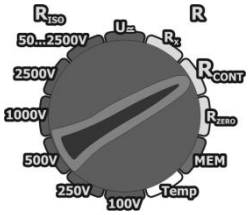
Additional information displayed by the meter

ErrAuto	During measurement the meter has detected the error related to AutoISO (e.g. disconnection).

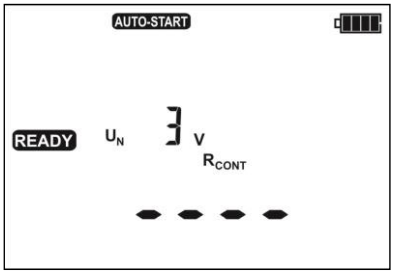
3.2 Low-voltage measurement of resistance

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

①



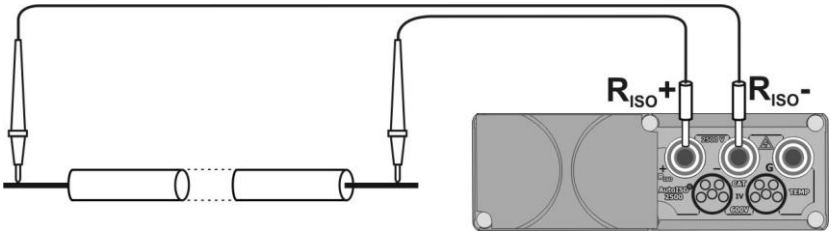
Set the rotary switch of function selection at $\mathbf{R_{CONT}}$ position.



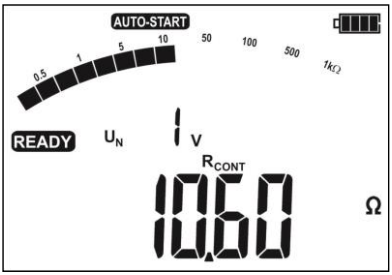
The meter is ready for measurement.

②

Connect the meter to the tested object.
The measurement starts automatically when the resistance drops by 50 times or more - for example from 1kΩ to 20Ω – the meter detects the sequence: opening (activated), and closing (triggers the measurement).
The measurement may be also triggered manually by pressing **START** push-button.



③



Read out the result.

④

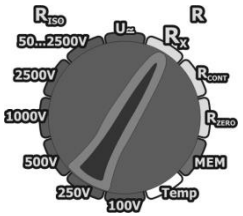
Press **START** push-button in order to start a next measurement without disconnecting test leads from the object.

Additional information displayed by the meter

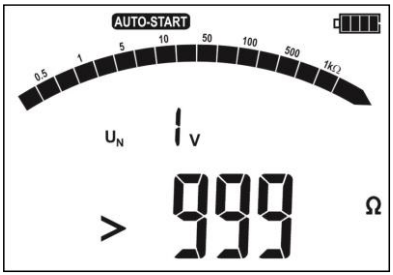
NOISE!	Interference voltage occurs on the tested object. The measurement is possible however it will be burdened with additional uncertainty that is specified in the technical data.
UdEt + two-tone, continuous beep + LED-lit in red	Interference voltage exceeds the allowable value, the measurement is blocked.

3.2.2 Measurement of resistance

1



Set the rotary switch of function selection at **R_X** position.

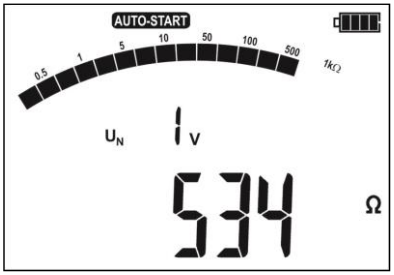


The meter is ready for measurement.

2

Connect the meter to the tested object as in par. 3.2.1. The measurement is continuous.

3



Read out the result.

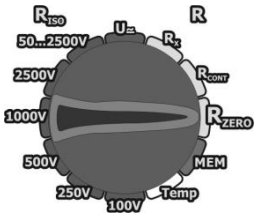
Note:

- For R <10Ω there is a continuous beep and LED lights green.
- Remarks and messages are the same as in par. 3.2.1.

3.2.3 Calibration of test leads

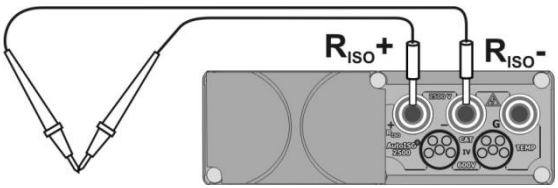
In order to eliminate the impact of the resistance of test leads on measurement result (R_{CONT} and R_X), the compensation (auto-zeroing) of resistance may be performed.

1



Set the rotary switch of function selection at R_{ZERO} position.

2

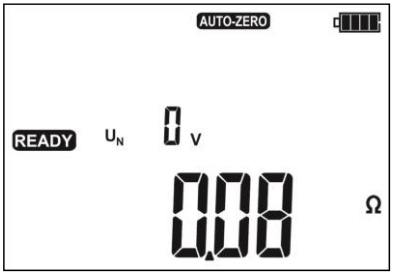


Short the test leads – **READY** message should be displayed.

3

Press **START**.

4



AUTO-ZERO message appears that confirms completion of test leads calibration.

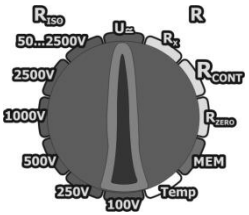
The result is a compensated value and the amendment is available for R_{CONT} and R_X. The compensation is active even after the meter is switched off and on again.

5

In order to remove the calibration made (return to default calibration), perform the above-mentioned activities with test leads open (without **READY** symbol).

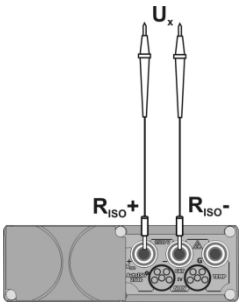
3.3 Voltage measurement

1



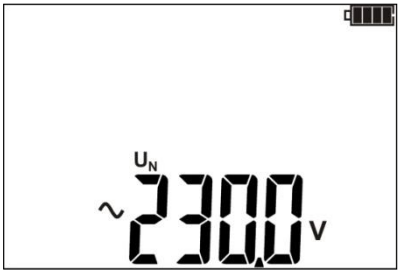
Set the rotary switch of function selection at **U** ∿ position.

2



Connect the meter to a voltage source.

3



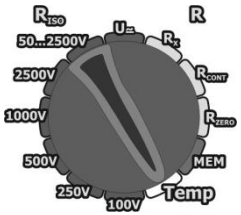
Measurement is performed in a continuous manner.

Additional information displayed by the meter

> 600 V, LED is lit in red, two-tone acoustic signal	Voltage is higher than acceptable. **Immediately** disconnect the test leads.

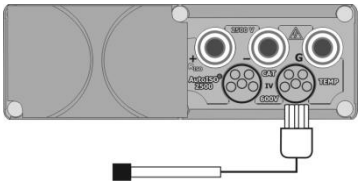
3.4 Temperature Measurement

1



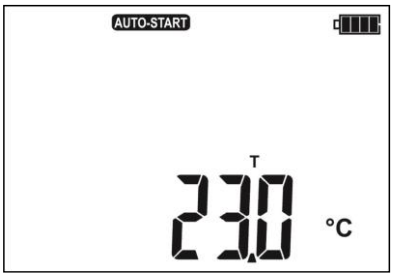
Set the rotary switch of function selection at **Temp** position.

2



Connect the temperature probe into **TEMP** socket.

3



Measurement is performed in a continuous manner.
The correct connection is confirmed by green light of LED and the result displayed on the LCD.

4 Memory of measurement results

MIC-2510 meters are equipped with a memory capable of storing 11880 single test results (990 cells, each of which may contain a set of measurements of R_{ISO} with AutoISO, R_{CONT} and temperature). The whole memory is divided into 10 memory banks with 99 cells in each bank. Thanks to dynamic memory allocation, each of the memory cells can contain different quantity of single measurement results, depending on the needs. Optimal use of the memory can be ensured in this way. Each measurement result can be stored in a memory cell marked with a selected number and in a selected memory bank. Thanks to this, the user of the meter can, at his/her option, assign memory cell numbers to individual measurement points and the memory bank numbers to individual facilities. The user can also perform measurements in any sequence and repeat them without losing other data.

Memory of measurement results **is not deleted** when the meter is switched off. Thanks to this, the data can be later read or sent to a computer. The number of a current memory cell or memory bank is not changed either.

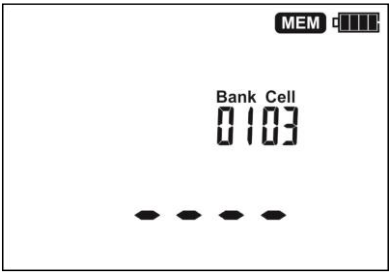
Note:

- Results of measurements performed for all measuring functions can be stored in one memory cell, excluding R_X and U ≂.
- After entering the measurement result, the number of the cell is automatically increased.
- It is recommended to delete the memory after reading the data or before performing a new series of measurements that may be stored into the same memory cells as the previous ones.

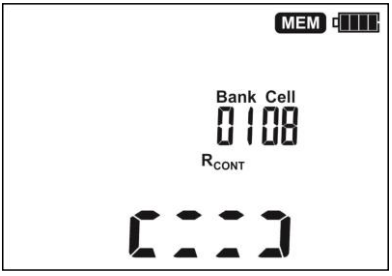
4.1 Storing the measurement results in the memory

① 

After completing measurement press **ENTER**.



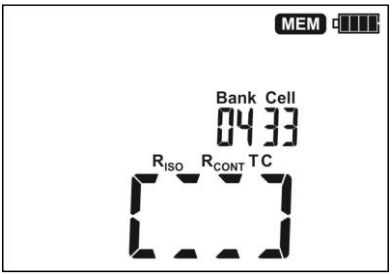
The cell is empty.



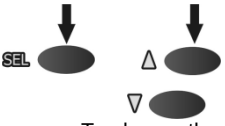
The cell is occupied, symbols of stored values are displayed.

Use **SEL** to view measurement results.

Use △ and ▽ to scroll the components of the result.

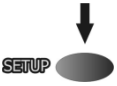


The cell is fully occupied.

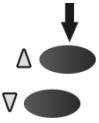


Use **SEL** to view measurement results and use △ and ▽ buttons to scroll through thee components of the result.

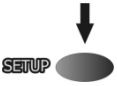
To change the cell number or bank number:

2 

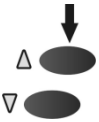
Press **SETUP** – cell number is flashing

3 

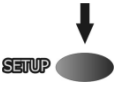
Use △ and ▽ to set desired number of the cell.

4 

Press **SETUP** – bank number is flashing.

5 

Use △ and ▽ to set the desired number of the bank.

6 

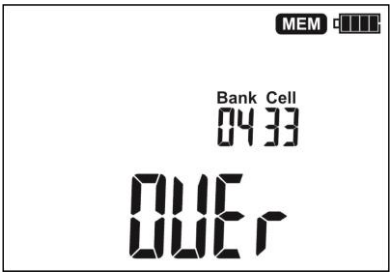
Press **SETUP** – bank number stops flashing. Results may be saved in the selected cell.

7

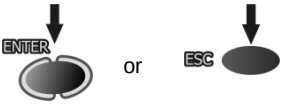
Press **ENTER**, to save the result in the memory. Saving is indicated by a triple beep and by a rectangle displayed on the main display field.

Press **ESC** to return to displayed result without saving.

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



8



Press **ENTER**, to overwrite the result or **ESC**, to cancel saving.

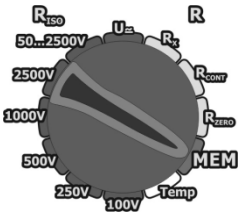
Note:

- After the measurement result is shown on the display until:
  - the rotary switch is rotated,
  - Auto-OFF function is activated,
  - the meter detects interference voltage> 50V,
  - one of the following operations is performed:
    - **ESC** button is pressed to exit to the voltmeter,
    - a next measurement is performed,
    - an entry into the memory is introduced.

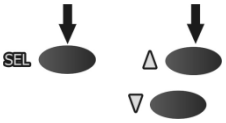
- After exiting to the voltmeter by pressing **ESC** or after saving the results to the memory, the last result may be recalled by pressing **ENTER** (even after power is turned off, providing that the switch position has not been changed).
- Complete set of results (main result and supplementary results) for a given measuring function and preset measurement settings are stored in the memory.
- In a given cell, the user may save R_{ISO} measurement result only for a single measurement or only for AutoISO-2500.
- When saving the temperature, the value currently displayed is saved.

4.2 Viewing memory data

1



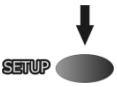
Set the rotary switch of function selection at **MEM** position.



Use **SEL** button to switch between $R_{ISO} \rightarrow R_{CONT} \rightarrow Temp \rightarrow R_{ISO}$, and buttons Δ and ∇ to scroll the components of the result.

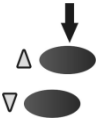
To change the cell number or bank number:

2



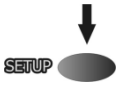
Press **SETUP** – **Cell** message is flashing

3



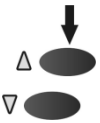
Use Δ and ∇ to set desired number of the cell.

4



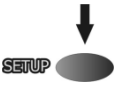
Press **SETUP** – **Bank** message is flashing.

5



Use Δ and ∇ set the desired number of the bank.

6



Press **SETUP** – **Bank** message stops flashing. Use Δ and ∇ to scroll the components of the result again.

Note:

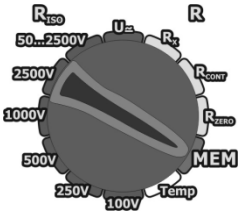
- While viewing measurement results, pressing **ESC** button has similar effect as pressing **SETUP**, but the sequence is inverted i.e. after first pressing **Bank** message is flashing.
- While viewing R_{ISO} results, the field of timer / memory displays alternately bank and cell numbers and the time in which the result was entered into memory. This applies to all R_{ISO} and I_L measurements.
- Press **ESC** to immediately display basic component of the result.
- For R_{CONT} and temperature, there is no option of scrolling through the components of the result.
- For measurements with AutoISO-2500, use **SEL** button to switch between results of individual conductor pairs and the meter is switched to R_{CONT}, T and then returns to measurements with AutoISO-2500.

4.3 Deleting memory data

You can delete the entire memory or its individual banks.

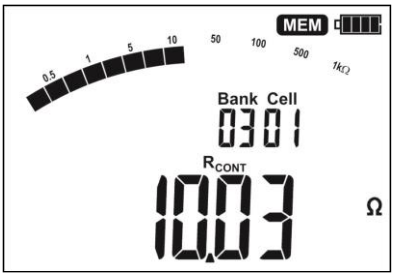
4.3.1 Deleting bank data

1

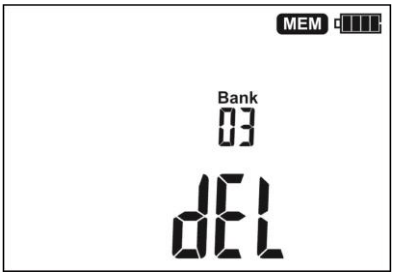


Set the rotary switch of function selection at **MEM** position.

2



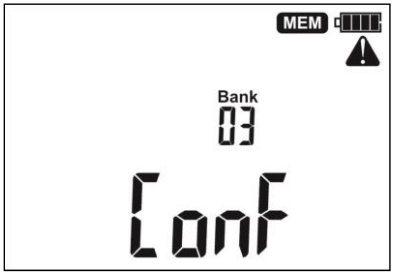
Set the bank number to be deleted acc. to section 4.2. Set the cell number before “1”...



...the cell number disappears, and appears the dEL symbol indicating the readiness to delete.

3

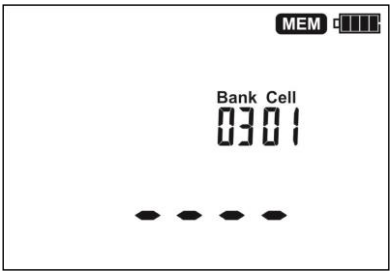
Press **ENTER** push-button.



⚠ and Conf ask you to confirm deletion.

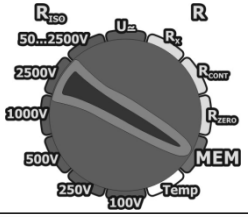
④

Press **ENTER** again.
After deleting the bank, the meter beeps three times.



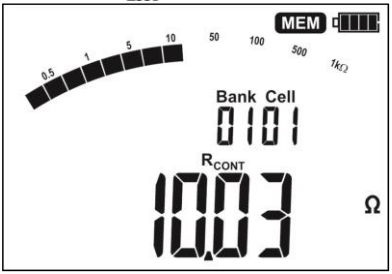
4.3.2 Deleting the whole memory

①

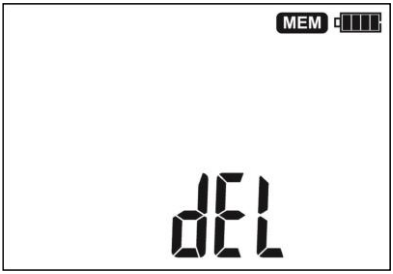


Set the rotary switch of function selection at **MEM** position.

②



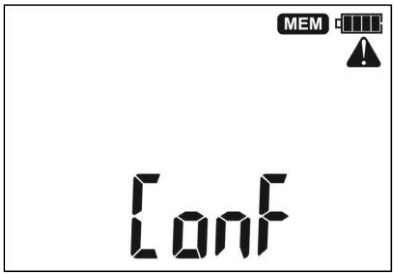
Set the bank number between “0” and “9”...



...the bank number disappears, and dEL symbol is displayed, indicating the readiness to delete.

3

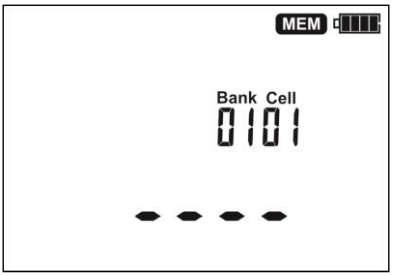
Press **ENTER** push-button.



⚠ and ConF ask you to confirm deletion.

4

Press **ENTER** again.
After deleting the memory, the meter beeps three times.



5 Data transmission

Remarks:

- Data transmission is not possible during the charging of accumulators.

5.1 Computer connection accessories

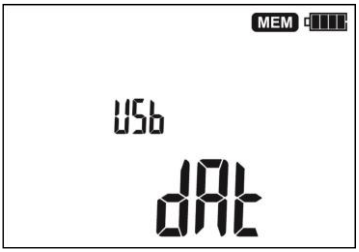
What is necessary in order to operate the meter with a computer is additional accessories, namely a USB cable or radio modul OR-1 and appropriate software. If the required accessories have not been purchased along with the meter, then they are available from the manufacturer or an authorised distributors.

The software may be used in case of many devices manufactured by SONEL S.A. which are equipped with the USB interface and/or OR-1 modul.

Detailed information regarding software is available from the manufacturer or an authorised distributors.

5.2 Data transmission with USB port

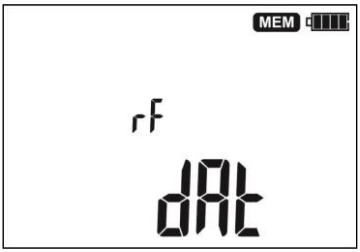
1. Set the rotational function selector at **MEM**.
2. Connect the cable to the USB port of the computer and the USB socket of the meter.



3. Start the programme.

5.3 Data transmission with OR-1 radio module

1. Set the rotary switch on **MEM** position, the radio connection is activated automatically.
2. Connect OR-1 module to the USB socket of the PC.
3. If necessary, change PIN code (par. 2).
4. Start data storing programme.



Standard pin for OR-1 is "123".

6 Software updates

Turn on the meter, holding **ENTER** and **SETUP** buttons depressed.

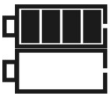
The meter displays the following screen.

After connecting the meter to a PC using a USB cable, follow the instructions of the software.

7 Meter power supply

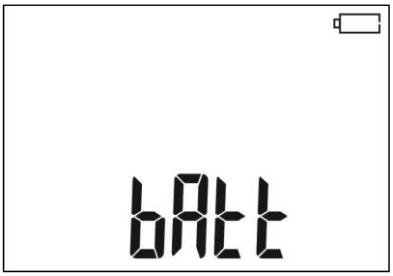
7.1 Monitoring of the power supply voltage

The charge level of rechargeable batteries is indicated by the symbol in the right upper corner of the display on a current basis:



Batteries charged.

Batteries low. Only voltage measurement is available.



Batteries fully discharged, all measurements are blocked. The meter switches off automatically after 5 sec.

7.2 Replacing rechargeable batteries

MIC-2510 meter is powered from SONEL NiMH 9.6 V battery pack, including NiMH rechargeable batteries.

Battery charger is installed inside the meter and cooperates only with the manufacturer's battery pack. The charger is powered by external power supply adapter. It can be also powered from the car cigarette lighter socket, using an optional charger.

WARNING:
If the test leads are left in the terminals during replacement of the batteries, there is a risk of electric shock with a dangerous voltage.

To replace the rechargeable batteries:
1. Disconnect the leads from the measuring circuit and turn off the meter,
2. Unscrew the 3 screws and remove the battery compartment (in the bottom of the enclosure).
3. Insert and bolt the battery compartment containing a new battery pack.

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

7.3 Charging rechargeable batteries

Charging commences once the power supply has been connected to the meter regardless of the fact whether the meter is on or off. Charging is indicated by changing status of battery charge. The rechargeable batteries are charged in accordance with the algorithm of „quick charge" – this process permits to reduce the duration of charging to approximately three hours. Completed charging process is indicated by full battery charge status and beep. In order to turn the device off, remove the power supply plug of the charger.

Note:

- As a result of interferences in the network it is possible that the process of charging of accumulators will finish too fast. When charging time is too short, turn off the meter and start charging again.

Additional information displayed by the meter

Signalling	Cause	Proceeding
Battery symbol appears as un-filled.	Temperature of the battery pack is too high!	Wait until the battery pack is cool. Start charging process again.
The symbol of unfilled battery flashes.	Emergency	Try to start the charging process again. If this does not help, it is possible that battery pack is damaged - replace it.
The symbol of full battery flashes.	An attempt of recharge fully charged battery pack was detected.	

7.4 General principles regarding using NiMH rechargeable batteries

- If you do not use the device for a prolonged period of time, then it is recommended to remove the rechargeable batteries and store them separately.

- Store the rechargeable 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. If the rechargeable batteries are stored for a long time in a high temperature, then the occurring chemical processes may reduce their lifetime.

- NiMH batteries withstand normally 500-1000 charging cycles. These batteries reach their maximum capacity after being formatted (2-3 charge/discharge cycles). The most important factor which influences the lifetime of rechargeable batteries is the level of their discharge. The deeper the discharge level of the batteries, the shorter their lifetime.

- The memory effect is limited in case of NiMH batteries. These batteries may be charged at any point with no serious consequences. However, it is recommended to discharge them completely every few cycles.

During storage of NiMH batteries they are self-discharged at the rate of approximately 30% per month. Keeping rechargeable batteries at high temperatures may accelerate this process even 100%. In order to prevent excessive discharge of rechargeable batteries, after which it would be necessary to format them, it is recommended to charge them from time to time (even if they are not used).

- Modern fast chargers detect both too low and too high a 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. An increase of the temperature of the rechargeable batteries is a signal to stop charging and is a typical phenomenon. However charging at a high ambient temperature apart from reducing batteries' lifetime causes an accelerated increase of their temperature and the result is that the batteries are not charged to their full capacity.

- Please note that when the batteries are charged with a fast-charger they are charged only to approx. 80% of their capacity - better results can be achieved by continuing charging: the charger enters trickle-charging mode and during the next few hours batteries are charged to their full capacity.
- Do not charge or use rechargeable batteries in extreme temperatures. Extreme temperatures reduce the lifetime of batteries and rechargeable batteries. Avoid placing devices powered by rechargeable batteries in very hot environments. The nominal working temperature must be absolutely observed.

8 Cleaning and maintenance

NOTE!
Apply solely the maintenance methods specified by the manufacturer in this manual**.**

The casing of the meter may be cleaned with a soft, damp cloth using all-purpose detergents. Do not use any solvents or cleaning agents which might scratch the casing (powders, pastes, etc.).

The electronic system of the meter does not require maintenance.

9 Storage

In the case of storage of the device, the following recommendations must be observed:

- Disconnect all the test leads from the meter.
- Clean the meter and all its accessories thoroughly.
- In the case the meter is to be stored for a prolonged period of time, batteries/rechargeable batteries must be removed from the device.
- In order to prevent a total discharge of the rechargeable batteries in the case of a prolonged storage, charge them from time to time.

10 Dismantling and disposal

Used electrical and electronic equipment should be collected selectively, i.e. it must not be placed with another kinds of waste.

Used electronic equipment should be sent to a collection point in accordance with the Used Electrical and Electronic Equipment Act.

Before the equipment is sent to a collection point, do not dismantle any elements.

Observe the local regulations concerning disposal of packages and used batteries/rechargeable batteries.

11 Technical specifications

11.1 Basic data

⇒ Abbreviation "m.v" used in the specification of measurement uncertainty means a standard measured value

AC / DC voltage measurement

Display range	Resolution	Basic uncertainty
0…600V	1 V	±(3% m.v. + 2 digits)

- Frequency range: 45...65Hz

Measurement of insulation resistance

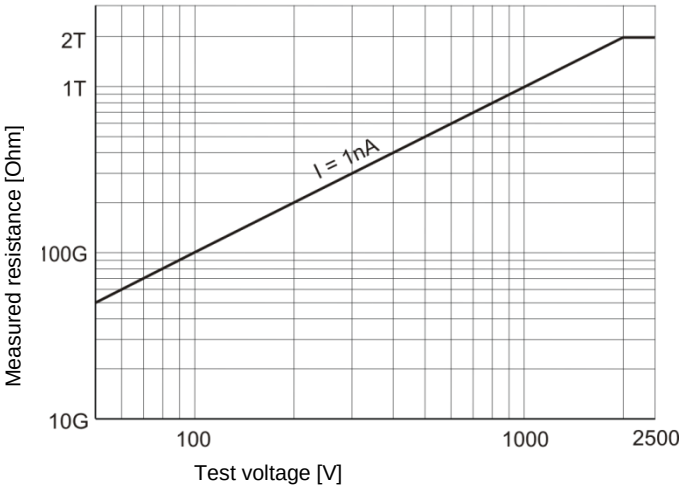
Measuring range according to IEC 61557-2: $R_{ISOmin} = U_{ISOnom}/I_{ISOnom}$ …2,000TΩ (I_{ISOnom} = 1mA)

Double-lead measurement

Display range	Resolution	Basic uncertainty
0.0 ... 999.9 kΩ	0.1 k Ω	±(3 % m.v. + 20 digits)
1.000 ... 9.999 MΩ	0.001MΩ	
10.00...99.99 MΩ	0.01 MΩ	
100.0 ... 999.9 MΩ	0.1 MΩ	
1.000 ... 9.999 GΩ	0.001 GΩ	
10.00 ... 99.99 GΩ	0.01 GΩ	
100.0...999.9GΩ	0.1 GΩ	
1.000...2.000 TΩ	0.001TΩ	

Approximate maximum values of the measured resistance, depending on the test voltage, are presented in the table below. For other voltages the range limits may be read from the chart below.

Voltage	Test range
50V	50GΩ
100V	100GΩ
250V	250GΩ
500V	500GΩ
1000V	1.00TΩ
2500V	2.00 TΩ



Measurement with AutoISO-2500

Display range	Resolution	Basic uncertainty
0.0 ... 999.9 kΩ	0.1 kΩ	± (4 % m.v. + 20 digits)
1.000 ... 9.999 MΩ	0.001MΩ	
10.00...99.99MΩ	0.01 MΩ	
100.0 ... 999.9 MΩ	0.1 MΩ	
1.000 ... 9.999 GΩ	0.001 GΩ	
10.00 ... 99.99 GΩ	0.01 GΩ	
100.0...400.0GΩ	0.1 GΩ	± (8 % m.v. + 20 digits)

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

Voltage	Test range
100V	100GΩ
250V	250GΩ
500V, 1000V, 2500V	400GΩ

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

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

where:

R_{ISOmin} - minimum insulation resistance measured without limiting the converter current
U_{ISOnom} - nominal test voltage
I_{ISOnom} - nominal inverter current (1mA)

Measurement of capacitance

Display range	Resolution	Basic uncertainty
1...999nF	1nF	±(5% m.v. + 5 digits)
1.00...9.99µF	0.01µF	

- Measurement of capacity is available only during R_{ISO} measurement (when discharging the object).

Low-voltage continuity and resistance measurement

Measurement of continuity of protective conductors and equipotential bondings with ±200 mA current

Measuring range according to IEC 61557-4: 0.10…999Ω

Display range	Resolution	Basic uncertainty
0.00...19.99Ω	0.01Ω	±(2% m.v. + 3 digits)
20.0...199.9Ω	0.1Ω	
200...999Ω	1Ω	±(4% m.v. + 3 digits)

- Voltage at open terminals: 8…16V
- Output current at R < 2 Ω: I_{SC} > 200mA
- Compensation of test leads resistance
- Measurements for both current polarizations

Measurement of resistance with low current

Range	Resolution	Basic uncertainty
0.0...199.9Ω	0.1Ω	± (2% m.v. + 3 digits)
200...999Ω	1Ω	±(4% m.v. + 4 digits)

- Voltage at open terminals: 8…16V
- Output current >10mA
- Audio signal for measured resistance <10 Ω± 10%
- Compensation of test leads resistance

Temperature Measurement

Range	Resolution	Basic uncertainty
-40.0 ... 99.9 ° C	0.1 ° C	±(3 % m.v. + 8 digits)
-40.0 ... 211.8 ° F	0.1 ° F	±(3 % m.v. + 16 digits)

- Measurement using an external probe

Other technical specifications

a) type of insulation.....double, EN 61010-1 and IEC 61557 compliant
b) measurement category ..... IV 600V (III 1000V) according to EN 61010-1
c) degree of housing protection acc. to EN 60529.....IP54
d) power supply of the meter..... SONEL L-1 battery pack 9.6 V, NiMH
e) parameters of AC adapter for the battery charge ..... 100 V…240 V, 50 Hz…60 Hz
f) dimensions ..... 260 x 190 x 60 mm
g) meter weight.....approximately 1.3 kg
h) storage temperature ..... –20...+70°C
i) working temperature ..... -10...+40°C
j) temperature range suitable for initiating battery charging ..... +10°C to +40°C
k) temperatures at which loading is interrupted..... below +5°C and above (or equal to) +50°C
l) humidity..... 20...90%
m) nominal temperature..... +23 ± 2°C
n) reference humidity ..... 40...60%
o) altitude (above sea level)..... <2000m
p) number of R_{ISO} measurements ..... approximately 800
q) display.....LCD segment
r) memory of measurement results..... 990 cells, 11880 entries
s) data transmission .....USB connection or wireless link
t) quality standard .....development, design and manufacturing are ISO 9001 compliant
u) the device meets the requirements of IEC 61557 standard
v) the product meets EMC requirements (immunity for industrial environment) according to the following standards.....EN 61326-1 and EN 61326-2-2

11.2 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.

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

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0% (**BAT** is not lit)
Temperature 0...35°C	E_3	0.1%/ºC

11.2.2 Additional uncertainties according to IEC 61557-4 (R ±200mA)

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0.5% (**BAT** is not lit)
Temperature 0...35°C	E_3	1.5%

12 Accessories

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

12.1 Standard accessories

Standard set of equipment supplied by the manufacturer includes:

- mater MIC-2510
- set of test leads:
  - 5kV leads, 1.8m, cat. IV 1000V terminated with banana plugs - 2 pcs. (red – **WAPRZ1X8REBB** and blue – **WAPRZ1X8BUBB**)
  - 5kV shielded lead, 1.8m, cat. IV 1000V, terminated with banana plugs - (black – **WAPRZ1X8BLBB**
- USB interface cable - **WAPRZUSB**
- accessories
  - 11kV crocodile clip, cat. IV 1000V – 3 pcs. (black – **WAKROBL32K09**, red – **WAKRORE32K09** and blue – **WAKROBU32K09**)
  - pin probe with banana socket – 2 pcs. (red – **WASONREOGB2** and black – **WASONBLOGB2**)
- battery pack – **WAAKU10**
- adapter for battery pack charging – **WAZASZ7**
- mains cable with IEC C7 plug – **WAPRZLAD230**
- meter harness – **WAPOZSZE2**
- carrying case L-4 – **WAFUTL4**
- user manual
- calibration certificate issued by an accredited laboratory (no accreditation)

12.2 Optional accessories

Additionally, the following items that are not included in the scope of standard equipment can be purchased from the manufacturer or the distributors:

WAPRZ005BLBBE5K

- 5m shielded lead, black, cat. IV 1000V

WAPRZ005REBB5K

- 5kV lead, 5m, red, with banana plugs

WAPRZ005BUBB5K

- 5kV lead, 5m, blue terminated with banana plugs

WAADAAISO25

- AutoISO-2500 adapter

WAPRZ010BLBBE5K

- 10m shielded lead, black, cat. IV 1000V

WAPRZ010REBB5K

- 5kV lead, 10 m, red, with banana plugs

WAPRZ010BUBB5K

- 5kV lead, 10m, blue terminated with banana plugs

WASONT1

- temperature probe ST-1

WAPRZLAD12SAM

- Cable for charging the accumulator package from the car cigarette lighter socket (12V)
- Calibration certificate with accreditation

13 Manufacturer

The manufacturer of the device and provider of warranty and post-warranty service:

SONEL S.A.
Wokulskiego 11
58-100 Świdnica
Poland
tel. +48 74 858 38 60
fax +64 74 858 38 09
E-mail: export@sonel.pl
Web page: www.sonel.pl

NOTE
Service repairs must be performed solely by the manufacturer.

14 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.

WARNINGS AND GENERAL INFORMATIONS DIPLAYED BY THE METER

NOTE!

Connecting voltage higher than 600V, 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 inscription displayed after the measurement indicates noise in the system during the measurement The measurement result may be affected by additional uncertainty.
READY disappears, LED lights red, two-tone beep.	Interference voltage higher than 50V, is present on the tested object. The measurement is blocked.
LIMIT I!	Activation of current limit. The symbol displayed is accompanied by a continuous beep.
Err HiLE	Breakdown of the tested object insulation, the measurement is interrupted. The message appears after displaying **LIMIT I!** for 20s during the measurement, when voltage previously reached the nominal value.
Err UdEt, LED lights red, two-tone beep.	During the measurement, AC voltage appeared or the object cannot be discharged for 30 seconds. After 5 seconds the meter returns to its default state - voltmeter.
Err	Internal error.
AUTO-ZERO	Resistance compensation completed for test leads.
 bAtt	Status of rechargeable batteries: Batteries charged Batteries discharged Batteries fully discharged. Recharge or replace battery pack.

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