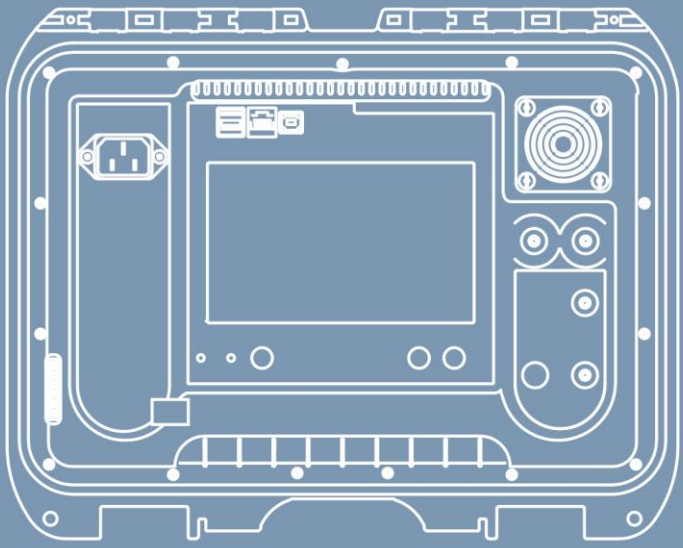
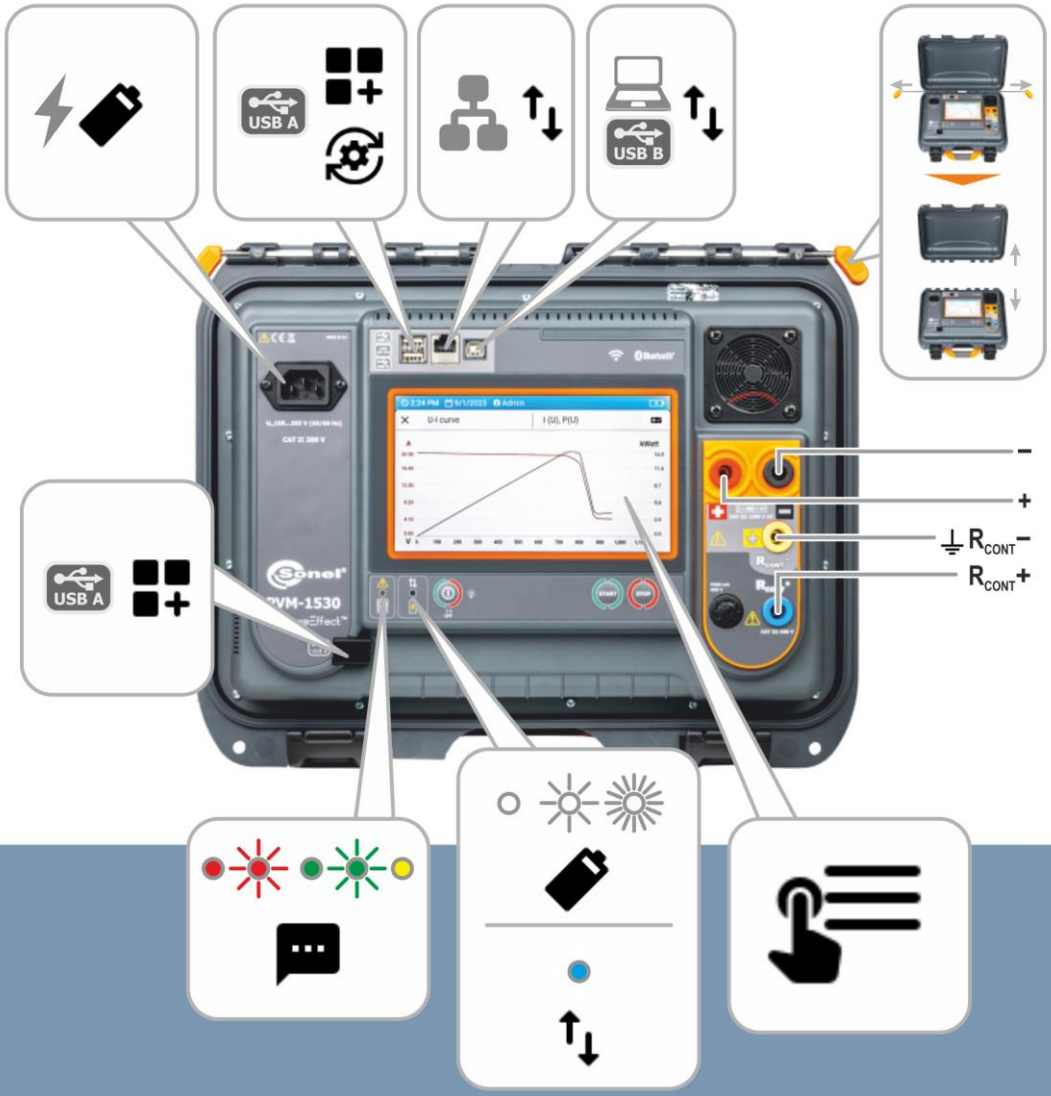


User manual

PVM-1530

Photovoltaic meter


USB A
USB B
USB A
VM-1530
−
+
R_{CONT}−
R_{CONT}+

User manual

PVM-1530

Photovoltaic meter

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

Version 1.01 04.10.2024

The PVM-1530 meter is a modern, top quality measuring instrument which is easy and safe to use, provided that the principles presented in this manual are observed.

MeasureEffect™

The meters are part of the **Sonel MeasureEffect™** platform. It is a comprehensive system that enables you to take measurements, store and manage data, and provides multi-level control of your instruments. You can find a detailed description of the system in the dedicated user manual.

The manual can be found on the manufacturer's website. Check **www.sonel.com › EN › Download › User manuals** (**Software** section) and the instrument page (**Files** section).

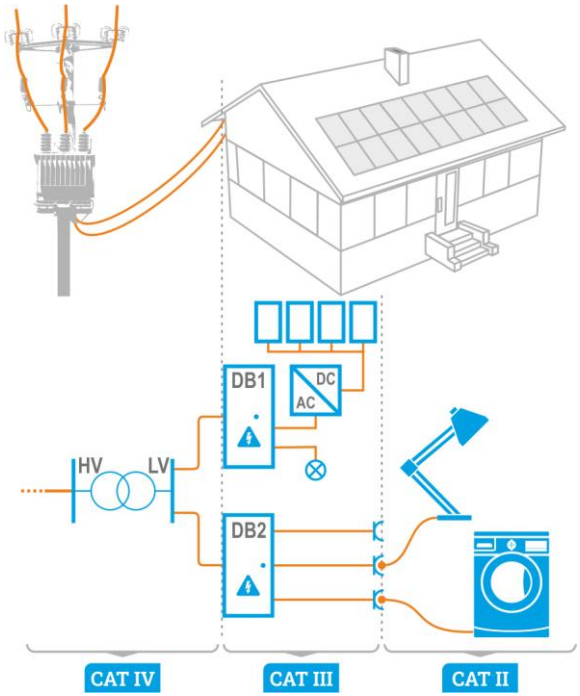
CONTENTS

1 General information

1.1 Safety symbols

The following international symbols are used in the device and/or in this manual:

	Refer to the user manual for additional information and explanations		Ground		AC current/voltage
	DC current/voltage		Double insulation (protection class)	CE	Declaration of Conformity with EU directives (*Conformité Européenne*)
	Do not dispose of with other household waste		Attention, risk of electric shock	>1650 V DC	Do not connect the device to DC systems with voltages above 1650 V



Measurement categories according to EN IEC 61010-2-030:

- **CAT II** – concerns measurements performed in circuits directly connected to low voltage installations,
- **CAT III** – concerns measurements performed in buildings installations,
- **CAT IV** – concerns measurements performed at the source of low voltage installation.

1.2 Behaviour of signalling LEDs

The LED is on continuously

The LED flashes slowly

The LED flashes rapidly

1.3 Safety

To avoid electric shock or fire, as well as provide the conditions for correct operation and accuracy of obtained results, you must observe the following guidelines:

- Before you proceed to operate the device, acquaint yourself thoroughly with this manual and observe the safety regulations and specifications defined by the producer.
- Any application that differs from those specified in this manual may result in damage to the device and constitute a source of danger for the user.
- The device must be operated solely by appropriately qualified personnel with relevant certificates to realise measurements of electric installation. Operating the meter by unauthorised personnel may result in damage to the device and constitute a source of danger for the user.
- 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, check the device, wires, adapters and other accessories for any sign of mechanical damage. Pay special attention to the connectors.
- It is unacceptable to operate:
  - ⇒ it is damaged and completely or partially out of order,
  - ⇒ its cords and cables have damaged insulation,
  - ⇒ of the device and accessories mechanically damaged,
  - ⇒ it was stored for an excessive period of time in disadvantageous conditions (e.g. excessive humidity) After moving the device from a cool to a warm place with a high level of relative humidity, do not start measurements until the device is warmed up to the ambient temperature (approximately 30 minutes).
- Before measurement, choose a correct measurement function and make sure that the test leads are connected to their respective measuring terminals.
- The correct operation of the instrument and accessories must be checked regularly to avoid any hazard which may result from erroneous results.
- In a situation where the product works with other instruments or accessories, the lowest measurement category of the connected devices is used.
- Do not power the meter from sources other than those listed in this manual.
- Repairs may only be performed by an authorised service point.
- The device must be used within its rated conditions (**sec. 11.2**). It should not be exposed to direct sunlight.

WARNING

- **It is prohibited to use the meter in places at risk of explosion (Ex zones)!**
- **Do not touch the tested object during the R_{ISO} insulation resistance measurement or after the measurement before it is fully discharged. It may result in electric shock.**

NOTE!

- Do not use the device in power supply systems with voltage higher than 1000 V AC.
- Do not connect the inputs of the device to photovoltaic systems:
  - with voltage exceeding 1000 V DC and short-circuit current exceeding 40 A,
  - with voltage exceeding 1500 V DC and short-circuit current exceeding 30 A,
  - with grounded circuits.
- Do not disconnect MC4 connectors under load under risk of arcing.
- The PE terminal should only be used to connect the ground of photovoltaic systems. Don't apply any voltage to it!
- It is forbidden to perform measurements: R_{CONT} continuity, and test lead compensation, on energized circuits. This may damage the meter.
- Only accessories intended for a given device should be used. Using other accesso-

ries may cause damage to measuring terminals, introduce additional measurement errors and create a risk for the user.

Due to continuous development of the meter's software, the actual appearance of the display for some features may slightly differ from that presented in this user manual. The latest version of the manual is provided on the manufacturer's website.

1.4 General characteristics

PVM-1530 is a multifunctional measuring device designed to measure the parameters of photovoltaic systems and the parameters of the inverter connection points to the power grid. It allows you to perform the necessary measurements for a photovoltaic system according to category 1 and 2 specified in standard "EN 62446-1 - Photovoltaic systems (PV). Testing, documentation and maintenance requirements. Part 1: Networked Systems. Documentation, acceptance and supervision". The meter allows the measurement of photovoltaic panels, including bifacial and high-efficiency panels.

Measured parameters:

- DC voltage of an open module / chain PV – U_{OC},
- AC voltage on the AC side (connection of the inverter to the power grid),
- DC short-circuit current of the PV module/chain – I_{SC},
- R_{ISO}PV insulation resistance of the PV system on the DC side by method 1 according to EN 62446-1 standard (i.e. the measurement does not cause a module / string short-circuit), allowing the determination of the insulation resistance of the PV module / string at both poles: R_{ISO}+ and R_{ISO}-,
- R_{ISO} insulation resistance of the PV system on the AC side (connection of the inverter to the power grid),
- DC current and power of the PV module / string / system on the DC side,
- DC and power of the PV system on the AC side (connection of the inverter to the power grid),
- circuit continuity (R_{CONT}) of the earthing and equipotential bonding cables of the PV module / string,
- parameters of the blocking diode, used in PV systems,
- I-U Curve (measurement category 2 of EN 62446-1).

The meter is equipped with banana sockets. The sockets are used for functional measurements of the systems (when working with the inverter turned on). Measurements are made using the sockets marked as „+" and „–". The socket ⏚ (PE) is used for measuring the insulation resistance of a photovoltaic system. R_{CONT}+ and R_{CONT}- sockets are used to measure continuity.

The meter has radio interfaces: **Bluetooth** i **Wi-Fi**.

- **Bluetooth** and **Wi-Fi** module is used to communicate between the meter and a computer, printer or mobile device.
- It is possible to communicate with the IRM-1 device.

IRM-1 is a meter designed for measuring solar irradiance and the temperature of photovoltaic cells and their environment. The data it provides is necessary to convert the values measured by PVM-1530 to the STC conditions. The standardized values enable the user to determine whether the photovoltaic system is working with optimal efficiency and to check the PV modules for potential damage.

1.5 Compliance with standards

The tester meets the requirements of the following standards:

- EN IEC 61557-1 – Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements.
- EN IEC 61557-2 – Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance.
- EN IEC 61557-4 – Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 4: Resistance of earth connection and equipotential bonding.
- EN 61557-10 – Electrical safety in low voltage distribution systems up to 1 000 v a.c. and 1 500 v d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 10: Combined measuring equipment for testing, measuring and monitoring of protective measures.

Safety standards:

- EN 61010-1 – Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements.
- EN IEC 61010-2-030 – Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits.

Standards for electromagnetic compatibility:

- EN IEC 61326-1 – Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements.
- EN IEC 61326-2-2 Electrical equipment for measurement, control and laboratory use – Electromagnetic compatibility (EMC) requirements – Part 2-2: Particular requirements – Test configurations, operational conditions and performance criteria for portable testing, measuring and monitoring equipment used in low-voltage distribution systems.

Referenced standards:

- EN 62446-1 with Appendix A1 – Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance – Part 1: Grid connected systems – Documentation, commissioning tests and inspection.
- EN IEC 60891 – Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics.
- EN 61829 – Photovoltaic (PV) panels. Measurement of current-voltage characteristics at the place of their installation.

2 Quick start

When you start the device for the first time, you must set the interface language and create a user account. Finally, set the date, time and time zone.

1		Turn the meter on.
2		Create or log in to a user account.
3		Enter the meter settings
4		Select measurement. You can find information about it under ⓘ icon and in the **Sonel MeasureEffect™** platform manual.
5		Enter the measurement settings.
6		Connect the meter to the tested object.
7		Start the measurement.
8		End the measurement or wait for it to be completed. Then you can enter additional information about the measurement.
9		Save the result in the memory.
10	1 s	Turn the meter off.

You can save measurements in two ways:

- by performing a measurement and then assigning it to an object in the memory structure,
- entering an object in the memory structure and making a measurement at this memory location

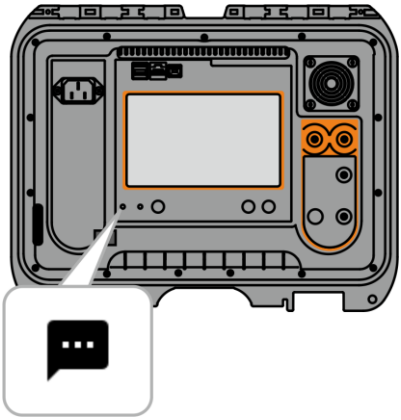
3 Interface

- Turn on the meter (short press)
- Turn off the meter (press and hold)
- Call up the brightness and volume menu (press briefly when the meter is on)

START Start measurement

STOP Stop measurement

4 Measurement indicators



Before the measurement	
R_{ISO}	**R_{ISO} PV**
The voltage on the object is present continuously and does not exceed 50 V. The measurement is possible, but it may be burdened with an additional error.	The diode does not light.
• The voltage on the object is present continuously and exceeds 50 V. The measurement is blocked. • Emergency state of the meter.	

During the measurement	
R_{ISO}	**R_{ISO} PV**
The meter is measuring the insulation resistance.	The meter is measuring the insulation resistance.
The meter has finished measuring the insulation resistance and is currently discharging the tested object.	The meter has finished measuring the insulation resistance and is currently discharging the tested object.
3x The measurement is completed and the tested object is discharged.	**3x** The measurement is completed and the tested object is discharged.

5 Data transmission

PVM-1530 is equipped with communication channels:

- wired USB,
- wired LAN,
- wireless Bluetooth,
- wireless Wi-Fi.

Communication via USB is used to transfer the results from the device's memory to a PC.
Communication via LAN is for service purposes.
Bluetooth and Wi-Fi communication is used to work with the printer and mobile devices.

Additionally, it is possible to receive measurement results from the IRM-1 meter. Any potential loss of communication does not result in data loss. The readings are then recorded in the temporary memory of IRM-1 and transmitted to PVM-1530 meter after the communication is restored.

5.1 Set of accessories to connect the meter to a PC

In order to ensure the communication of the meter with a computer a USB cable and the relevant software are required:

- Sonel Reader,
- Sonel Reports Plus.

The software may be used for many devices manufactured by SONEL S.A. which are equipped with a USB interface. Detailed information is available from the manufacturer and distributors.

If the required software has not been purchased with the meter, it may be obtained from the manufacturer or from an authorised distributor.

5.2 Data transmission through USB port

1 

Enter the USB mode on the meter.

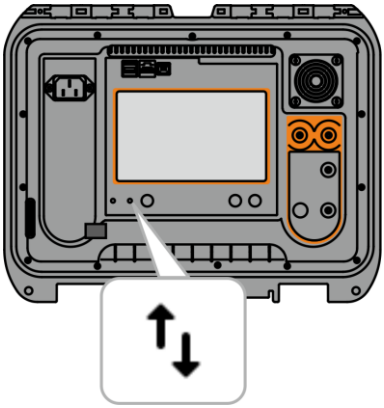
2 

Use the USB cable to connect the meter to the computer.

3 

Start the software for data transfer. During data transmission, all buttons on the meter are locked, except for those responsible for interrupting the transmission and switching off the device.

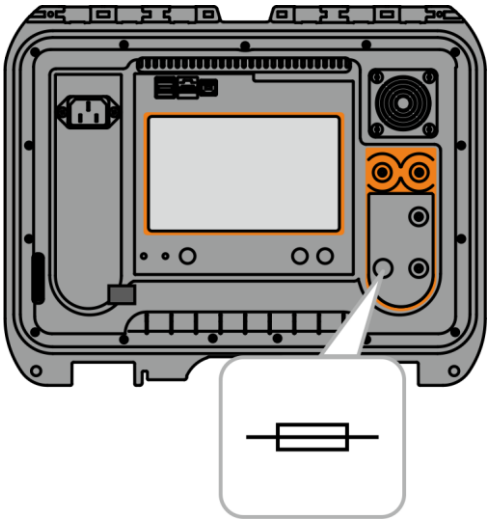
Additional information displayed by the meter



USB communication, data transfer.

6 Fuse replacement

The device is protected by one fast-acting fuse 6.3 x 32 mm 500 mA / 1000 V AC/DC. To replace the fuse, unscrew the socket head, place a working fuse in place of the damaged fuse, and then screw on the socket head.



NOTE!

Do not use fuses other than those listed in this manual.

7 Power supply

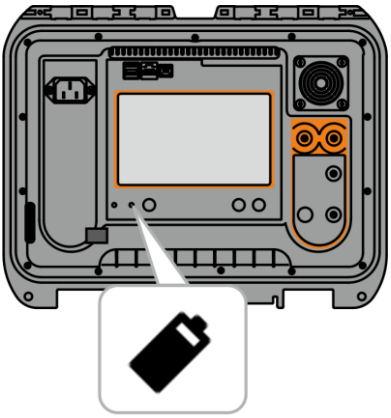
NOTE!

Before operating the meter, discharge the battery and then fully charge it, so that the indication of its charged status is correct.

The charge level of the rechargeable battery is indicated by the symbol in the right upper corner of the display on a permanent basis.

100% Battery charged.	Charging voltage too high. Change the charger or power supply source.
1% Battery completely discharged – charge it. All measurements are blocked. The meter will turn off automatically when the battery charge drops to a critical level.	Battery temperature out of permissible range. If a charging is in progress, it will be aborted.
Charging of the battery is in progress.	No battery. The meter operates on an external power supply.
Battery failure. It is recommended to replace it with a new one.	Battery status unknown. Contact the customer service centre.

Additional information displayed by the meter



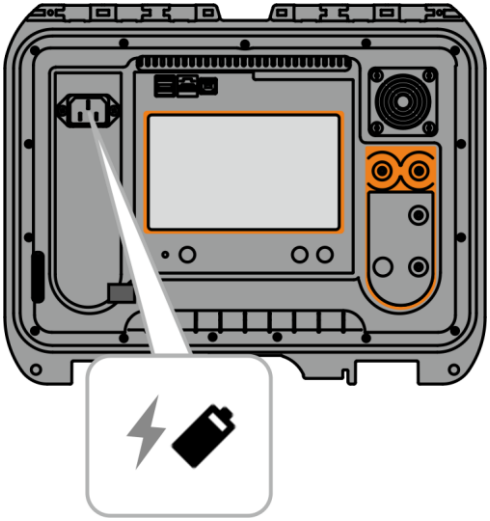
Low battery charge level.

Battery problem

Charging of the battery is in progress.

7.1 Battery power

The meter is powered by a Li-Ion battery. The whole device is powered via the power cord.



NOTE!

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

7.2 Charging rechargeable battery

Charging starts once the power supply has been connected to the meter, regardless of whether the meter is on or off. The charging status is indicated on the display and by an active LED.

Algorytm ładowania pozwala na naładowanie akumulatora:

- up to approx. 90% in less than 5 hours,
- up to approx. 100% in less than 6.5 hours,

When the meter is turned off by button or by AUTO-OFF, the charging process is not stopped.

Indication of completed charging is shown by: 100%.

7.3 Power supply from mains

It is possible to charge the battery when carrying out the measurements. To do this, just connect the power cable to the meter.

When the meter is turned off by button or by **AUTO-OFF**, the charging process is not stopped.

7.4 General rules for using Li-Ion rechargeable batteries

- Store the meter with batteries charged at least to 50%. 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. The environment should be dry and well ventilated. Protect the device from direct sunlight.
- 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. When the temperature is too low, charging is prevented as it may irreparably damage the batteries.
- 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 of the battery pack into fire.
- Li-Ion cells are sensitive to mechanical damage. This kind of damage may cause its permanent damage and thus cause ignition or explosion. Any interference in the structure of Li-ion battery pack may cause its damage. This may result in its 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 comes into contact with eyes or skin, immediately rinse the affected area with plenty of water and consult with 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 its ignition. The seller and the manufacturer shall not be liable for any damages resulting from improper handling of the Li-Ion battery pack.

8 Cleaning and maintenance

NOTE!

Use only 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 damage the casing (powders, pastes, etc.).

Clean the probe with water and dry it.

The test leads should be cleaned with water and detergents, and then dried.

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,
- wind the test leads,
- in order to prevent a total discharge of the battery pack in the case of a prolonged storage, charge the device **at least once every six months**.

10 Dismantling and utilisation

Worn-out electric and electronic equipment should be gathered selectively, i.e. it must not be placed with waste of another kind.

Worn-out electronic equipment should be sent to a collection point in accordance with the regulations valid in a given region.

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

Observe local regulations concerning disposal of packages, waste batteries and rechargeable batteries.

11 Technical data

11.1 Basic data

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

11.1.1 Measurement of DC voltage

Measurement range: **0 V…1500 V DC**

Display range	Resolution	Accuracy
0.0…1500.0 V	0.1 V	±(0.5% m.v. + 2 digits)

11.1.2 Measurement of AC True RMS voltage

Measurement range: **0 V…1000 V AC**

Display range	Resolution	Accuracy
0.0…1000.0 V	0.1 V	±(2% m.v. + 6 digits)

- Frequency range: 45…65 Hz

11.1.3 Measurement of frequency

Measurement range: **10,0…100,0 Hz**

Display range	Resolution	Accuracy
0.0…100.0 Hz	0.1 Hz	±(0.5% m.v. + 2 digits)

- Voltage range: 10…1000 V

11.1.4 Measurement of I_{SC} short-circuit current

Display range	Resolution	Accuracy
0.00…30.00 A for 1500 V DC 0.00…40.00 A for 1000 V DC	0.01 A	±(1% m.v. + 2 digits)

- In the voltage range of 1000…1500 V DC the maximum measurable current is lower by 1 A for every 50 V above 1000 V. For example, for 1050 V DC it is 39 A, and for 1100 V DC it is 38 A

11.1.5 Measurement of insulation resistance of the module / PV system

Measurement of R_{ISO} resistance

Measuring range according to EN IEC 61557-2 for U_{ISO} = 250 V / 500 V / 1000 V / 1500 V: **250 kΩ…500 MΩ**

Display range	Resolution	Accuracy
0.0…999.9 kΩ	0.1 kΩ	±(8% m.v. + 8 digits)*
1.000…9.999 MΩ	0.001 MΩ	
10.00…99.99 MΩ	0.01 MΩ	
100.0…500.0 MΩ	0.1 MΩ	

* If the $R_{ISO}PV+$ and $R_{ISO}PV-$ values differ by more than 20%, then:

1. the lower resistance ($R_{ISO}PV_1$) is measured with the specified accuracy,
2. the higher resistance ($R_{ISO}PV_2$) is an uncertain value, measured with an unspecified accuracy,
3. the sum of the larger resistance and its unspecified accuracy is greater than or equal to the smaller resistance: $R_{ISO}PV_2 + \Delta(R_{ISO}PV_2) \geq (R_{ISO}PV_1)$.

- Type of test voltage: DC
- Test voltage: 250 V, 500 V, 1000 V, 1500 V
- Accuracy of generated voltage (R_{LOAD} [Ω] ≥ 1000*U_N [V]): 0…+5% from the set value
- Detection of a dangerous voltage before commencing a measurement
- Discharging the tested object
- Measurement of voltage on terminals „+”, „–” within the range of: 0…1000 V AC, 0…1500 V DC
- Test current: 3 mA

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:

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

where:
R_{ISOmin} – minimum insulation resistance measured without limiting the converter current
U_{ISOnom} – nominal test voltage
I_{ISOnom} – nominal converter current (3 mA)

Measurement of leakage current

Display range	Resolution	Accuracy
0…I_{Lmax}	mA, µA, nA	Calculated on the basis of resistance readings

- I_{Lmax} – maximum current at short circuit of leads
- Resolution and units result from the measurement range of individual insulation resistance

11.1.6 Measurement of insulation resistance

Measuring range according to EN IEC 61557-2 for U_{ISO} = 250 V: **250 kΩ…200 MΩ**

Display range for U_N = 250 V	Resolution	Accuracy
0.0…999.9 kΩ	0.1 kΩ	±(3% m.v. + 8 digits)
1.000…9.999 MΩ	0.001 MΩ	
10.00…99.99 MΩ	0.01 MΩ	
100.0…200.0 MΩ	0.1 MΩ	

Measuring range according to EN IEC 61557-2 for U_{ISO} = 500 V: **500 kΩ…500 MΩ**

Display range for U_N = 500 V	Resolution	Accuracy
0.0…999.9 kΩ	0.1 kΩ	±(3% m.v. + 8 digits)
1.000…9.999 MΩ	0.001 MΩ	
10.00…99.99 MΩ	0.01 MΩ	
100.0…500.0 MΩ	0.1 MΩ	

Measuring range according to EN IEC 61557-2 for U_{ISO} = 1000 V: **1000 kΩ…1.000 GΩ**

Display range for U_N = 1000 V	Resolution	Accuracy
0.0…999.9 kΩ	0.1 kΩ	±(3% m.v. + 8 digits)
1.000…9.999 MΩ	0.001 MΩ	
10.00…99.99 MΩ	0.01 MΩ	
100.0…1000.0 MΩ	0.1 MΩ	

- Type of test voltage: DC
- Test voltage: 250 V, 500 V, 1000 V
- Accuracy of generated voltage (R_{LOAD} [Ω] ≥ 1000*U_N [V]): 0…+5% from the set value
- Detection of a dangerous voltage before commencing a measurement
- Discharging the tested object
- Measurement of voltage on terminals „+”, „–” within the range of: 0…1000 V AC, 0…1500 V DC
- Test current: <3 mA

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:

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

where:
R_{ISOmin} – minimum insulation resistance measured without limiting the converter current
U_{ISOnom} – nominal test voltage
I_{ISOnom} – nominal converter current (3 mA)

Measurement of leakage current

Display range	Resolution	Accuracy
0…I_{Lmax}	mA, µA, nA	Calculated on the basis of resistance readings

- I_{Lmax} – maximum current at short circuit of leads
- Resolution and units result from the measurement range of individual insulation resistance

11.1.7 Measurement of operating current and power

P power measurement – AC and DC voltage

Display range	Resolution	Accuracy
0.0…999.0 kW	0.01 kW	Depends on the accuracy of voltage and current measurement

Current measurement at power measurement – AC and DC voltage

- As in the Sonel CMP-1015-PV meter

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

Measuring range according to EN IEC 61557-4: **0.11…1999 Ω**

Display range	Resolution	Accuracy
0.00…19.99 Ω	0.01 Ω	±(2% m.v. + 3 digits)
20.0…199.9 Ω	0.1 Ω	
200…1999 Ω	1 Ω	±(4% m.v. + 3 digits)

- Voltage at open terminals: 4…24 V
- Output current at R < 2 Ω: I_{SC} > 200 mA
- Compensation of test leads resistance
- Measurements for both current polarizations

11.1.9 I-U Curve

- Measurement of I_{SC}, I_{mpp} – ranges and accuracies as in section "Measurement of I_{SC} short-circuit current"
- Measurement of U_{OC}, U_{mpp} – ranges and accuracies as in section "Measurement of DC voltage"
- The I-U curve graph consists of 150 points
- Measurement duration:
  - Without connected IRM-1 – ca. 8 s
  - With connected IRM-1 – from ca. 15 s to ca. 40 s, depending on solar variation

11.2 Operating data

a) type of insulation acc. to EN 61010-1 and EN IEC 61557 ..... double
b) measurement category acc. to EN IEC 61010-2-030
- group of sockets: „–", „+", ⏚ – rated operating altitude ≤2000 m ..... CAT III 1500 V DC
- group of sockets: R_{CONT}-, R_{CONT}+ – rated operating altitude ≤2000 m ..... CAT III 600 V

c) ingress protection acc. to EN 60529
- open enclosure IP40
- closed enclosure IP65

d) power supply ..... Li-Ion 7.2 V 9.8 Ah rechargeable battery
e) dimensions ..... 390 x 308 x 172 mm
f) weight ..... ca. 8.8 kg
g) storage temperature ..... -20…+60°C
h) operating temperature ..... -10…+45°C
i) humidity ..... 20…90%
j) reference temperature ..... +23°C ± 2°C
k) reference humidity ..... 40…60%
l) display ..... LCD, color capacitive touchscreen 7" ..... resolution 1280x720 dots, max brightness 800 cd/m^2
m) number of measurements with battery power supply (frequency of 1 measurement/minute)
- I-U Curve (meter ON, no working radio modules, screen backlight 50%, no IRM-1) ..... ca. 400
- R_{ISO} PV (meter ON, no working radio modules, screen backlight 50%, U_{ISO}=1500 V) ..... ca. 500

n) time of operation on a single battery charge
- meter ON, not used, no working radio modules, screen backlight 50%, ... ca. 9.5 h

o) memory of measurement results ..... 9999 results
p) transmission of results – wired ..... USB-B, RJ-45
q) transmission of results – wireless
- interface ..... Bluetooth, Wi-Fi
- range ..... up to 10 m

r) communication with external device – wired ..... USB-A
s) communication with IRM-1
- maximum number of connected meters 2
- range ..... up to 300 m

t) Wi-Fi band frequency ..... 2.4 GHz, 5 GHz
u) quality standard ..... development, design and manufacturing are ISO 9001, ISO 14001, ISO 45001 compliant
v) the device meets the requirements of ..... EN 61010-1, EN IEC 61557, EN IEC 61010-2-030
w) the product meets EMC requirements (immunity for industrial environment) according to the following standards .... EN IEC 61326-1, EN IEC 61326-2-2

NOTE
*** Information about the use of meter at altitude from 2000 m a.s.l. to 5000 m a.s.l.**

For voltage inputs, it should be assumed that the measurement category is reduced to the following values with respect to ground:

- –, +, ⏚: CAT III 600 V
- R_{CONT}-, R_{CONT}+: CAT IV 300 V

Markings and symbols indicated on the instrument are to be considered valid when using it at altitude ≤2000 m.

NOTE!
The meter is classified in terms of Electromagnetic Compatibility (EMC) as instruments of Class A (for use in industrial environments – according to EN 55011). Interferences, impacting the operation of other devices must be taken into account when the meters are used in other environments (e.g. domestic).

SONEL S.A. hereby declares that the radio device type PVM-1530 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 Bluetooth specification

a) version ..... v4.2 Classic, BLE
b) frequency range ..... 2400 MHz…2483.5 MHz (ISM band)
c) frequency response ..... 1 MHz < f < 3.5 MHz
d) modulation method GFSK/π/4DQPSK/8DPSK/LE
e) receiver sensitivity ..... -89 dBm
f) minimum transmission power ..... 3…7 dBm

11.4 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.

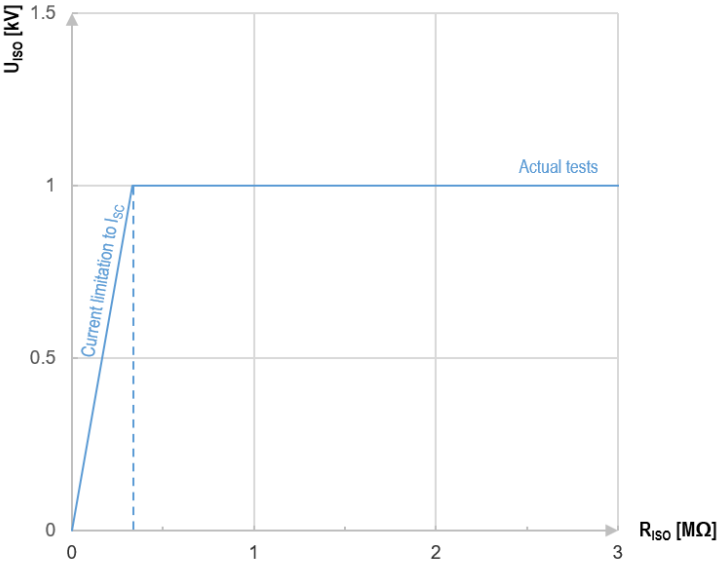
11.4.1 Additional uncertainties according to EN IEC 61557-2 (R_{ISO})

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	1% (1% not displayed)
Temperature 0°C…35°C	E_3	6%

11.5 Inverter characteristics

The meter measures the insulation resistance by applying to tested resistance R_{ISO} the U_{ISO} test voltage and measuring current I flowing through it, which is controlled from **+** terminal side. In calculating the value of insulation resistance, the meter applies the technical method of resistance measurement ($R_{ISO}=U_{ISO}/I$).

Inverter output current $\mathbf{I_{SC}}$ is 3 mA. Activation of the current limit is indicated by a continuous beep. The measurement result is correct, but on the test **terminals** the **voltage is lower than the set voltage**. The current limitation occurs in the first phase of the measurement due to charging the capacitance of the tested object



The actual test voltage U_{ISO} as a function of the measured insulation resistance R_{ISO} (for maximum test voltage)

12 Manufacturer

The manufacturer of the device and provider of guarantee and post-guarantee 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

NOTE!

Service repairs must be performed only by the manufacturer.

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

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