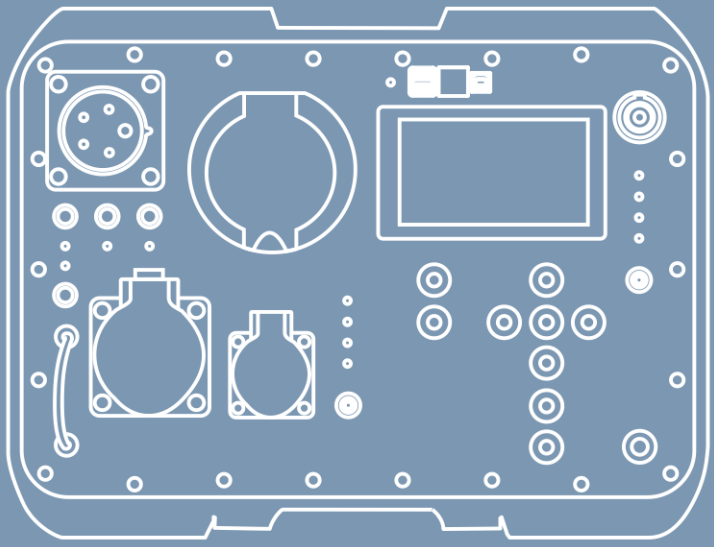
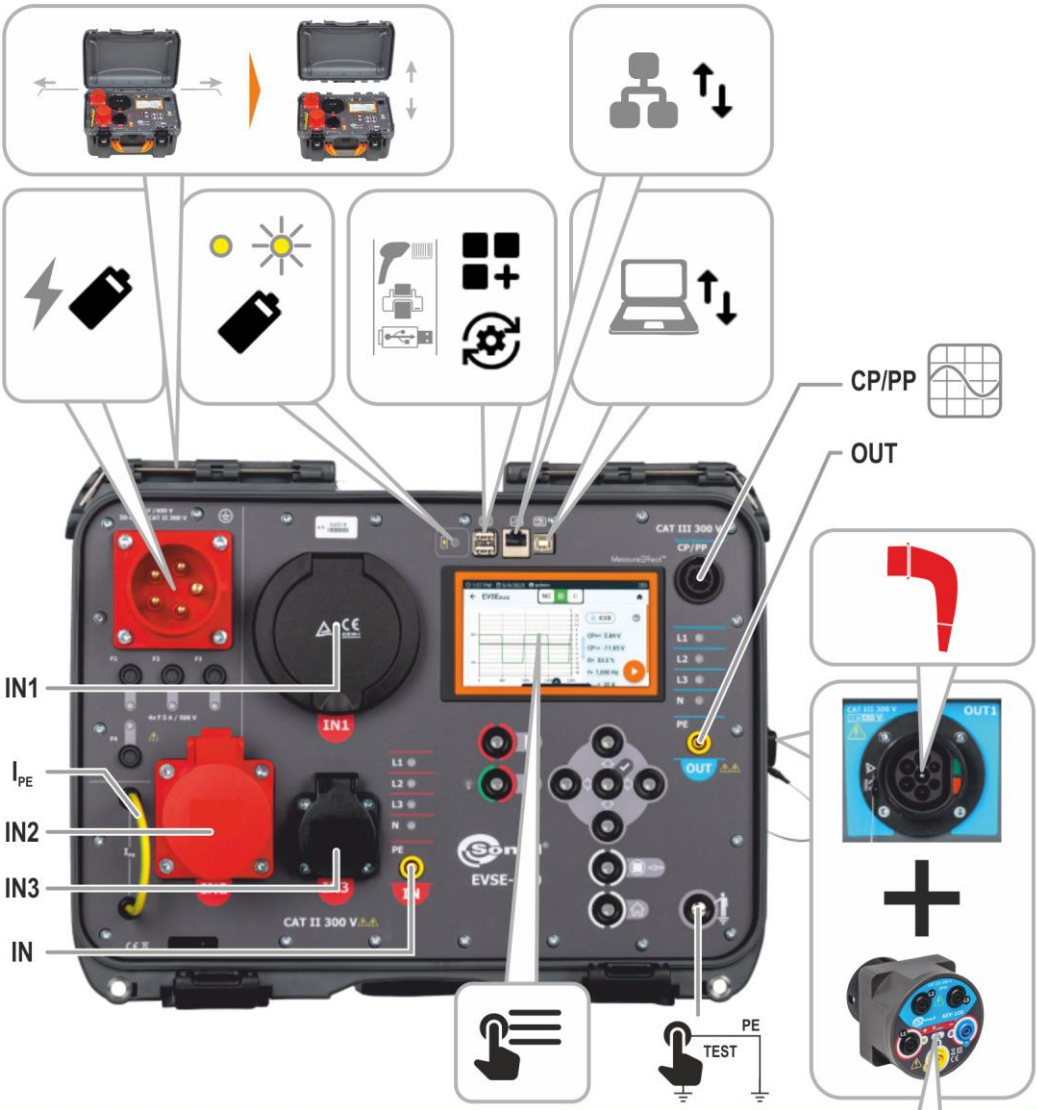


User manual

EVSE-100

Multifunctional analyzer for electric vehicle charging stations


CP/PP
OUT
IN1
I_{PE}
IN2
IN3
IN
PE
TEST
L2
L3
R_{ISO}+ / R_{CONT}+ / R_E H / L (L1)
R_{ISO}– / R_{CONT}– / R_E S / N
R_E E / PE

User manual

EVSE-100

Multifunctional analyzer for electric vehicle charging stations

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

Version 1.02 29.07.2025

The EVSE-100 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), the platform page and the instrument page (**Files** section).

TROUBLE WITH MEASUREMENTS?

You can find all the information about the desired test in the help menu of the respective measurement function.

Download the user manual for the **Sonel MeasureEffect™** platform and find information on the test in it. To do so, visit:

- the Sonel MeasureEffect™ platform web page,
- the web page of your instrument.

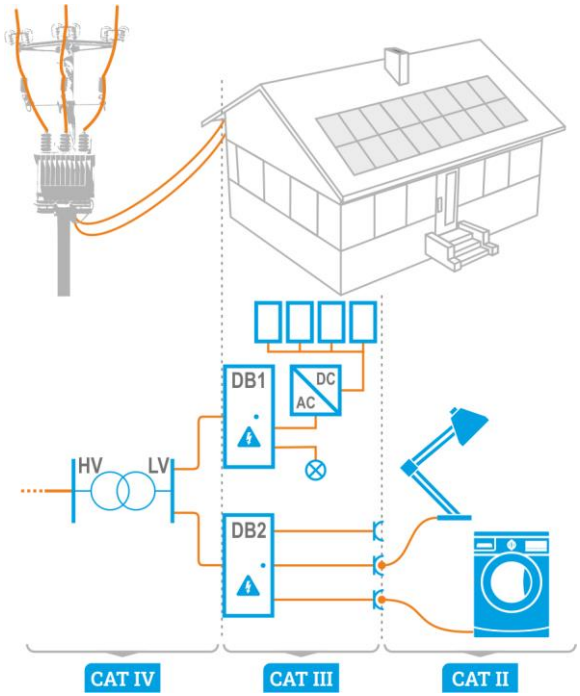
CONTENTS

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		Single insulation (protection class)		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	⚠>550 V	Do not connect the device to systems with voltages above 550 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 with the device in special environments, e.g. potentially fire-risk/explosive environment, it is necessary to consult with the person responsible for health and safety.
- 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.

WARNING

- **Only accessories intended for a given device should be used. Using other accessories may cause damage to measuring terminals, introduce additional measurement errors and create a risk for the user.**
- **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!

It is forbidden to perform measurements: R_{CONT} continuity, and test lead compensation, on energized circuits. This may damage the meter.

- OUT1 meter input is electronically protected against overloads (caused by e.g. connecting the meter to a live circuit) up to 550 V RMS for 60 seconds.
- 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

The EVSE-100 is a tool designed for diagnosing electric vehicle charging stations and cables. It can be used to perform a complete range of tests on these items.

By simulating the CP and PP circuits appropriately, the meter can put the station into various operating states. This makes it possible to verify the functionality of the control system and perform electric shock protection measurements. The functionality and safety checks are complemented by error simulations for both the power supply and the vehicle charging function (CP circuit).

Objects suitable for testing with EVSE-100

EVCS – electric vehicle charging station (type 2 connector, AC, wallbox or stationary, with or without permanently attached EV charging cable, single-phase or three-phase (mode 3 charging))

ICCB – portable electric vehicle charging station (type 2 connector, AC, single-phase or three-phase (mode 2 charging))

EV charging cables (type 2 connector)

Device sockets

IN1 – IEC 62196-2 type 2 female socket. Connect the EV cable (male plug) here.

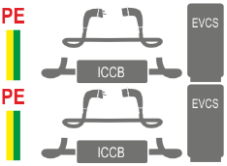
IN2 – 3P+N+PE female socket. For powering a three-phase ICCB charging station

IN3 – 2P+Z female socket. For powering a single-phase ICCB charging station

OUT1 – IEC 62196-2 type 2 male socket. Connect the EVCS or ICCB station (female plug) or cable here.

I_{PE} – cable for measuring the leakage current to the PE cable of the EVCS station (measurement with clamps or a separate clamp meter)

CP/PP – BNC socket For outputting the signal to an oscilloscope.



IN – banana socket Connecting the PE line of the EV cable or ICCB/EVCS station.

OUT – banana socket Connecting the PE line of the EV cable or ICCB/EVCS station.

Basic functions of the device

- Simulation of PP cable parameters:
  - open circuit,
  - 13 A, 20 A, 32 A, 63 A, 80 A.
- Simulation of CP communication:
  - state A – vehicle not connected,
  - state B – vehicle connected, not charging,
  - state C – vehicle connected, charging without ventilation,
  - state D – vehicle connected, charging with ventilation.
- Safety measurements:
  - measurement of short circuit loop Z,
  - measurement of parameters of RCD circuit breakers (AC, A, B, 6 mA DC),
  - measurement of insulation resistance R_{ISO},
  - measurement of R_{CONT},
  - phase sequence indication,
  - measurement of resistance of coding resistor R_C,
  - measurements of grounding R_E.
- EVSE analysis – diagnostics:
  - CP+, CP- voltage,
  - frequency f (PWM),
  - signal filling D (PWM),
  - maximum charging current I_{MAX},
  - graph of CP+, CP-, f, D, I_{MAX},
  - t_{off} off time,
  - t_{on} on time.
- EVSE analysis – simulation of errors (ICCB, EVCS):
  - CPsh – short circuit of CP to PE,
  - Dsh – diode short circuit,
  - PEop – interruption in PE.
- EVSE analysis – simulation of errors (ICCB):
  - L1op – interruption in phase L1,
  - L2op – interruption in phase L2,
  - L3op – interruption in phase L3,
  - Nop – interruption in N,
  - PEop – interruption in PE,
  - L↔PE – interchanged L and PE wires,
  - U_{EXT}(PE) – voltage on PE wire.
- EVSE analysis – transition time between states.

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 61557-3 – 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 3: Loop impedance.
- 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 IEC 61557-5 – 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 5: Resistance to earth.
- EN IEC 61557-6 – 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 6: Effectiveness of residual current devices (RCD) in TT, TN and IT systems.
- 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.
- EN IEC 61010-2-034 – Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-034: Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength.

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 IEC 61851-1 – System Electric vehicle conductive charging system – Part 1: General requirements
- IEC 62955 – Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles – applies to charging stations operating in charging mode 3
- IEC 62752 – In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD) – applies to portable charging cables with integrated RCD EV 6 mA protective device

2 Quick start

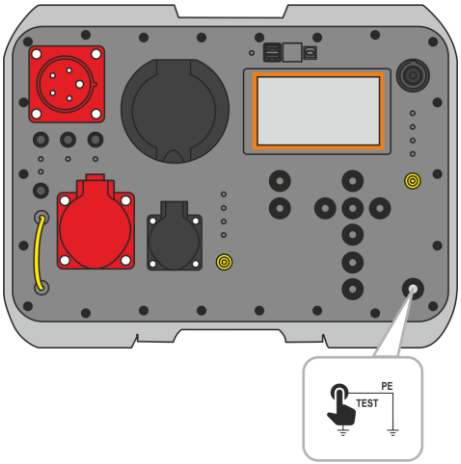
When you start the device for the first time, you must set the interface language and create a user profile (local user account). Finally, set the date, time and time zone.

1		Turn the meter on.
2		Create or log in to a user profile (local 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		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 Voltage check on the PE cable



- Connect the meter to the PE cable of the object being tested, enable the RCD or Z measurement function (except for $Z_{L-N,L-L}$!), touch the electrodes and wait approx. 1 second.
- If the meter detects voltage on the PE cable, it will display a warning. In this case, **immediately stop the measurements and correct the installation error.**

- During the test, be sure to stand on an uninsulated ground. Insulated ground may cause an incorrect test result.
- If the voltage on the PE conductor exceeds the acceptable limit value (approx. 50 V), the meter will signal the fact.
- If the meter is set to IT network, the electrode is inactive.

4 Measurements

WARNING

- **<u>Take particular care during cable measurement.</u> The risk of electric shock is present also after discharging their capacitance by the meter, as the voltage can be rebuilt automatically. Therefore, it is recommended to:**
  - **connect the working cores of the cable to its grounded shield or local grounding before measurement,**
  - **disconnect the grounding of the cores only after connecting the meter's test leads to the cable and only then start the measurement,**
  - **after measuring and discharging the cable by the meter, ground the working cores as in the first step,**
  - **disconnect the grounding of the cores just before applying the operating voltage to the cable.**
- **During measurements, it is recommended to use electrical insulating personal protection equipment, which reduces the risk of touching the wires that may pose a threat to the user.**
- **During measurements of insulation resistance, dangerous voltage up to 1 kV + (0…10%) occurs at the ends of test leads of the 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.**

5 Control signal modulation test

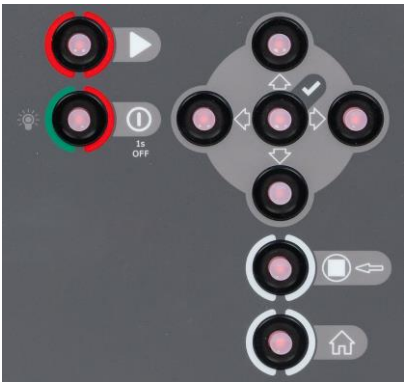
Connect the oscilloscope to the CP socket, in order to obtain information about the Pulse-Width Modulation (PWM) of the control signal. The signal has a frequency of 1 kHz. Signal duty cycle indicates the status of the charging station or the maximum current that the station can supply. The current value can be determined based on the following table, contained in EN IEC 61851-1 standard.

Nominal duty cycle interpretation by vehicle	Maximum current to be drawn by vehicle
Duty cycle < 3 %	Charging not allowed
3 % ≤ duty cycle ≤ 7 %	Indicates that digital communication will be used to control an off-board DC charger or communicate available line current for an on-board charger. Digital communication may also be used with other duty cycles. Charging is not allowed without digital communication. 5 % duty cycle shall be used if the pilot function wire is used for digital communication
7 % < duty cycle < 8 %	Charging not allowed
8 % ≤ duty cycle < 10 %	6 A
10 % ≤ duty cycle ≤ 85 %	Available current = (% duty cycle) × 0,6 A
85 % < duty cycle ≤ 96 %	Available current = (% duty cycle - 64) × 2,5 A
96 % < duty cycle ≤ 97 %	80 A
Duty cycle > 97 %	charging not allowed
If the PWM signal is between 8 % and 97 %, the maximum current may not exceed the values indicated by the PWM even if the digital signal indicates a higher current.	

- Test CP signal in relation to the PE line.
- We recommend using a battery-powered portable oscilloscopes with isolated input and differential probes that ensure galvanic isolation of the oscilloscope.
- If the ground wire of the oscilloscope is not isolated from its casing, then before connecting the oscilloscope, make sure that the PE line of the charging station is free from dangerous voltage!

6 Interface

The physical buttons are used to navigate the menu – just like the touch interface controls. They are necessary for when you turn off the screen touch function.



▲

- Turn on the meter / display brightness (short press)
- Turn off the meter (press and hold)

Start / stop measurement

Up

Down

Left

Right

Confirm

Back / delete sign / stop measurement

Go to the main window

To activate a given interface element, use the arrows to select it (successive selected elements will be highlighted), and then press the ✓ button to confirm your selection. The same principle applies to the entire interface: from measurement screens, through the memory management menu and to the help.

7 Data transmission

7.1 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.

7.2 Data transmission through USB port

1 

Enter the USB mode on the meter.

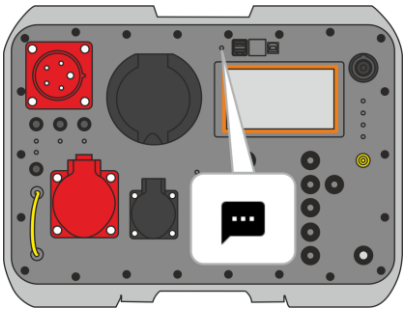
2 

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

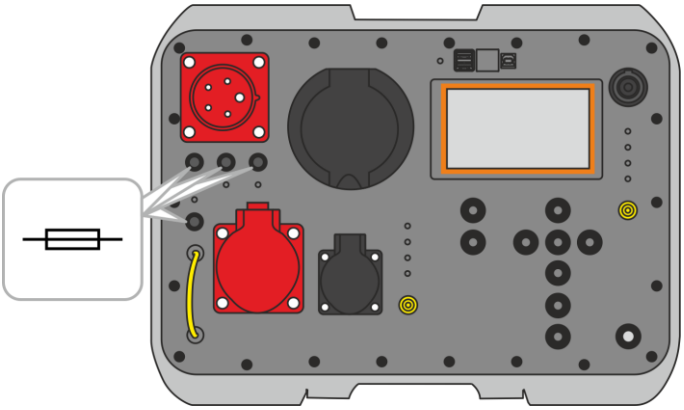


USB communication, data transfer.

8 Fuse replacement

The device is protected by one fast-acting fuses 5 x 20 mm 5 A / 500 V AC. 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.

- **F1** – protects the L1 line.
- **F2** – protects the L2 line.
- **F3** – protects the L3 line.
- **F4** – protects the N line.



NOTE!

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

9 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.

Battery charged.

Battery completely discharged – charge it. All measurements are blocked. The meter will turn off automatically when the battery charge drops to a critical level.


Charging of the battery is in progress.


Battery failure. It is recommended to replace it with a new one.

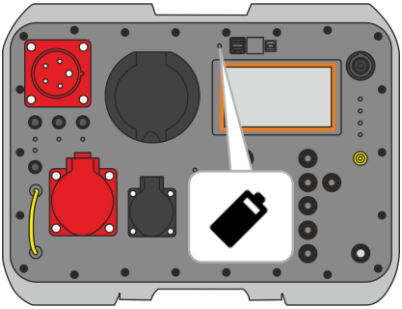

Charging voltage too high. Change the power supply source.


Battery temperature out of permissible range. If a charging is in progress, it will be aborted.


No battery. The meter operates on an external power supply.

Battery status unknown. Contact the customer service centre.

Additional information displayed by the meter



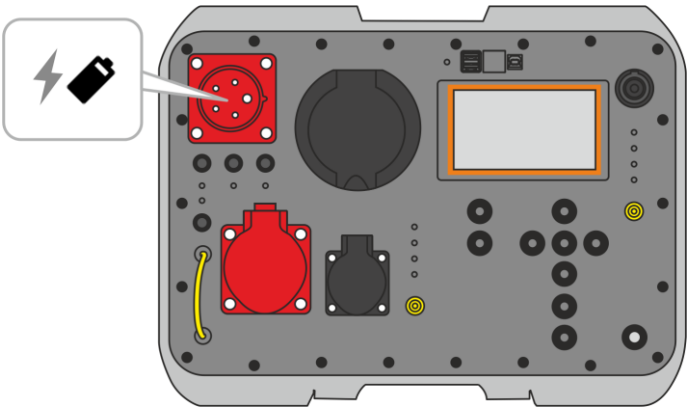

Low battery charge level


Battery problem


Charging of the battery is in progress

9.1 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.

9.2 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.

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

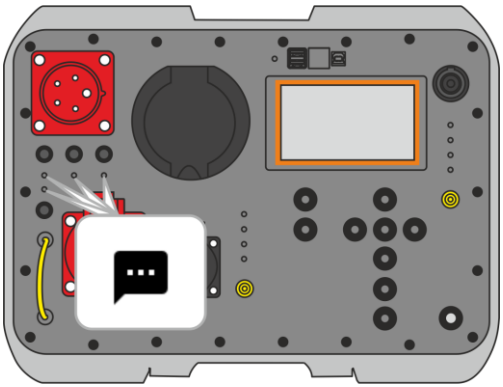
Indication of completed charging is shown by: 100%.

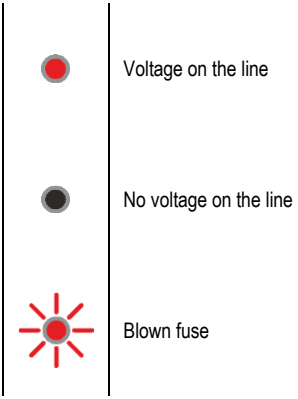
9.3 Power supply from mains

It is possible to charge the battery when carrying out the measurements. To do this, just connect the meter to the 230/400 V power supply using a single- or three-phase cable.

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

Additional information displayed by the meter





9.4 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.

10 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.

11 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**.

12 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.

13 Technical data

13.1 Basic data

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

13.1.1 Measurement of AC/DC voltage

Measurement range: **0 V…500 V**

Display range	Resolution	Accuracy
0.0 V…299.9 V	0.1 V	±(2% m.v. + 6 digits)
300 V…500 V	1 V	±(2% m.v. + 2 digits)

- Frequency range: 45…65 Hz

13.1.2 Measurement of frequency

Display range	Resolution	Accuracy
45.0…65.0 Hz	0.1 Hz	±(0.1% m.v. + 1 digit)

- Voltage range: 50…500 V

13.1.3 Measurement of Z_{L-PE}, Z_{L-N}, Z_{L-L} fault loop impedance

Z_S fault loop impedance measurement

Measuring range according to EN IEC 61557:

Test lead	Z_S measurement range
1.2 m	0.13…1999 Ω
5 m	0.17…1999 Ω
10 m	0.21…1999 Ω
20 m	0.29…1999 Ω
EVCAB 2.2 m	0.15…1999 Ω

Display ranges:

Display range	Resolution	Accuracy
0…19.99 Ω	0.01 Ω	±(5% m.v. + 3 digits)
20.0…199.9 Ω	0.1 Ω	±(5% m.v. + 3 digits)
200…1999 Ω	1 Ω	±(5% m.v. + 3 digits)

- Rated operating voltage U_{nL-N}/U_{nL-L}: 220/380 V, 230/400 V, 240/415 V
- Voltage operating range: 180…270 V (for Z_{L-PE} and Z_{L-N}) and 180…460 V (for Z_{L-L})
- Mains rated frequency f_n: 50 Hz, 60 Hz
- Frequency operating range: 45…65 Hz
- Maximum test current: 7.6 A for 230 V (4x10 ms), 13.3 A for 400 V (4x10 ms)
- Check of PE terminal connection correctness with the contact electrode (for Z_{L-PE})

Readings of fault loop impedance R_S and fault loop reactance X_S

Display range	Resolution	Accuracy
0…19.99 Ω	0.01 Ω	±(5% + 5 digits) of Z_S value
20.0…199.9 Ω	0.1 Ω	±(5% + 5 digits) of Z_S value

- Calculated and displayed for Z_S values <200 Ω

Readings of short-circuit current I_K

Measurement ranges according to EN IEC 61557 can be calculated from the measurement ranges Z_S and rated voltages.

Display range	Resolution	Accuracy
0.110…1.999 A	0.001 A	Calculated on the basis of accuracy for the fault loop
2.00…19.99 A	0.01 A	
20.0…199.9 A	0.1 A	
200…9999 A	1 A	

- Prospective fault current calculated and displayed by the meter may slightly differ from the value calculated by the user with a calculator, basing on the displayed value of the impedance, because the meter calculates the current from unrounded value of fault loop impedance (which is used for displaying). As the correct value, consider I_k current value, displayed by the meter or by firmware.

13.1.4 Measurement of $Z_{L\text{-}PE[RCD]}$ fault loop impedance (without tripping the RCD)

Z_S fault loop impedance measurement

Measuring range according to EN IEC 61557: **0.5…1999 Ω** for the 1.2 m leads and **0.51…1999 Ω** for the 5 m, 10 m and 20 m leads and EVCAB 2.2 m

Display range	Resolution	Accuracy
0…19.99 Ω	0.01 Ω	±(6% m.v. + 10 digits)
20.0…199.9 Ω	0.1 Ω	±(6% m.v. + 5 digits)
200…1999 Ω	1 Ω	±(6% m.v. + 5 digits)

- Does not trip the RCD's with $I_{\Delta n} \geq 30$ mA
- Rated operating voltage U_n: 220 V, 230 V, 240 V
- Voltage operating range: 180…270 V
- Mains rated frequency f_n: 50 Hz, 60 Hz
- Frequency operating range: 45…65 Hz
- Check of PE terminal connection correctness with the contact electrode

Readings of fault loop impedance R_S and fault loop reactance X_S

Display range	Resolution	Accuracy
0…19.99 Ω	0.01 Ω	±(6% + 10 digits) of Z_S value
20.0…199.9 Ω	0.1 Ω	±(6% + 5 digits) of Z_S value

- Calculated and displayed for Z_S values <200 Ω

Readings of short-circuit current I_K

Measurement ranges according to EN IEC 61557 can be calculated from the measurement ranges Z_S and rated voltages.

Display range	Resolution	Accuracy
0.110…1.999 A	0.001 A	Calculated on the basis of accuracy for the fault loop
2.00…19.99 A	0.01 A	
20.0…199.9 A	0.1 A	
200…9999 A	1 A	

- Prospective fault current calculated and displayed by the meter may slightly differ from the value calculated by the user with a calculator, basing on the displayed value of the impedance, because the meter calculates the current from unrounded value of fault loop impedance (which is used for displaying). As the correct value, consider I_k current value, displayed by the meter or by firmware.

13.1.5 Measurement of $Z_{L\text{-}PE[RCD]}$ fault loop impedance (without tripping the RCD) – EV type RCD

Z_S fault loop impedance measurement

Measuring range according to EN IEC 61557: **0.5…1999 Ω** for the 1.2 m leads and **0.51…1999 Ω** for the 5 m, 10 m and 20 m leads and EVCAB 2.2 m

Display range	Resolution	Accuracy
0…19.99 Ω	0.01 Ω	±(6% m.v. + 10 digits)
20.0…199.9 Ω	0.1 Ω	±(7% m.v. + 5 digits)
200…1999 Ω	1 Ω	±(7% m.v. + 5 digits)

- Does not trip the EV type RCDs with $I_{\Delta n} \geq 15$ mA
- Rated operating voltage U_n: 220 V, 230 V, 240 V
- Voltage operating range: 180…270 V
- Mains rated frequency f_n: 50 Hz, 60 Hz
- Frequency operating range: 45…65 Hz
- Check of PE terminal connection correctness with the contact electrode

Readings of fault loop impedance R_S and fault loop reactance X_S

Display range	Resolution	Accuracy
0…19.99 Ω	0.01 Ω	±(6% + 10 digits) of Z_S value
20.0…199.9 Ω	0.1 Ω	±(7% + 5 digits) of Z_S value

- Calculated and displayed for Z_S values <200 Ω

Readings of short-circuit current I_K

Measurement ranges according to EN IEC 61557 can be calculated from the measurement ranges Z_S and rated voltages.

Display range	Resolution	Accuracy
0.110…1.999 A	0.001 A	Calculated on the basis of accuracy for the fault loop
2.00…19.99 A	0.01 A	
20.0…199.9 A	0.1 A	
200…9999 A	1 A	

- Prospective fault current calculated and displayed by the meter may slightly differ from the value calculated by the user with a calculator, basing on the displayed value of the impedance, because the meter calculates the current from unrounded value of fault loop impedance (which is used for displaying). As the correct value, consider I_k current value, displayed by the meter or by firmware.

13.1.6 Measurement of earth resistance – 3-pole method (R_E3P)

The measurement method: 3-pole, in accordance with EN IEC 61557-5.
Measuring range according to EN IEC 61557-5: **0.85 Ω…1999 Ω** for U_n = 50 V.

Display range	Resolution	Accuracy
0.00…19.99 Ω	0.01 Ω	±(3% m.v. + 5 digits)
20.0…199.9 Ω	0.1 Ω	
200…1999 Ω	1 Ω	±5% m.v.

- Measuring current at the short circuit: 15 mA
- Measuring frequency: 125 Hz or 150 Hz
- Selected test voltage: 25 V or 50 V
- Maximum interference voltage for the R_E measurement: 24 V
- Maximum resistance of auxiliary earth electrodes: 2 kΩ

Measurement of resistance of auxiliary earth electrodes R_H, R_S

Display range	Resolution	Accuracy
0…999 Ω	1 Ω	±(5% (R_S + R_E + R_H) + 8 digits)
1.00…1.99 kΩ	0.01 kΩ	

13.1.7 Measurement of the RCD parameters

- Measurement of RCDs type: AC, A, B, B+, F, EV
- Rated operating voltage U_n: 220 V, 230 V, 240 V
- Voltage operating range: 180…270 V
- Mains rated frequency f_n: 50 Hz, 60 Hz
- Frequency operating range: 45…65 Hz

RCD tripping test and t_A tripping time measurement (for t_A measurement function)

Measuring range according to EN IEC 61557-6: **10 ms … to the upper limit of displayed value**

RCD type	Multiplication factor setting	Display range	Resolution	Accuracy
General type and short-time delay type	0.5 $I_{\Delta n}$	0…300 ms	1 ms	±(2% m.v. + 2 digits)[1]
	1 $I_{\Delta n}$			
	2 $I_{\Delta n}$	0…150 ms		
	5 $I_{\Delta n}$	0…40 ms		
Selective	0.5 $I_{\Delta n}$	0…500 ms		
	1 $I_{\Delta n}$			
	2 $I_{\Delta n}$	0…200 ms		
	5 $I_{\Delta n}$	0…150 ms		
▪ EV 6 mA DC ▪ RCM	1 $I_{\Delta n}$	0.0…10.0 s	0.1 s	±(2% m.v. + 3 digits)
	10 $I_{\Delta n}$	0…300 ms	1 ms	
	33 $I_{\Delta n}$[2]	0…100 ms		
	50 $I_{\Delta n}$[3]	0…40 ms		

1) for $I_{\Delta n}$ = 10 mA and 0.5 $I_{\Delta n}$ accuracy is ±(2% m.v. + 3 digits)
2) for measurements acc. to IEC 62955
3) for measurements acc. to IEC 62752

- Accuracy of differential current setting:
  - ▪ for 1 $I_{\Delta n}$, 2 $I_{\Delta n}$, 5 $I_{\Delta n}$ ..... 0…8%
  - ▪ for 0.5 $I_{\Delta n}$ .....-8…0%

Effective value of forced leakage current at measurement of RCD disconnection time (does not apply to RCD EV 6 mA DC and RCM) [mA]

$I_{\Delta n}$	Multiplication factor setting											
	0.5			1			2			5		
	∿	∿	⎓	∿	∿	⎓	∿	∿	⎓	∿	∿	⎓
10	5	3.5	5	10	20	20	20	40	40	50	100	100
15	7.5	5.25	7.5	15	30	30	15	60	60	75	150	150
30	15	10.5	15	30	42	60	60	84	120	150	210	300
100	50	35	50	100	140	200	200	280	400	500	–	–
300	150	105	150	300	420	–	–	–	–	–	–	–
500	250	175	250	500	–	–	–	–	–	–	–	–

Effective value of forced leakage current at measurement of RCD disconnection time (applies to RCD EV 6 mA DC and RCM) [mA]

$I_{\Delta n}$	Multiplication factor setting			
	1	10	33	50
6 mA DC acc. to IEC 62955	6	60	200	—
6 mA DC acc. to IEC 62752	6	60	—	300

R_E – protective conductor resistance for RCD

Selected RCD rated current	Measurement range	Resolution	Test current	Accuracy
10 mA	0.01 kΩ…5.00 kΩ	0.01 kΩ	4 mA	0….+10% m.v. ±8 digits
15 mA	0.01 kΩ…3.33 kΩ		5.3 mA	0….+10% m.v. ±5 digits
30 mA	0.01 kΩ…1.66 kΩ		12 mA	
100 mA	1 Ω…500 Ω	1 Ω	40 mA	0….+5% m.v. ±5 digits
300 mA	1 Ω…166 Ω		120 mA	
500 mA	1 Ω…100 Ω		200 mA	

Measurement of touch voltage U_B referred to rated residual current

Measuring range according to EN IEC 61557: **10…50 V**

Measurement range	Resolution	Test current	Accuracy
0…9.9 V	0.1 V	0.4 $I_{\Delta n}$	0…10% m.v. ± 5 digits
10.0…99.9 V			0…15% m.v.

RCD I_A tripping current measurement for sinusoidal residual current

Measuring range according to EN IEC 61557: **(0.3…1.0)$I_{\Delta n}$**

Selected RCD rated current	Measurement range	Resolution	Test current	Accuracy
10 mA	3.0…10.0 mA	0.1 mA	0.3 $I_{\Delta n}$…1.0 $I_{\Delta n}$	±5% $I_{\Delta n}$
15 mA	4.5…15.0 mA			
30 mA	9.0…30.0 mA			
100 mA	30…100 mA	1 mA		
300 mA	90…300 mA			
500 mA	150…500 mA			

- It is possible to start the measurement from positive or negative half-period of forced residual current
- Test current flow time: max. 3200 ms

Measurement of RCD disconnection current I_A for differential unidirectional pulsed current and unidirectional pulsed current with 6 mA direct current offset

Measuring range according to EN IEC 61557: **$(0.4…1.4)I_{\Delta n}$** for $I_{\Delta n}$≥30 mA and **$(0.4…2)I_{\Delta n}$** for $I_{\Delta n}$=10 mA

Selected RCD rated current	Measurement range	Resolution	Test current	Accuracy
10 mA	3.5…20.0 mA	0.1 mA	0.35 $I_{\Delta n}$…2.0 $I_{\Delta n}$	±10% $I_{\Delta n}$
15 mA	5.3…21.0 mA		0.35 $I_{\Delta n}$…1.4 $I_{\Delta n}$	
30 mA	10.5…42.0 mA		0.35 $I_{\Delta n}$…1.4 $I_{\Delta n}$	
100 mA	35…140 mA	1 mA		
300 mA	105…420 mA			

- Measurement may be performed for positive or negative half-periods of forced leakage current
- Test current flow time: max. 3200 ms

Measurement of RCD disconnection current I_A for differential direct current

Measuring range according to EN IEC 61557: **$(0.2…2)I_{\Delta n}$**

Selected RCD rated current	Measurement range	Resolution	Test current	Accuracy
6 mA [1)]	1.0…6.0 mA	0.1 mA	1.0…6.0 mA	±6% $I_{\Delta n}$
10 mA	2.0…20.0 mA	0.1 mA	0.2 x $I_{\Delta n}$…2.0 x $I_{\Delta n}$	±10% $I_{\Delta n}$
15 mA	3.0…30 mA			
30 mA	6…60 mA	1 mA		
100 mA	20…200 mA			
300 mA	60…600 mA			

- Measurement can be performed for positive or negative forced leakage current
- Test current flow time (does not apply to RCD EV and RCM): max. 3200 ms

1) Test current flow time (applies to RCD EV and RCM)
   - acc. to IEC 62955.....30 s
   - acc. to IEC 62752.....40 s

13.1.8 Measurement of insulation resistance

Measuring range according to EN IEC 61557-2 for U_N = 50 V: **50 kΩ…49.9 MΩ**

Display range for U_N = 50 V	Resolution	Accuracy
0…1999 kΩ	1 kΩ	±(5% m.v. + 8 digits)
2.00…19.99 MΩ	0.01 MΩ	
20.0…49.9 MΩ	0.1 MΩ	

Measuring range according to EN IEC 61557-2 for U_N = 100 V: **100 kΩ…99.9 MΩ**

Display range for U_N = 100 V	Resolution	Accuracy
0…1999 kΩ	1 kΩ	±(5% m.v. + 8 digits)
2.00…19.99 MΩ	0.01 MΩ	
20.0…99.9 MΩ	0.1 MΩ	

Measuring range according to EN IEC 61557-2 for U_N = 250 V: **250 kΩ…199.9 MΩ**

Display range for U_N = 250 V	Resolution	Accuracy
0…1999 kΩ	1 kΩ	±(5% m.v. + 8 digits)
2.00…19.99 MΩ	0.01 MΩ	
20.0…199.9 MΩ	0.1 MΩ	

Measuring range according to EN IEC 61557-2 for U_N = 500 V: **500 kΩ…599.9 MΩ**

Display range for U_N = 500 V	Resolution	Accuracy
0…1999 kΩ	1 kΩ	±(5% m.v. + 8 digits)
2.00…19.99 MΩ	0.01 MΩ	
20.0…599.9 MΩ	0.1 MΩ	

Measuring range according to EN IEC 61557-2 for U_N = 1000 V: **1000 kΩ…599.9 MΩ**

Display range for U_N = 1000 V	Resolution	Accuracy
0…1999 kΩ	1 kΩ	±(8% m.v. + 8 digits)
2.00…19.99 MΩ	0.01 MΩ	
20.0…599.9 MΩ	0.1 MΩ	

- Type of test voltage: DC
- Test voltage: 50 V, 100 V, 250 V, 500 V, 1000 V
- Accuracy of generated voltage (R_{LOAD} [Ω] ≥ 1000*U_N [V]): -0+10% from the set value
- Detection of a dangerous voltage before commencing a measurement
- Discharging the tested object
- Measurement of voltage on OUT1 terminals within the range of: 0…440 V
- Test current: <2 mA
- Discharge time of C=2 µF capacitance charged to 1000 V: <30 s

Long-term exposure to moisture will impair the performance of the OUT1 socket. If the meter is stored and/or operated in humidity conditions other than those specified in **section 13.2**, the measurement accuracy may be reduced.

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 (1.6 mA)

13.1.9 Low-voltage measurement of continuity and resistance

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

Measuring range according to EN IEC 61557-4: **0.12…400 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…400 Ω	1 Ω	

- Voltage at open terminals: 4…20 V
- Output current at R < 2 Ω: I_{SC} = 200…250 mA
- Compensation of test leads resistance
- Measurements for both current polarizations

Continuity testing of EV cable wires (wires: L1, L2, L3, N, PE, CP) with ±200 mA

Measuring range according to EN IEC 61557-4: **0.20…400 Ω**

Display range	Resolution	Accuracy
0.00…19.99 Ω	0.01 Ω	±(3% m.v. + 5 digits)
20.0…199.9 Ω	0.1 Ω	
200…400 Ω	1 Ω	

- Voltage at open terminals: 4…20 V
- Output current at R < 2 Ω: I_{SC} = 200…250 mA
- Measurements for both current polarizations

13.1.10 Phase sequence

- Phase sequence indication: correct, incorrect
- Range of mains voltage U_{L-L}: 100…440 V (45…65 Hz)
- Display of phase-to-phase voltages

13.1.11 Resistance of coding resistor

Measurement of R_C resistors (PP-PE) – IN PEop socket and OUT PEpp

Measuring range according to EN IEC 61557-4: **0.32…6000 Ω**

Display range	Resolution	Accuracy
0,00…19,99 Ω	0,01 Ω	±(3% m.v. + 8 digits)
20,0…199,9 Ω	0,1 Ω	
200…6000 Ω	1 Ω	

- Voltage at open terminals: 4…20 V
- Output current at R < 2 Ω: I_{SC} = 200…250 mA
- Measurements for both current polarizations

13.1.12 Simulation of PP cable parameters

Display range	Value	Accuracy
NC	Open circuit	-
13 A	1500 Ω	±2%
20 A	680 Ω	±2%
32 A	220 Ω	±2%
63 A	100 Ω	±2%
80 A	56 Ω	±3%

13.1.13 Simulation of CP communication

Display range	Value	Accuracy
State A – vehicle not connected	Open circuit	-
State B – vehicle connected, not charging	2740 Ω	±1%
State C – vehicle connected, charging without ventilation	882 Ω	±1%
State D – vehicle connected, charging with ventilation	246 Ω	±1%

13.1.14 $EVSE_{DIAG}$ diagnostics

Voltage measurement for CP (PWM) and PP signals

Display range	Resolution	Accuracy
-19.99… 19.99 V	0.01 V	±(1% m.v. + 8 digits)

- Separate positive and negative voltage amplitude for CP (CP+, CP-)

Measurement of frequency f (PWM) for CP signal

Measuring range according to EN IEC 61557-4: **950…1050 Hz**

Display range	Resolution	Accuracy
800…1200 Hz	1 Hz	±1 digit

- Voltage range: 3…20 V

Measurement of duty cycle (D) for CP signal (PWM)

Measuring range according to EN IEC 61851-1: **3.0...97.0%**

Display range	Resolution	Accuracy
1.0…99.0%	0.1%	±3 digits

- Voltage range: 3…20 V

Maximum charging current I_{MAX}

Display range	Resolution	Accuracy
0…80 A	1 A	-

- Voltage range: 3…20 V
- Determined based on the “Measurement of the duty cycle (D) for the CP (PWM) signal” section according to EN IEC 61851-1

13.1.15 $EVSE_{ERR}$ station error simulation

OUT station error simulation

Error type	Display range	Resolution	Accuracy
Short circuit of CP to PE (CPsh)	0…3100 ms	1 ms	±(3% m.v. + 3 digits)
Diode short circuit (Dsh)			
Interruption in PE (PEop)	0…1000 ms		

IN station error simulation

Error type	Display range	Resolution	Accuracy
Interruption in phase L1 (L/L1op)	as in $EVSE_{DIAG}$	as in $EVSE_{DIAG}$	as in $EVSE_{DIAG}$
Interruption in phase L2 (L/L2op)			
Interruption in phase L3 (L/L3op)			
Interruption in N (Nop)			
Interruption in PE (PEop)			
Interchanged L1 and PE wires (L1↔PE)			
Interchanged L2 and PE wires (L2↔PE)			
Interchanged L3 and PE wires (L3↔PE)			
Voltage on PE wire (U_{EXT}(PE))			

- Voltage range: 3…20 V
- Determined based on the “Measurement of the duty cycle (D) for the CP (PWM) signal” section according to EN IEC 61851-1

13.1.16 Transition time between states

Measurement of the transition time for the charger (ICCB, EVCS)

Transition between states	Display range	Resolution	Accuracy
A→C, B→C, A→D, B→D	0…3100 ms	1 ms	±(3% m.v. + 3 digits)
C→A, C→B, D→A, D→B	0…1000 ms		

13.2 Operating data

a) type of insulation acc. to EN 61010-1 and EN IEC 61557 ..... single
b) measurement category acc. to EN IEC 61010-2-030
   - socket OUT1 – rated operating altitude ≤2000 m ..... CAT III 300 V
   - socket IN1, IN2, IN3 – rated operating altitude ≤2000 m ..... CAT II 300 V
c) ingress protection acc. to EN 60529
   - open enclosure IP20
   - closed enclosure IP54
d) power supply
   - mains ..... 220…240 V / 380…415 V, 50…60 Hz
   - rechargeable battery ..... Li-Ion 7.2 V 9.8 Ah
e) power supply line load current ..... max. 5 A (230 / 400 V)
f) dimensions ..... 429 x 328 x 236 mm
g) weight ..... ca. 8.7 kg
h) storage temperature ..... -20…+70°C
i) operating temperature ..... -10…+45°C
j) humidity ..... 20…90%
k) reference temperature ..... +23°C ± 2°C
l) reference humidity ..... 40%…60%
m) display ..... LCD, color capacitive touchscreen 5" ..... resolution 1280x720 dots, max brightness 700 cd/m^2
n) number of R_{ISO} measurements acc. to EN IEC 61557-2 with battery power supply ..... min. 600
o) time of operation on a single battery charge
   - for R_{ISO}=1 MΩ, U_{ISO}=500 V, T=(23±5)°C, screen backlight 50% ..... approx. 3 h
   - under conditions according to EN IEC 61557-2 p. 6.7, screen backlight 50% ..... approx. 7 h
p) memory of measurement results ..... 9999 results
q) transmission of results – wired ..... USB-B, RJ-45
r) transmission of results – wireless
   - interface ..... Bluetooth, Wi-Fi
   - range ..... up to 10 m
s) communication with external device – wired ..... USB-A
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!
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 EVSE-100 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/

13.3 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

13.4 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.

13.4.1 Additional uncertainties according to EN IEC 61557-3 (Z)

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0% (1% not displayed)
Temperature 0°C…35°C	E_3	1.2 m lead – 0 Ω 5 m lead – 0.011 Ω 10 m lead – 0.019 Ω 20 m lead – 0.035 Ω EVCAB 2.2 m – 0.015 Ω
Phase angle 0°…30° at the bottom of measurement range	$E_{6.2}$	0.6%
Frequency 95%…105	E_7	0%
Mains voltage 85%…110%	E_8	0%
Harmonics	E_9	0%
DC component	E_{10}	0%

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

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0% (1% not displayed)
Temperature 0°C…35°C	E_3	1.5%

13.4.3 Additional uncertainties according to EN IEC 61557-6 (RCD)

I_A, t_A, U_B

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0% (1% not displayed)
Temperature 0°C…35°C	E_3	0%
Electrodes resistance	E_5	0%
Mains voltage 85%…110%	E_8	0%

13.4.4 Influence of serial interference voltage on the resistance measurements for function R_E3P

R_E	U_N	Additional uncertainty [Ω]
0.00…10.00 Ω	25 V	$\pm(0.001R_E+0.01)U_z+0.007U_z^2$
	50 V	$\pm(0.001R_E+0.01)U_z+0.004U_z^2$
10.01…1999 Ω	25 V, 50 V	$\pm(0.001R_E+0.01)U_z+0.001U_z^2$

13.4.5 Influence of the auxiliary electrodes on earth resistance measurements for function R_E3P

R_H, R_S	Additional uncertainty [%]
$R_H \leq 1.99$ kΩ $R_S \leq 1.99$ kΩ	$\pm(\frac{R_S}{R_S+100000}\cdot 150+\frac{R_H\cdot 0.17}{R_E})$

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

13.4.6 Additional uncertainties according to EN IEC 61557-5 (R_E3P)

Significant parameter	Designation	Additional uncertainty
Position	E_1	0%
Supply voltage	E_2	0% (1% not displayed)
Temperature	E_3	±0.2 digit/°C for R<1 kΩ ±0.07%/°C ± 0.2 digit/°C for R≥1 kΩ
Serial interference voltage	E_4	According to the formulas shown in sec. 13.4.4 (U_N=3 V 50/60 Hz)
Resistance of auxiliary electrodes	E_5	According to the formula in sec. 13.4.5

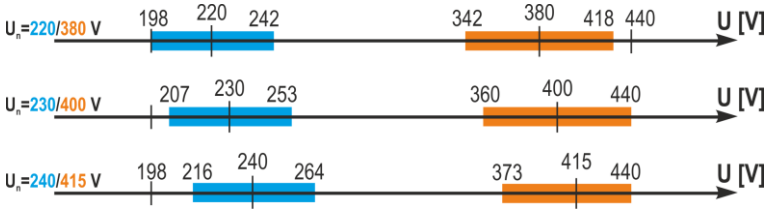
13.5 Prospective short-circuit current

The device always measures impedance, and the short-circuit current displayed is calculated from the formula:

$$I_k = \frac{U_n}{Z_S}$$

where:
U_n – rated voltage of the network being tested,
Z_s – impedance measured.

In a case when the installation voltage is outside of tolerance, the meter will not be able to determine the rated voltage for the short-circuit current calculation. In such event the display will show horizontal dashes instead of the short-circuit current value. The figure below shows the voltage ranges for which the short-circuit current is calculated.



Relationship between the network voltage and the ability to calculate the short-circuit current
– the U_{L-N} voltage ranges, for which the short-circuit current is calculated
– the U_{L-L} voltage ranges, for which the short-circuit current is calculated
198 V...440 V – the voltage range for which the impedance measurement is performed

14 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.

NOTES

TROUBLE WITH MEASUREMENTS?

You can find all the information about the desired test in the help menu of the respective measurement function.

Download the user manual for the **Sonel MeasureEffect™** platform and find information on the test in it. To do so, visit:
- the Sonel MeasureEffect™ platform web page,
- the web page of your instrument.

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