



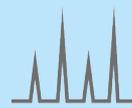
Insulation analysis within wide range

15 kV

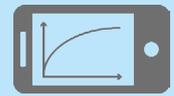
maximal
measuring
voltage

40 TΩ

maximal
measurement
range



partial
discharges
indicator



remote
control
by phone

Features

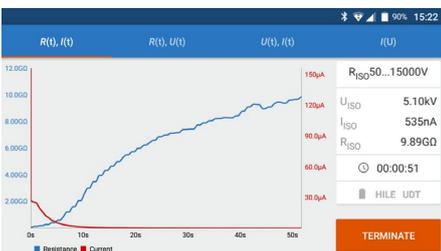
- Partial discharge indicator **PDI**.
- Diagnostics of insulation systems based on standard measurements of **IR, DAR, PI, SV, RT, DD**.
- It allows testing the electrical durability of the tested object - **breakdown voltage indication**.
- High resistance to electromagnetic interferences guarantees uninterrupted work in power stations and in close proximity to high voltage transmission lines up to **1200 kV AC** and **500 kV DC**.
- The function of smooth voltage rise in time (RT - Ramp Test) allows to state the partial discharges in the facility and to carry out a partial location of their occurrence.
- Efficient converter with a **power of ~150 W** that enables insulation burnout, allowing for pinpointing the location of cables and wires short circuit using one of the following:
 - visual method (if power cables are visible along the entire length),
 - reflectometric methods, seismic-acoustic waves detector, or with A-frame to indicate direction of the fault (the conductor must be buried in the ground with earth direct contact).
- Compatible with external software.



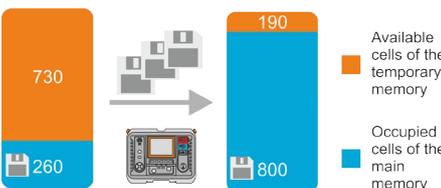
Professional diagnostic tool



For the most harsh operating conditions



Supported by a mobile application



Static and dynamic memory of measurements

Application

MIC-15k1 meter is designed to measure insulation resistance of power objects, i.e.:

- single- and multicore cables,
- transformers,
- motors and generators,
- capacitors, switches and other devices installed in power stations.

It is especially recommended for measurements in areas with very high electromagnetic disturbances, e.g. electrical substations with **1200 kV AC** and **500 kV DC**. Thanks to the 15 kV measuring voltage (in accordance with ANSI / NETA ATS-2009 TABLES 100.1) the meter can be used for measuring objects with a nominal voltage above 34.5 kV.

Capabilities of the device

Highly efficient HV inverter, with test voltage of **15 kV** and current **up to 10 mA**, suitable for measuring the insulation resistance **up to 40 TΩ**. Achieving such a result makes these meters unrivalled devices. Three-wire resistance measurement, performed using a "GUARD" wire, eliminates surface leakage currents caused by contaminated insulation, thereby increasing the reliability of obtained results.

The meter indicates the Dielectric Absorption Ratio **DAR**, Polarization Index **PI** and the value of Dielectric Discharge **DD**.

The device allows user to assess the condition of the insulation, by applying the test voltage incrementally in steps (SV - Step Voltage) or smoothly (RampTest - RT).

- SV method ensures that a dielectric in good condition will provide the same results, regardless of the applied voltage.
- RT method allows to determine the characteristics of the insulating material. The meter smoothly increases the measuring voltage without exposing the object to so-called electrical stress. It records the time and voltage value at which the electrical breakdown of the insulation took place.

Built-in **digital filters**, with averaging time of 10, 30, 60, 100, 200 sec. guarantee stable measurement results in areas of strong electromagnetic interference.

Burnout

A very useful solution is the function that allows to Burnout the damaged object. In case of **exposed cables**, it enables **visual identification** of the fault location. In the case of shielded cables, the method allows to generate a **seismic-acoustic wave** from the place of damage.

In special conditions, an energetic discharge will appear cyclically. By using the geophone it will be possible to precisely pinpoint the place where such a discharge occurs.

Burnout feature allows also locating transient faults (appearing, for example, only during rainfall) with the support of reflectometry, and in case of a short circuit (of a screen or return wire) to the ground - applying the method of measuring voltage drop (the A-frame).

Autosaving the measurement results

The device automatically saves the measurement results. The number of autosave points depends on the amount of data, which is saved within the main memory.

Data analysis

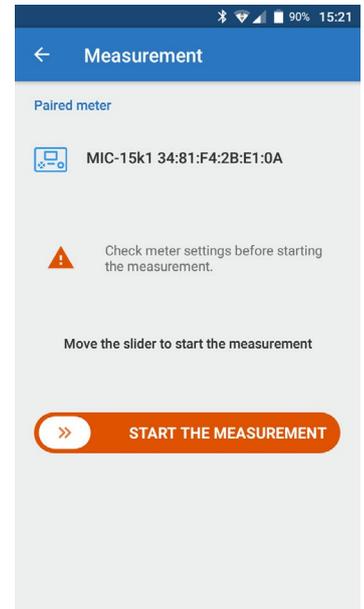


The **Sonel MIC Mobile** mobile app allows to observe the results during the measurement. The application can generate real-time graphs in various configurations. This allows to evaluate the condition of the object already during the tests.

The option of remote start and stop of the measurement is particularly useful. Thanks to it, the tests can be carried out remotely, eg. from a different room or inside the car, when there are difficult weather conditions for the user. Using the phone GPS, it is possible to precisely determine the place of measurement.



Thanks to the mobile application and the **Sonel Reader** software, the user can store previous measurements data and compare them with current results transferred from the meter's extensive memory. This solution allows to prepare a measurement report, track the progress of insulation degradation and plan renovation works.



Insulation resistance measurement

Measuring range according to IEC 61557-2

$U_N = 15\,000\text{ V}$: 50 k Ω ...40.0 T Ω

Measurement with DC and increasing voltage (SV) for $U_{ISO} = 5\text{ kV}$

| Range | Resolution | Accuracy |
|--------------------------|-----------------|--|
| 0...999 k Ω | 1 k Ω | |
| 1.00...9.99 M Ω | 0.01 M Ω | |
| 10.0...99.9 M Ω | 0.1 M Ω | $\pm(3\% \text{ m.v.} + 10 \text{ digits})$ |
| 100...999 M Ω | 1 M Ω | |
| 1.00...9.99 G Ω | 0.01 G Ω | |
| 10...0...99.9 G Ω | 0.1 G Ω | |
| 100...999 G Ω | 1 G Ω | $\pm(3.5\% \text{ m.v.} + 10 \text{ digits})$ |
| 1.00...9.99 T Ω | 0.01 T Ω | $\pm(7.5\% \text{ m.v.} + 10 \text{ digits})$ |
| 10.0...20.0 T Ω | 0.1 T Ω | $\pm(12.5\% \text{ m.v.} + 10 \text{ digits})$ |
| 10.0...40.0 T Ω | | |

Ranges of measured resistance depending on the test voltage

| Voltage U_{ISO} | Measuring range |
|-------------------|------------------|
| 50 V | 200 G Ω |
| 100 V | 400 G Ω |
| 250 V | 1.00 T Ω |
| 500 V | 2.00 T Ω |
| 1000 V | 4.00 T Ω |
| 2500 V | 10.00 T Ω |
| 5000 V | 20.0 T Ω |
| 10 000 V | 40.0 T Ω |
| 15 000 V | 40.0 T Ω |

Capacitance measurement

| Range | Resolution | Accuracy |
|----------------------|--------------|--|
| 0...999 nF | 1 nF | $\pm(5\% \text{ m.v.} + 5 \text{ digits})$ |
| 1.00...49.99 μ F | 0.01 μ F | |

- Displaying measured capacity after R_{ISO} measurement
- For measurement voltages below 100 V the measurement error is not specified

Technical specification

| | |
|--|---|
| type of insulation acc. to EN 61010-1 and IEC 61557 | double |
| measurement category acc. to EN 61010-1 | IV 1000 V (operating altitude $\leq 2000\text{ m}$) IV 600 V (operating altitude $\leq 3000\text{ m}$) |
| ingress protection acc. to EN 60529 | IP67 (IP40 for closed case) |
| resistance to external interference voltages | up to 1550 V |
| resistance to external interference currents | up to 10 mA |
| advanced, digital filtering of interferences | 10 / 30 / 60 / 100 / 200 seconds |
| test leads lock | yes |
| power supply | Li-Ion 14.8 V rechargeable battery from network 90 V \div 260 V, 50 Hz/60 Hz |
| dimensions | 390 x 308 x 172 mm |
| weight | approx. 6.3 kg |
| storage temperature | -25°C...+70°C |
| operating temperature | -20°C...+50°C |
| humidity | 20%...90% |
| operating altitude | $\leq 3000\text{ m}$ |
| reference temperature | +23°C \pm 2°C |
| reference humidity | 40%...60% |
| display | graphical LCD |
| number of R_{ISO} measurements with battery power supply | min. 1000 acc. to EN 61557-2 |
| data transmission | USB and Bluetooth |
| quality standard | ISO 9001 compliant |
| device meets the requirements of standards | EN 61010-1 and IEC 61557 |
| the product meets EMC requirements (immunity for industrial environment) | with accordance to standards EN 61326-1 and EN 61326-2-2 |

Standard accessories



**Test lead 15 kV
1.8 m CAT IV 1000 V
with crocodile clip, black**

WAPRZ1X8BLKROE15KV



**Test lead 15 kV
1.8 m CAT IV
1000 V with
crocodile clip, red**

WAPRZ1X8REKRO15KV



**Test lead 15 kV
1.8 m CAT IV
1000 V with crocodile clip, blue**

WAPRZ1X8BUKRO15KV



**Mains cable with
IEC C13 plug**

WAPRZ1X8BLIEC



L4 carrying case

WAFUTL4



W1 hanging straps

WAPOZSZE5



USB cable

WAPRZUSB



Calibration certificate

Optional accessories



**Test lead 15 kV
CAT IV 1000 V with
crocodile clip, black
3 m / 5 m / 10 m / 20 m**

WAPRZ003BLKROE15KV
WAPRZ005BLKROE15KV
WAPRZ010BLKROE15KV
WAPRZ020BLKROE15KV



**Test lead 15 kV
CAT IV 1000 V with
crocodile clip, red
3 m / 5 m / 10 m / 20 m**

WAPRZ003REKRO15KV
WAPRZ005REKRO15KV
WAPRZ010REKRO15KV
WAPRZ020REKRO15KV



**Test lead 15 kV
CAT IV 1000 V with
crocodile clip, blue
3 m / 5 m / 10 m / 20 m**

WAPRZ003BUKRO15KV
WAPRZ005BUKRO15KV
WAPRZ010BUKRO15KV
WAPRZ020BUKRO15KV



**PRS-1 resist-
ance test probe**

WASONPRS1GB



**Resistance calibra-
tor SRP-10G0-10T0**

WMXXSRP10G010T0



**CS-5kV cali-
bration box**

WAADACS5KV



**PC software:
Sonel Reader**

WAPROREADER



**Calibration cer-
tificate issued
by an accredited
laboratory**



Please see available applications with "Virtual Instruments Applications". They allow to check the functions of the meter and its interface before the purchase. Application user may set changes in device settings and perform all possible measurements as in reality.

<https://www.sonel.pl/en/virtual-instrument-applications>

Times of charging and discharging the tested object at measuring voltage of 1.05 U_{ISO}

| Meter | Measuring voltage | | | Capacitance [μF] | Charging the object | | Discharging the object down to voltage of 50 V [s] |
|---------------------|-------------------|-------|-------|---------------------|---------------------|------------------|---|
| | 5 kV | 10 kV | 15 kV | | Current [mA] | Maximal time [s] | |
| MIC-5005 / MIC-5010 | ✓ | | | 1 | 1.2 | 4.3 | 0.4 |
| | | | | | 3 | 1.7 | |
| MIC-5050 / MIC-05s1 | ✓ | | | 1 | 1.2 | 4.3 | 0.4 |
| | | | | | 3 | 1.7 | |
| | | | | | 6 | 0.8 | |
| MIC-10k1 / MIC-10s1 | ✓ | | | 1 | 1.2 | 4.3 | 0.9 |
| | | | | | 3 | 1.7 | |
| | | | | | 6 | 0.8 | |
| | | ✓ | | 1 | 1.2 | 8.7 | 1.0 |
| | | | | | 3 | 3.5 | |
| | | | | | 6 | 1.7 | |
| MIC-15k1 | ✓ | | | 1 | 1.2 | 4.3 | 1.1 |
| | | | | | 3 | 1.7 | |
| | | | | | 5 | 1.0 | |
| | | | | | 7 | 0.7 | |
| | | ✓ | | 1 | 10 | 0.5 | 1.3 |
| | | | | | 1.2 | 8.7 | |
| | | | | | 3 | 3.5 | |
| | | | ✓ | 1 | 5 | 2.1 | 1.4 |
| | | | | | 7 | 1.5 | |
| | | | | | 10 | 1.0 | |
| | | | 1 | 1.2 | 13.1 | 1.4 | |
| | | | | 3 | 5.2 | | |
| | | | | 5 | 3.1 | | |
| | | | | 7 | 2.2 | | |
| | | | | | 10 | 1.5 | |

Times of charging and discharging the tested object at measuring voltage of 1.025 U_{ISO}

| Meter | Measuring voltage | | | Capacitance [μF] | Charging the object | | Discharging the object down to voltage of 50 V [s] |
|---------------------|-------------------|-------|-------|---------------------|---------------------|------------------|---|
| | 5 kV | 10 kV | 15 kV | | Current [mA] | Maximal time [s] | |
| MIC-5005 / MIC-5010 | ✓ | | | 1 | 1.2 | 4.2 | 0.4 |
| | | | | | 3 | 1.7 | |
| MIC-5050 / MIC-05s1 | ✓ | | | 1 | 1.2 | 4.2 | 0.4 |
| | | | | | 3 | 1.7 | |
| | | | | | 6 | 0.8 | |
| MIC-10k1 / MIC-10s1 | ✓ | | | 1 | 1.2 | 4.2 | 0.9 |
| | | | | | 3 | 1.7 | |
| | | | | | 6 | 0.8 | |
| | | ✓ | | 1 | 1.2 | 8.5 | 1.0 |
| | | | | | 3 | 3.4 | |
| | | | | | 6 | 1.7 | |
| MIC-15k1 | ✓ | | | 1 | 1.2 | 4.2 | 1.1 |
| | | | | | 3 | 1.7 | |
| | | | | | 5 | 1.0 | |
| | | | | | 7 | 0.7 | |
| | | ✓ | | 1 | 10 | 0.5 | 1.3 |
| | | | | | 1.2 | 8.5 | |
| | | | | | 3 | 3.4 | |
| | | | ✓ | 1 | 5 | 2.0 | 1.4 |
| | | | | | 7 | 1.4 | |
| | | | | | 10 | 1.0 | |
| | | | 1 | 1.2 | 12.8 | 1.4 | |
| | | | | 3 | 5.1 | | |
| | | | | 5 | 3.0 | | |
| | | | | 7 | 2.1 | | |
| | | | | | 10 | 1.5 | |

