



Measurement instruments

**MEASURE
COMPREHENSIVELY**
CHEAPER IN A SET

By choosing Sonel WME, you gain



Multiple products
in one suitcase



Set for specific
applications



Lower price



New

Sonel PVM-1530 Max

Set for measurements
in photovoltaic
systems

page 43



New

Sonel PQM-750

Power quality
analyzer

page 146



New

Sonel EVSE-100

Multifunctional
analyzer for electric
vehicle charging
stations

page 38



New

Sonel PVM-1021

Photovoltaic
meter

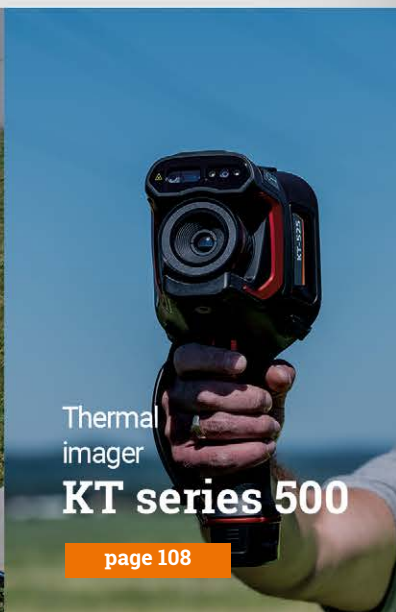
page 46



Cable and underground
infrastructure locator

Sonel LKZ-2500

page 132



Thermal
imager

KT series 500

page 108



Remote control

High-current fault loop impedance meter

Sonel MZC-340-PV

page 79

Sonel software	8
Measurement sets	10
	Measurement sets NEW! Sonel WME-9 / 12 / 13 10
Electrical safety measurements	16
	Multi-function instruments NEW! Sonel EVSE-100 20-40
	Residual current device measurements PV installation measurements NEW! Sonel PVM-1530, PVM-1021 Accessories 41-54
	Insulation resistance measurements NEW! MIC-RS (RS-485) Accessories 55-74
	Fault loop measurements Accessories 75-86
	Earth (ground) measurements NEW! Sonel MRU-12 Accessories 87-101
	Sonel Reports Plus software 101
Temperature measurements	102
	Thermal imagers, pyrometers Accessories 106-116
	Sonel ThermoAnalyze software 111
High voltage measurements	117
	Partial discharges meters High voltage insulation testers 118-122
Low resistance measurements	123
	Low resistance meters Accessories 125-129
Location of hidden infrastructure and faults	130
	Cable and underground infrastructure locators Reflectometers Accessories 132-138

Illuminance measurements	139
	Illuminance meters Accessories 140
Power quality analysis	142
	Power quality analyzers NEW! Sonel PQM-750 Accessories 144-156
	Sonel Analysis software 158
Safety of electrical equipment	159
	Safety of electrical equipment NEW! Sonel PAT-95 / 96 Accessories 161-166
	Sonel PAT Analysis software 165
Handheld devices	167
	Clamp meters NEW! Sonel CMP-100 Accessories 170-179
	Multimeters Accessories 180-186
	Voltage testers 187-188
	Distance meter 188
	Phase sequence testers 189
Other devices	190
	Battery tester 191
	Acoustic imager 192
	Leakage current alarm signaller 193
	Demonstration boards 194-195
	Tools 196
SMT and THT assembly	197
Laboratory	198

Find out what problems you can solve **using Sonel products**.

Scan the code of the selected area **with your smartphone**.



Scan me

Electromobility

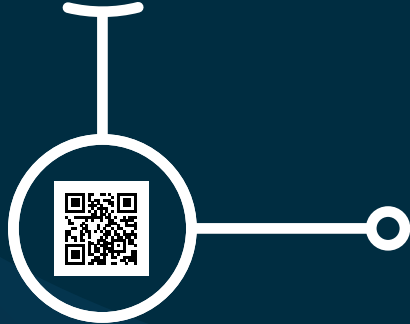
EVSE (*Electric Vehicle Supply Equipment*) charging stations are increasingly becoming part of the landscape of our cities, homes, workplaces and public spaces. Ensuring **maximum user safety** when operating them is the philosophy that defines our products. It is also important to guarantee **maximum comfort and ergonomics** by means of proper lighting in the charging area.



Scan me

Photovoltaics

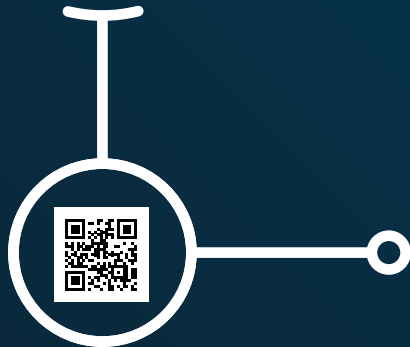
Photovoltaic systems represent an **environmentally friendly source of renewable energy**. Photovoltaic cells work all year round - even in winter and the only condition for their operation is the presence of sunlight. Our equipment makes it possible to **measure the parameters of these systems**. A range of DC and AC side tests according to **EN 62446** is available, as well as all measurements to determine the **safety status of domestic electrical systems**.



Scan me

Industry and Production

Sonel devices let you monitor the production process as well as the quality of the manufactured products. Analyse the power quality and the electrical installation status in order to avoid failure of your machines and devices. Control the safety parameters, ensure trouble-free operation and optimise energy generation in the facility thanks to the use of numerous dedicated series of measuring instruments and thermal imaging cameras. Using Sonel instruments, you can also ensure the continuity of operation by diagnosing problems before the occurrence of failure of important installations and devices.



Scan me

Energy Efficiency

In an era of rising utility prices, any savings are very welcome. When electricity, heat or fuel becomes more expensive, logic dictates that action needs to be taken appropriately to optimise the bills. Just which ones, specifically? How do you identify where and how to reduce costs? We want to help you answer these questions and offer you the tools you need to achieve your objectives: to improve energy efficiency with your customers, in your own business and at your home.

Stay up to date with our series of articles on areas of applications **and increase your safety.**

Time has allowed us to gain experience. We are a leader on the market!

- 1989** The beginning of activity as the Innovation Implementation Centre in Wrocław
- 1990** The first digital fault loop tester is created
- 1994** The production plant in Świdnica is opened
- 1995** The first Polish microprocessor-based insulation resistance meter is created
- 1996** Export sales of meters are initiated
- 1997** Start-up of surface mounting process in an automated line, and the creation of the first Polish microprocessor-based fault loop impedance meter
- 1998** Change of company name and legal entity
- 1999** The first Polish microprocessor-based earth resistance meter is manufactured
- 2001** Implementation and certification of quality management system
- 2004** First multi-function meter
- 2006** Sales in over 20 countries around the world
- 2008** Relocation to new headquarters and purchase of the most modern SMT assembly line in the world
- 2008** Debut on the Warsaw Stock Exchange
- 2008** Over 200 employees barrier exceeded
- 2010** Thermal imagers added to offer
- 2011** Creation of the first Polish safety tester of electrical equipment
- 2012** Implementation of SPS production management system
- 2013** Establishment of the Polish-Indian company Sonel Instruments India Private Limited
- 2013** Foxytech founded
- 2015** Start of cooperation with Lincoln Electric and acquisition of Lower Silesian Economic Certificate
- 2016** Won gold medal at the ENERGETAB trade fair in Bielsko-Biała - the largest electrotechnics and energy exhibition in Poland for PQM-711: power quality analyzer
- 2017** Acquisition of accreditation of Polish Centre for Accreditation
- 2018** Won gold medal at the ENERGETAB trade fair for MPI-540: multi-function meter of electrical system parameters
- 2019** We are celebrating 25 years on the market
- 2020** Launch of the company's digital transformation
- 2022** Sonel MIC-2511: the first meter operating within the MeasureEffect™ platform
- 2022** Establishment of a subsidiary company in Singapore: Sonel South East Asia Pte Ltd
- 2023** Commissioning of a new automatic assembly line
- 2023** Establishment of the Customer Service
- 2024** Over 360 employees barrier exceeded
- 2024** Establishment of the Polish-German company MBS-Sonel GmbH
- 2024** We are celebrating 30 years on the market



Quality and safety

Our products have achieved a high position on the market thanks to the continuous development of the technologies and functions of the products we offer and their adaptation to market requirements. This has been confirmed by the following international certificates: **Quality Management System ISO 9001:2015, Environmental Management System ISO 14001:2015, and Occupational Health and Safety Management System ISO 45001:2018**. Manufactured instruments are compliant with standards **EN 61557, EN 61010 as well as the electromagnetic compatibility directive**, which allows us to bear the full responsibility that comes with the CE mark that we place on our products.



Be up to date with updates. Visit us online!

Complete product support is available on our website - including current: **meter firmware, drivers, instruction manuals, technical specifications and practical articles** that help to expand knowledge about the theory and practice of taking measurements.



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Modern technologies for you

Our offer is not limited to measuring instruments only. We also provide calibration and rating services in our accredited Calibration and Research Laboratory. The calibration offer applies to all electrical safety meters. Besides such instruments, we also test many other meters of electrical values, as well as thermal imagers, pyrometers, illuminance meters and similar instruments.

We offer SMT surface mounting assembly services on a professional, automated assembly line manufactured by FUJI. We have two SMT surface assembly lines, a THT through-hole assembly line and inspection stations. All Assembly process are fulfill in accordance to IPC-A-610D standard.

We sincerely invite you to cooperate with us!

We sell our products in more than 100 countries around the world.



We care about our customers. Grow with us!

Excellent products, good logistical support, efficient guarantee and post-guarantee service as well as customer support after purchase are the most important elements of our success.

During numerous trainings, conferences and meetings organized by us, we systematically analyze the current needs of our clients

To satisfy these needs, we create new designs of measuring instruments that are fully adapted to users' expectations.

We are also preparing increasingly interesting training formulas. Over the course of training seminars and conferences, our specialists present the latest technological solutions, supported by an interpretation of currently applicable regulations and standards, and conduct practical demonstrations of measurement techniques.



Computer programs and mobile applications

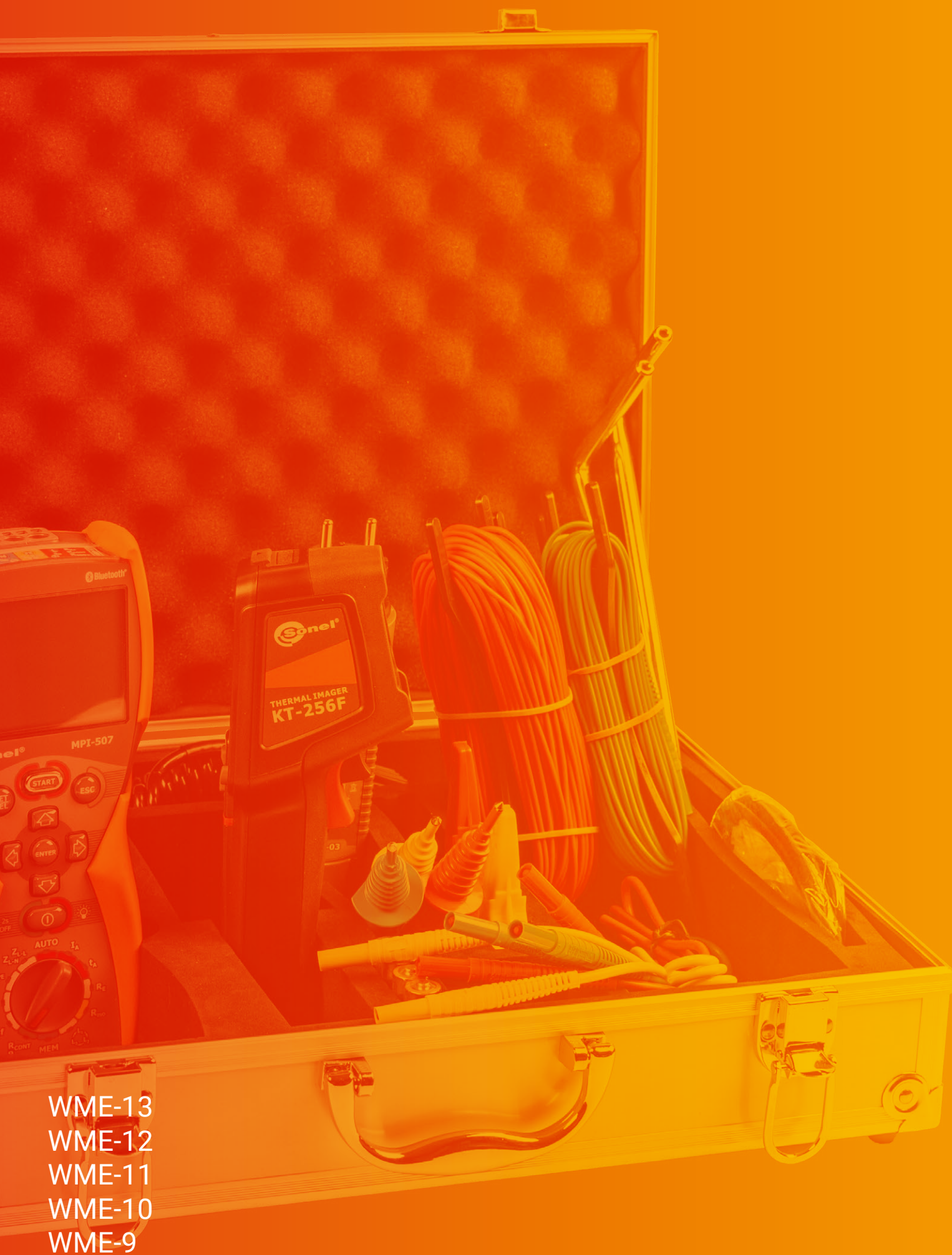
Set of standard and optional applications

	Photo	Name	See page	MPI-540-PV	MPI-540	MPI-536	MPI-535	MPI-530/530-IT	MPI-525	MPI-520	MPI-507	MPI-506	MPI-502F	MRP-201	PVM-1530	PVM-1021	IRM-1	MIC-15k1	MIC-5050/MIC-10k1	MIC-5005/MIC-5010	MIC-5001	MIC-2511	MIC-2501	MIC-30	MIC-10	MIC-5	MZC-320S/MZC-330S	MZC-310S	MZC-306	MZC-304F	MZC-20E	MRU-200/MRU-200-GPS	MRU-120HD	MRU-120	MRU-30	MRU-21	MRU-12	MRU-10	KT-1K	KT-670	KT-650	KT-560	KT-550	KT-530				
Computer programs		Sonel Reports Plus	101	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
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		Sonel ThermoAnalyze2	-																																													
		Sonel ThermoAnalyze3	111																																													
		Sonel IR Thermometer	112																																													
		Sonel VLF Tester Software	120																																													
		Sonel Analysis	158	*	*																																											
Mobile apps		Sonel PAT Analysis	165																																													
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		Sonel MIC Mobile	59															1	1	1																												
		Sonel MRU Mobile	101																															1														
		Sonel KT Mobile	111																																													
		Sonel LKZ Mobile	132																																													
		Sonel Analysis Mobile	158																																													
		Sonel PAT Analysis Mobile	165																																													
		Sonel Multimeter Mobile	169																																													

1, 2, 4 - number of standard accessories
 - - optional accessories

KT-525	KT-520	KT-510	KT-256F	KT-256	KT-128	DIT-500	DIT-200	DIT-120	S-57 VLF	S-44 VLF	S-36 VLF	S-24 VLF	MMR-6700	MMR-6500	MMR-650	MMR-630	MMR-620	LKZ-2500	LXP-10A	LXP-10B	LXP-2	PQM-711	PQM-710	PQM-707	PQM-700	PAT-96	PAT-95	PAT-10	PAT-2E	PAT-2	CMM-60	CMM-40	CMM-30	CMM-11	CMM-10	CMP-3000	CMP-2000	CMP-1015-PV	CMP-1010	CMP-403/402	CMP-3KR	CMP-200F	CMP-200	CMP-100	BT-120	See page	Name	Photo					
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																																	1		1																169	Sonel Multimeter Mobile	

Measurement sets



WME-13
WME-12
WME-11
WME-10
WME-9

Set for testing electrical installations

SONEL WME-13

index: WMGBWME13



MPI-507
Multifunctional electrical
installations meter



KT-256F
Thermal imager

Capabilities

- » **MPI-507** | Measurement of short circuit loop parameters.
- » **MPI-507** | Testing RCD breakers of AC, A types.
- » **MPI-507** | Earth resistance measurement.
- » **MPI-507** | Insulation resistance measurement.
- » **MPI-507** | Measurement of resistance of protective conductors and equipotential bondings.
- » **MPI-507** | Phase sequence indication.
- » **KT-256F** | Infrared diagnostics.

	MPI-507	KT-256F
Safety and work conditions		
Measuring category according to EN 61010	IV 300 V, III 600 V	-
Ingress protection	IP67	IP54
Dimensions	220 x 102 x 61 mm	194 x 62 x 76 mm
Weight	ca. 0.8 kg	ca. 0.4 kg
Memory and communication		
Memory of measurement results	990 cells, 10 000 records	32 GB
Data transmission	Bluetooth	USB

Standard accessories:

MPI-507 meter	WMGBMPI507
KT-256F thermal imager	WMGBKT256F
WS-03 adapter with START button with UNI-SCHUKO plug	WAADAWS03
Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB
Test lead 30 m, red (banana plugs, on H-frame reel)	WAPRZ030REBBN
Test lead 15 m, blue (banana plugs, on H-frame reel)	WAPRZ015BUBBN
Yellow "crocodile" clip 1 kV 20 A	WAKROYE20K02
Red "crocodile" clip 1 kV 20 A	WAKRORE20K02
Test probe with banana socket; 1 kV; blue	WASONBUOGB1
Test probe with banana socket; 1 kV; yellow	WASONYE0GB1
Test probe with banana socket; 1 kV; red	WASONRE0GB1
2x Earth contact test probe (rod), 25 cm	WASONG25
USB charger	WAZASZ20
L-9 hard carrying case	WAWALL11
Type C USB cable	WAPRZUSBC
16 GB microSD card	WAP0ZMSD16
Meter strap (type M-1)	WAP0ZSZE4
M-1 hanging hook straps	WAP0ZUCH1
Wristband	WAP0ZPAS1
4x AAA 1.5 V battery	
Factory calibration certificate - MPI-507	
Factory calibration certificate - KT-256F	



Set for testing electrical installations

SONEL WME-12

index: WMGBWME12



MPI-507
Multifunctional electrical
installations meter



KT-128
Thermal imager

Capabilities

- » **MPI-507** | Measurement of short circuit loop parameters.
- » **MPI-507** | Testing RCD breakers of AC, A types.
- » **MPI-507** | Earth resistance measurement.
- » **MPI-507** | Insulation resistance measurement.
- » **MPI-507** | Measurement of resistance of protective conductors and equipotential bondings.
- » **MPI-507** | Phase sequence indication.
- » **KT-128** | Infrared diagnostics.

	MPI-507	KT-128
Safety and work conditions		
Measuring category according to EN 61010	IV 300 V, III 600 V	-
Ingress protection	IP67	IP54
Dimensions	220 x 102 x 61 mm	194 x 62 x 76 mm
Weight	ca. 0.8 kg	ca. 0.4 kg
Memory and communication		
Memory of measurement results	990 cells, 10 000 records	32 GB
Data transmission	Bluetooth	USB

Standard accessories:

MPI-507 meter	WMGBMPI507
KT-128 thermal imager	WMGBKT128
WS-03 adapter with START button with UNI-SCHUKO plug	WAADAWS03
Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB
Test lead 30 m, red (banana plugs, on H-frame reel)	WAPRZ030REBBN
Test lead 15 m, blue (banana plugs, on H-frame reel)	WAPRZ015BUBBN
Yellow "crocodile" clip 1 kV 20 A	WAKROYE20K02
Red "crocodile" clip 1 kV 20 A	WAKRORE20K02
Test probe with banana socket; 1 kV; blue	WASONBUOGB1
Test probe with banana socket; 1 kV; yellow	WASONYE0GB1
Test probe with banana socket; 1 kV; red	WASONRE0GB1
2x Earth contact test probe (rod), 25 cm	WASONG25
USB charger	WAZASZ20
L-9 hard carrying case	WAWALL11
Type C USB cable	WAPRZUSBC
16 GB microSD card	WAP0ZMSD16
Meter strap (type M-1)	WAP0ZSZE4
M-1 hanging hook straps	WAP0ZUCH1
Wristband	WAP0ZPAS1
4x AAA 1.5 V battery	
Factory calibration certificate - MPI-507	
Factory calibration certificate - KT-128	



Installation set

SONEL WME-11

index: WMGBWME11



CMM-30
Industrial multimeter



NZ-2
Screwdriver set, 6-pieces +
voltage tester

Capabilities

- » **CMM-30** | Measurement of voltage, current, resistance, Low Z, frequency, capacitance, duty cycle, temperature, continuity, diode test.
- » **NZ-2** | Assembly and disassembly of screw connections.
- » **NZ-2** | Detection of voltage presence.

Standard accessories:

CMM-30 meter	WMGBCMM30
NZ-2 set	WNZ2
Test leads set (CAT IV, M)	WAPRZCMM2
Temperature probe (type K)	WASONTEMK
Type K temperature probe adapter	WAADATEMK
M-1 hanging hook straps	WAPOZUCH1
Magnetic hanging strap	WAPOZUCH6
Basic case	
S-9 carrying case	WAFUTS9
M-6 carrying case	WAFUTM6
2x watertight socket protection plug	
4x AAA 1.5 V battery	
Factory calibration certificate - CMM-30	

Installation set

SONEL WME-10

index: WMGBWME10



CMP-200F
Fork clamp meter



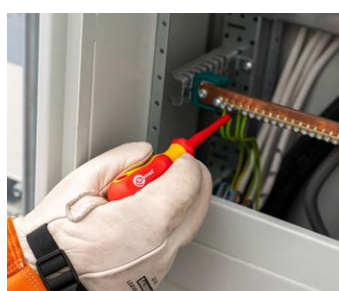
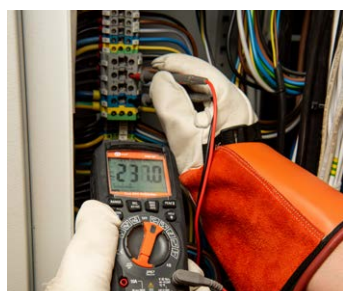
NZ-2
Screwdriver set, 6-pieces +
voltage tester

Capabilities

- » **CMP-200F** | Measurement of voltage, current, resistance, capacitance.
- » **NZ-2** | Assembly and disassembly of screw connections.
- » **NZ-2** | Detection of voltage presence.

Standard accessories:

CMP-200F meter	WMGBCMP200F
NZ-2 set	WNZ2
Test leads set (CAT IV, M)	WAPRZCMM2
Basic case	
S-9 carrying case	WAFUTS9
M-16 carrying case	WAFUTM16
2x AAA 1.5 V battery	
Factory calibration certificate - CMP-200F	



Set for electrical measurements

SONEL WME-9

index: WMGBWME9



MPI-502F
Multifunctional
electrical installations
meter



MIC-10
Insulation
resistance
meter



CMP-200F
Fork clamp meter

Standard accessories:

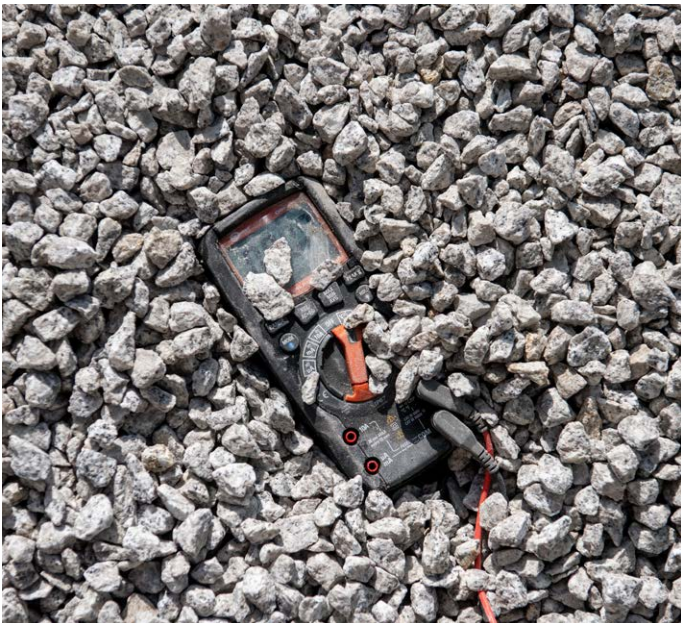
MPI-502F meter	WMGBMPI502F
MIC-10 meter	WMGBMIC10
CMP-200F meter	WMGBCMP200F
WS-03 adapter with START button with UNI-SCHUKO plug	WAADAWS03
Test lead 1.2 m, black, 1 kV (banana plugs)	WAPRZ1X2BLBB
2x Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB
Set of test leads (CAT IV, M)	WAPRZCMM2
Yellow "crocodile" clip 1 kV 20 A	WAKROYE20K02
Black "crocodile" clip 1 kV 20 A	WAKROBL20K01
Test probe with banana socket; 1 kV; blue	WASONBUOGB1
Test probe with banana socket; 1 kV; black	WASONBLOGB1
2x Test probe with banana socket; 1 kV; red	WASONREOGB1
L-9 hard carrying case	WAWALL9
Standard carrying case	
Meter strap (type M-1)	WAPOZSZE4
10x AAA 1.5 V battery	
Factory calibration certificate - MPI-502F	
Factory calibration certificate - MIC-10	
Factory calibration certificate - CMP-200F	

Capabilities

- » **MPI-502F** | Measurement of short circuit loop parameters.
- » **MPI-502F** | Testing RCD breakers of AC, A types.
- » **MPI-502F · MIC-10** | Measurement of resistance of protective conductors and equipotential bondings.
- » **MIC-10** | Insulation resistance measurements with voltage up to 1000 V.
- » **CMP-200F** | Measurement of voltage, current, resistance, capacitance.

	MPI-502F	MIC-10	CMP-200F
Safety and work conditions			
Measuring category according to EN 61010	IV 300 V, III 600 V	IV 600 V, III 1000 V	IV 600 V, III 1000 V
Ingress protection	IP67	IP67	IP40
Dimensions	228 x 102 x 61 mm	220 x 102 x 61 mm	230 x 44 x 66 mm
Weight	ca. 0.8 kg	ca. 0.6 kg	ca. 0.3 kg
Memory and communication			
Memory of measurement results	990 cells, 10 000 records	-	-
Data transmission	Bluetooth	-	-





Electrical safety measurements

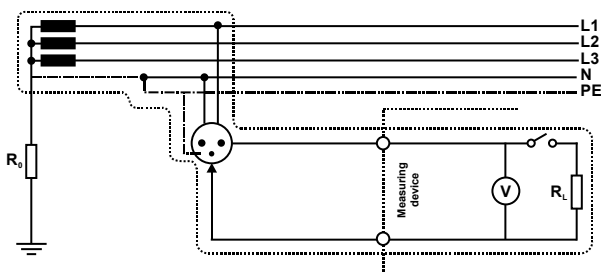
Current regulations require the measurements of electrical systems both during commissioning (after completing the installation, after any change or extension of the system), as well as regularly during the operation. The scope of acceptance or periodic inspection is specified in standard HD 60364-6. Requirements for measuring instruments are defined in standard EN 61557. Protective measures include, depending on needs, the measurement of fault loop impedance, insulation resistance, continuity of protection and equipotential bonding, earthing resistance and parameters of residual current devices. Devices used for this type of measurement shall have a document confirming their technical efficiency. Pursuant to the Metrology Act, this document shall be a calibration certificate. The period between checks of the instrument, recommended by the manufacturer is 12 months.

Measurement of fault loop impedance

One of measures for electric shock protection is a protection against indirect contact in circuits equipped with overcurrent protection - it is based on automatic disconnection of power supply in case of a dangerous touch voltage on the exposed conductive elements. In such case, the current will flow in the circuit of phase-protective conductor, and it is called the short-circuit current which should trip the overcurrent switch and power supply. As the exposed elements cannot remain too long under dangerous touch voltage, the protection has to trip in a sufficient time, which is specified in binding standards. The condition for correct protection is specified by the following formula:

$$Z_s = \frac{U_n}{I_A}$$

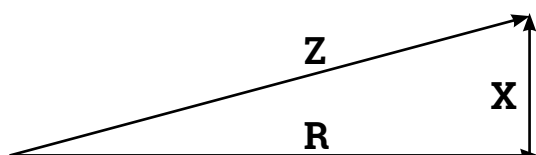
where: Z_s - fault loop impedance, I_A - current triggering overcurrent protection in required time (depending on the time-current characteristic of applied protection and required disconnection time), U_n - rated voltage of the network in relation to the earth.



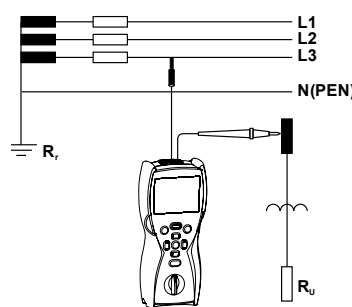
The impedance value Z_s (needed to determine whether the protection is correct) shall be measured. During fault loop measurement performed by the technical "method, an "artificial short circuit" is generated. The instrument measures the voltage without load and after that during a short-term load from short-circuit resistor. Fault loop impedance is calculated based on the difference in voltage drops. This measurement may be performed using the following fault loop impedance meters: MZC-304F, MZC-306, MZC-310S, MZC-320S and MZC-330S and MPI multifunctional meters - all of them indicate also components of the impedance, resistance and reactance.

$$Z = \sqrt{R^2 + X^2}$$

Fault loop impedance meters (except MZC-310S, MZC-320S and MZC-330S) provide also the measurement in L-PE circuits in systems protected by RCDs without any interference in the circuit. This measurement is carried out with current lower than 15 mA and it is extended in time, while the resolution of the result, is the same as for other measurements, i.e. 0.01 Ω . High current meters MZC-310S, MZC-320S and MZC-330S provide measurements with a result resolution of 0.1 m Ω (supply points, switchgear centres, transformer stations) applying the test current up to 300 A, which provides measurements in accordance with EN 61557 standard, even for circuits where the value of the fault loop impedance is in milli-ohm order.



Fault loop impedance meters may be used for measuring the earth resistance by using an auxiliary voltage source (phase conductor of the network). The measured value is then overstated - the measurement result is the sum of resistance of the measured earth electrode, operational earthing system, source and phase conductor.



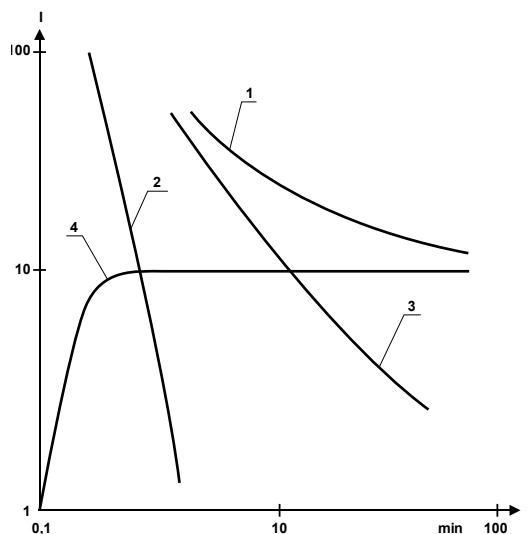
MZC-306 offers the measurements

- » for any AC voltages
- » up to 750 V – also in industrial systems.

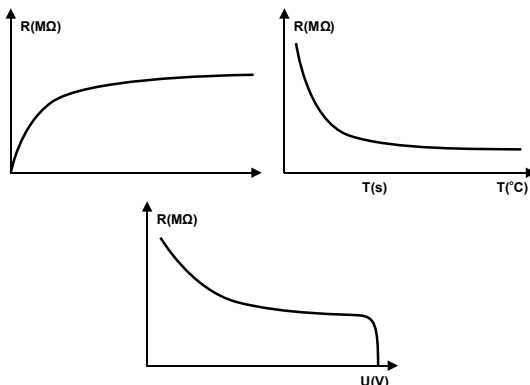
Measurement of insulation resistance

The insulation condition is crucial for the operational safety and proper functioning of the system and electric appliances, guaranteeing also protection against direct contact. Systematic inspection of the insulation is necessary to detect its deterioration and it is a permanent element of measurement and control works. In case of measurements on industrial equipment it is crucial to determine the tendency of changes in the resistance, which may indicate a gradual deterioration of the insulation. The basic factors causing the insulation degradation include: electrical and mechanical exposures, chemical attack, thermal exposure and environmental pollution; their impact during normal operation of electrical system causes insulation wear and tear. Insulation resistance measurements are performed with direct current (DC), to eliminate the impact of capacitance on the results. The method of measuring insulation resistance and the required test voltages are specified in standards: PN-HD 60364-6; PN-E-04700; EN 61557-2. During the measurements, after applying the voltage, the insulation conducts electricity. During the resistance measurement, the current flowing through the insulation (1) consists of the following components:

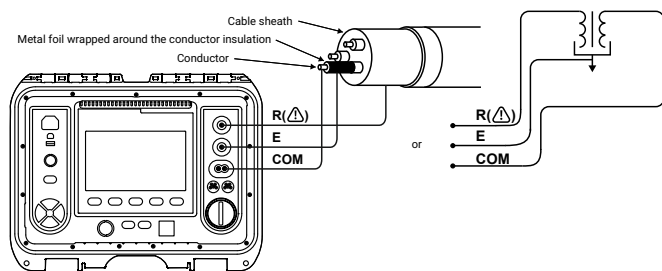
- » capacitance charging current (2) - it depends on the capacitance (e.g. on the length of the tested cable),
- » polarization (absorption) current (3) - the result of charges and dipoles moved by electric field,
- » insulation leakage current (4) - the sum of currents flowing through the material and on its surface.



Due to the nature of the current flowing through the insulation, the measured insulation resistance value is affected by the time of measurement as well as by humidity, temperature, measurement voltage and surface cleanliness of the insulating material.



The 3-wire method, used in all advanced instruments, allows user to eliminate the impact of surface leakage current. In case of cables, wrap the core insulation with metal foil, which is connected to the shield terminal of the meter - only leakage current flowing through the insulation is measured. The measurement by 3-wire method is recommended for large areas exposed to pollutants (cables of large diameter, HV bushings, transformers, HV switches):



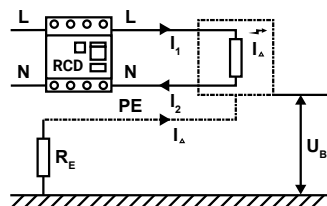
Using the 3-wire method is important in the case of measurements of objects with very large resistance values (100 M)

Meters MIC-10k1, MIC-5050, MIC-5010, MIC-5005, MIC-5001, MIC-2511, MIC-2501, MIC-30 as well as MPI-525 multifunctional meter, perform measurements at a specified time and provide readouts in intervals set by the user. The obtained results are used to calculate one or two absorption coefficients, providing information about the condition of the insulation. Before the measurements, make sure that the tested object is disconnected from the mains. Upon detection of voltage on the object (or when voltage appears during the measurements), the device stops the measurement signals the anomaly. During the measurement, the device displays the current, instantaneous value of the resistance or the current value of the leakage current. After completing the measurement, the devices save the values measured at the end of periods sets by the user (the range from 1 to 600 s) and the tested object is discharged by the device.

Measurements of RCD parameters

The main function of the Residual Current Device (RCD) is an additional protection against electric shock by disconnecting the protected circuit from power supply, when the circuit is subject to earth overcurrent.

When the circuit protected by the RCD is free from damage (differential current $I_{\Delta} = 0$), the inflow current I_1 is equal to outflow current I_2 . In case of any damage (e.g. punctured insulation) fault current I_{Δ} starts to flow and value of I_2 current is lower than I_1 .



The RCD will trip (disconnecting power supply) if the measured difference of currents I and I_2 exceeds a certain characteristic for the RCD value. When a fault current flows, U_B voltage will appear on the housing of the protected device, which in accordance with Ohm's law is:

$$U_B = I_{\Delta} \cdot R_E$$

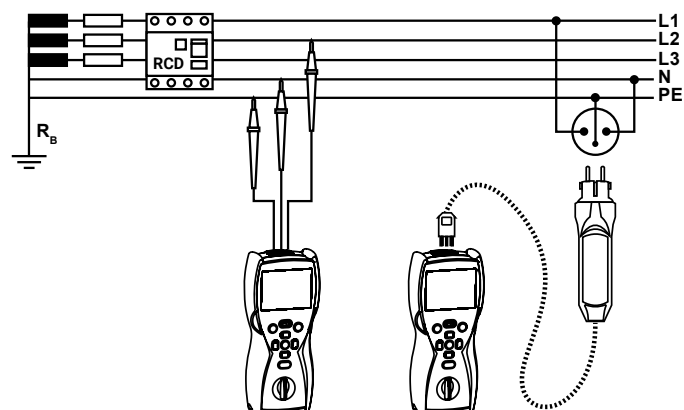
Rating current of the circuit breaker $I_{\Delta n}$ should be selected in a way ensuring that the contact voltage generated during fault current flow does not exceed the allowable long-term voltage U_L :

$$I_{\Delta n} < \frac{U_L}{R_E}$$

A system equipped with RCD must have, for safety reasons, a protective earthing conductor (PE). Therefore, the RCDs cannot be installed in networks without a dedicated protective conductor. RCD does not limit the fault current value, but only the time of its flow. However, as the criterion for tripping the RCD is the fault current exceeding the rated current of the RCD, it must be chosen appropriately to the type of protected devices. Due to the response time, the residual circuit devices are divided into: normal, short-time delay [G] - intended for receivers and circuits, where momentarily, small leakage currents and selective may occur. [S] - having a delayed triggering time, which is the minimum time, during which the device does not trip, despite the difference between the current flowing in and flowing out to/from the circuit. Depending on the shape of the fault current that causes tripping, the switches may be divided into: AC circuit breakers marked with [~] responding to a differential sinusoidal current, type A, marked with [A] responding to the sinusoidal, unidirectional pulsating current and pulsating current with constant component up to 6 mA, and B type switches marked with [B] responding to the sinusoidal, unidirectional pulsating current and pulsating current with constant component and to direct current Measurements on RCDs may be performed with MRP-201

meter or by multifunctional meters MPI.

During each measurement procedure (except AC voltage measurements), the me-



ter controls whether the resulting contact voltage does not exceed the predetermined voltage allowable for longer periods. If this value is exceeded, the measurement will be automatically interrupted (i.e. the differential test current is switched off). The value of the long-term allowable touch voltage can be set to 25 V or 50 V and for selective switches additionally at 12.5 V. The tripping time of RCD is measured from the start of differential current flow until the tripping of RCD - the user may select the initial phase (or polarity) as positive or negative. The maximum measured value of the triggering time is 300 ms, and with selected measurement of selective switches it is 500 ms. Tripping current of RCD is measured after enforcing a differential current increasing linearly in the tested circuit. The increases from approx. 30% of $I_{\Delta n}$ until RCD is tripped or $I_{\Delta n}$ exceeded for AC breakers (140% and 200% for A and B respectively).

With the touch electrode installed in the devices, instruments for RCD measurements may check the correctness of connections in the socket. When the voltage between the touch electrode and the protective conductor (PE) connected to the socket exceeds 50 V, the device will inform the user about it.

Measurements of resistance-to-earth

Earthing is an essential element of any electrical system regardless of its rated voltage. The efficient earthing system is important for:

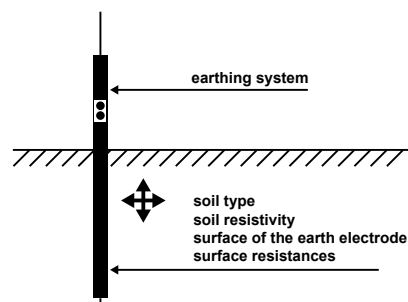
- » human safety during the operation of electrical devices,
- » proper operation of electrical equipment,
- » elimination or significant reduction of the impact of lightning.

Earthing systems may be called differently depending on their destination. e.g.:

- » protective,
- » functional (working),
- » lightning protection,
- » auxiliary.

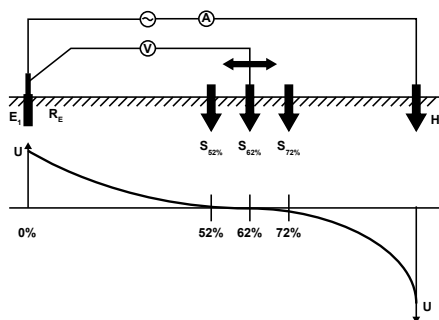
Checking the effectiveness of earthing, i.e. measuring its resistance or impedance, is carried out to determine whether the received value will effectively drain fault current. Term "effectiveness" means that the resistance does not exceed the maximum value allowed for the particular case and the type of the earth electrode.

Earthing system is subject to periodic checks, during the operation in order to assess whether corrosion or changes in soil resistivity do not significantly affect its performance.



Methods of performing measurements are described in detail at www.sonel.com

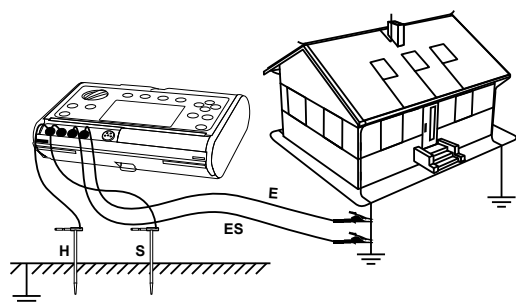
Earthing measurements may be carried out with multifunctional meters having the appropriate functions and with specialist meters of MRU series. The method most commonly used for measuring earth resistance is the 3-pole method, where the meter calculates the resistance by measuring the voltage across its terminals after applying test current. For measurements of individual earthing systems, the most commonly used is 3-pole method of potential drop, which enforces current flow in the following circuit: the meter - tested earthing system - current electrode - the meter. Distances between the electrodes should be as large as possible; in practice, the distance is >30 m between the tested earth electrode and the current electrode.



Distribution of voltage during the flow of the test current

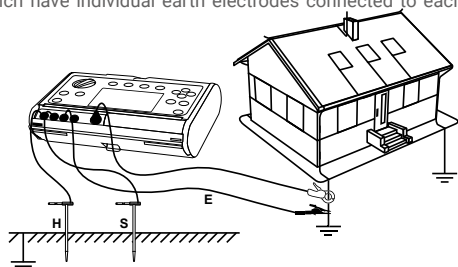
Voltage electrode is driven into the ground between the measured earth electrode and the current electrode in the area of the so-called zero potential. In practice, it is recommended to perform three measurements, changing the position of the voltage electrode by several meters in a direction from and to the tested earthing. If the results are identical, the place of driving the electrode into the ground has been chosen correctly. The measurement is performed with a current at a frequency that allows to avoid interference and distortion having the frequency of the network (50 Hz or 60 Hz) and its harmonics. Advanced earth resistance/resistivity meters of MRU series check and indicate the size of interference voltages before starting the measurement. In addition, these meters calculate the additional error related with too high resistance of electrodes.

Advanced devices have the ability to perform measurements using 4-lead method, eliminating the impact of the resistance of cable used to connect the meter with tested earthing system.



Measurement of resistance to earth - the 4-lead method

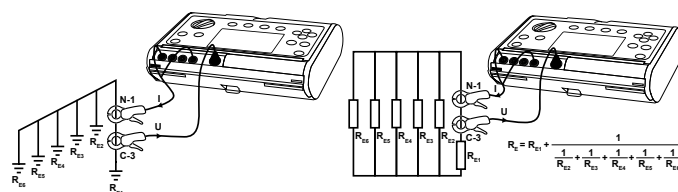
Nuisance arising from the need to disconnect individual earth electrodes when testing the systems with multiple electrodes may be eliminated by using the 3-pole method with additional clamps (MRU-30, MRU-120, MRU-120HD, MRU-200, MRU-200-GPS, MPI-530, MPI-530-IT, MPI-535, MPI-536, MPI-540, MPI-540-PV). Current and voltage electrodes are arranged similarly to the 3-pole method, but the current is measured with clamps attached to the tested earthing. The meter calculates the resistance knowing that part of the current which flows through the tested earth electrode. The method of measurement with clamps cannot be used in multiple systems, which have individual earth electrodes connected to each other underground.



Measurement of resistance to earth - the 3P method + clamps

The 3-pole method with additional clamp has one more variation. Instead of using a directly connected current clamp with a split core, this method uses a special ERP-1 adapter. ERP-1 works with MRU meters with a measuring current of 200 mA. With use of a flexible clamp, it is possible to measure the total value of the current flowing through the earthing points of objects such as high and medium voltage pylons with a lattice structure or prestressed concrete spun transmission poles of medium and low voltage lines. The measurement procedure consists in wrapping the entire pole with the earthing with flexible clamp, thanks to which we measure the entire current flowing in the circuit to the ground.

The two-clamp method (MRU-30, MRU-120, MRU-120HD, MRU-200, MRU-200-GPS, MPI-530, MPI-530-IT, MPI-535, MPI-536, MPI-540, MPI-540-PV) allows the user to measure the resistance of multiple earthing systems, without the need to drive auxiliary electrodes into the ground. During this measurement, the current generated by transmission clamps is closed within the following circuit: tested earthing system + parallel connection of other earthing probes and it is measured by the receiving clamps to provide data for calculating the circuit resistance. As the parallel connection of a few resistances generates the resultant resistance of much lower value, the result is higher than the tested resistance. The difference is the smaller, the more earthing electrodes is within the tested object.



Connection of the meter in the 2-clamp method

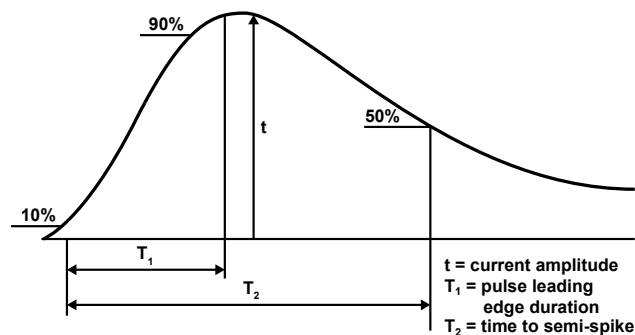
Equivalent circuit of multiple earthing system in the 2-clamp method

The 2-clamp method is used for measurements of systems with multiple earthing electrodes not connected with each other underground. If the earthing electrodes are also connected underground, this method allows user to measure only the continuity of the circuit.

In the earthing system assessed for electric shock protection, it is important to maintain currents of low frequency (50, 60 Hz). The task of the lightning protection earthing systems is to discharge lightning strikes into the ground. The pulsed nature of such discharge makes the inductive component of the earth electrode quite important, as the lightning current is effectively discharged only by a part of the earth electrode, located in the immediate vicinity of the discharge. Therefore an earth electrode with low static resistance, which provides good basic protection does not ensure adequate lightning protection parameters - especially in the case of extensive earthing systems, having low static resistance, but several times higher dynamic impedance. The measurement using the impulse method (MRU-200, MRU-200-GPS), in accordance with: EN 62305 and withdrawn, but still applied PN-86/E-05003, enables user to diagnose the parameters of dynamic lightning protection earthing systems. The pulsed nature of the measurement does not require the disconnection of the earthing in case of multiple earthing probes or live objects, as the test current pulse, similarly to lightning stroke, operates only within a limited distance. The measurement is carried out in accordance with the description specified in EN 62305 standard. This method allows to determine the theoretical value of the surge impedance (Z_s), which is the ratio of peak voltage to peak current.

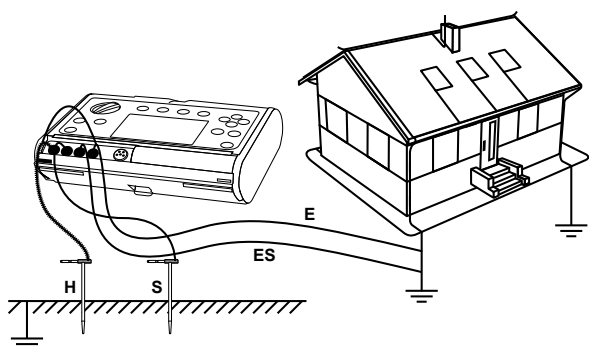
The surge impedance specified in the standard is a theoretical value, as generally peaks of voltage and current do not occur simultaneously. The surge impedance is considered an indicator of the effectiveness of earthing systems in the conditions of stricter or special protection.

Parameters of the test pulse (which simulates the shape of the lightning) are defined by two numbers: the pulse leading edge duration T_1 and a time to half-peak T_2 . The MRU-200 / MRU-200-GPS meter provides a selection of three pulse shapes: 10/350 μ s, 8/20 μ s and 4/10 μ s. Pursuant to EN 62305, the pulse with a shape of 10/350 μ s is typical for the first stroke of the lightning current. The same pulse is specified as a reference pulse in EN62305-1 standard. Pulse 4/10 μ s has parameters resulting from PN-92/E-04060.



The shape of test pulse in the impulse method

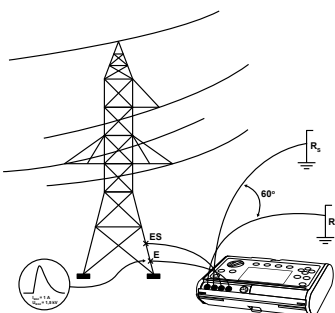
All devices comply with European directives on electromagnetic compatibility and safety and are marked with CE



Earthing impedance measurement system (4P impulse method)

When the impulse method is used for measurements on multiple earthing systems, connected both above and under the ground, the test pulse operates only in the close proximity of tested earthing electrode, which allows user to carry out the measurement without the need to disconnect testing terminals and equipotential bondings - i.e. without the need to disconnect the power supply of the object.

The impulse method may also be used to measure the impedance of earthing used for HV poles; it allows also to determine the earthing impedance of the entire pole, including both ground band systems as well as the resistance of pole legs, and it may be used without the need to disconnect the tested HV line or to remove components of the earthing system.

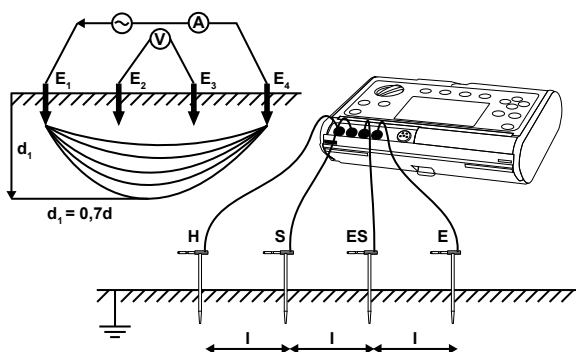


Measurements of HV pole earthing

Knowledge of the soil resistivity value (MRU-12, MRU-30, MRU-120, MRU-120HD, MRU-200, MRU-200-GPS, MPI-530, MPI-530-IT, MPI-535, MPI-536, MPI-540, MPI-540-PV) is important at the stage of designing the earthing system.

Knowing the cross-section of the soil, the user may select the appropriate type of earthing system - e.g. for low resistivity values occurring only at a certain depth, the single earth electrode may be designed as deeply immersed, whereas for soil with low resistivity at the shallower area; or rock base with a greater depth - it will be a set of shorter earthing electrodes connected by a vertical metal band.

Soil resistivity measurement is performed using four electrodes arranged linearly at equal distances (Wenner method) or different distances (Schlumberger method). In the Wenner method, the soil resistivity is measured at the depth equal to 0.7 of the distance between the probes.



Measurement of soil resistivity by the Wenner method

Facilitating the measurements

During measurements carried out under voltage (earth fault loop impedance, RCD parameters, voltage, sequence of phases) conductors ended with blade probes or crocodile clips may be used (of adequate measuring categories with a shape prevent slipping or disconnecting), as well as adapters suitable for measuring terminals/sockets.

Meters connected to the system equipped with sockets by a cable terminated with a mains plug, or by wires, automatically check the correctness of connections and signal any abnormalities. Measurements in single-phase sockets may be carried



out using adapters ended with Uni-Schuko plug; the measurements are performed also in the case of exchanging the phase conductor with neutral conductor (without the need for manual switching or using additional adapters). In addition, WS-01 and WS-03 adapters have buttons for triggering measurements and saving recorded values. For the measurements in three-phase or HV sockets, one of the following adapters may be optionally used: for three-phase sockets AGT-16P, AGT-32P, AGT-63P AGT-16C, AGT-32C and for HV sockets AGT-16T and AGT-32T.

Family of AutoISO adapters facilitate the insulation measurements carried out with suitable devices on insulation of 3-, 4- and 5-wire cables, without the need of manual selection of pairs and combinations of the measured wires. Adapter cables ended with crocodile clips (depending on the position 3, 4 or all 5) are attached to the tested cable cores; when the measurement is started, the adapter connected



AutoISO-1000

AutoISO-2500

AutoISO-2511



AutoISO-5000



TWR-1J

with the meters, performs the sequence of all required tests.

AutoISO-2500 and **AutoISO-2511** adapter allows user to perform tests on cables under 2500 V voltage. In other hand, for **AutoISO-5000** adapter the test voltage is as high as 5000 .

TWR-1J adapter enables user to check RCD parameters before installing it within the system.

Instruments for measuring earth resistance are delivered with many ergonomic accessories that simplify measurements. Cables used for testing earthing systems, due to their length (50, 30, 25,15 meters) are wound on drums made of a material resistant to frost and strokes, allowing fast winding and unwinding by the user.

Sonel offers also long probes (80 cm) with a suitable cover, clamps of high sensitivity and accuracy (C-3, N-1) for earthing measurements without the need to disconnect the test connections or for current measurements, as well as special terminals guaranteeing adequate contact.

Measuring devices are supplied in appropriate casings or suitcases fitted to their sizes with inner compartments for transporting measuring accessories.

Detailed lists of standard and optional accessories can be found at the end of product groups.

Multi-function meters of electrical system parameters

MPI-540-PV

MPI-540

MPI-536

MPI-535

MPI-530-IT

MPI-530

MPI-525

MPI-520

MPI-507

MPI-506

MPI-502F

EVSE-100

EVSE-01

MRP-201

IRM-1

PVM-1530

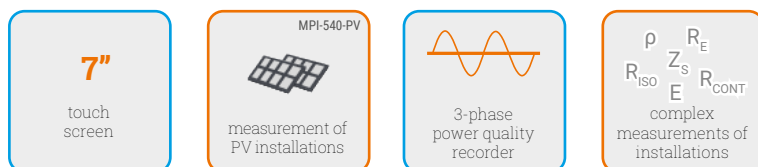
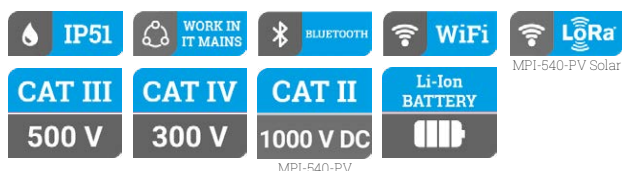
PVM-1021

Comparison of multi-function meters

						
	MPI-540-PV / MPI-540 / MPI-536 / MPI-535	MPI-530-IT / MPI-530	MPI-525	MPI-520	MPI-507 / MPI-506	MPI-502F
Display	7" LCD touchscreen	LCD graphic	LCD graphic	LCD graphic	segmented LCD	segmented LCD
Network parameters recorder	three-phase / three-phase / – / –	single-phase	–	–	–	–
Autotests	✓	–	–	–	–	–
Energy losses calculator	✓ / ✓ / – / –	–	–	–	–	–
Fault loop impedance resolution [Ω]	0...1999	0...1999	0...1999	0...1999	0...1999	0...1999
Maximum resolution of fault loop impedance measurement [Ω]	0.001	0.001	0.01	0.01	0.01	0.01
Measurement voltages [V]	95...440	95...440	95...440	95...440	180...460	180...460
Resolution of fault loop impedance measurement without RCD tripping [Ω]	0,01	0,01	0,01	0,01	0.01	0,01
Calculation of fault current according to rated voltage	✓	✓	✓	✓	✓	✓
Calculation of fault current according to measured voltage	✓	✓	✓	✓	✓	–
Automatic measurement in socket	✓	✓	✓	✓	✓	✓
Residual current device measurements	AC, A, F, B, B+, EV [] [G] [S]	AC, A, F, B, B+ [] [G] [S]	AC, A, F, B, B+ [] [G] [S]	AC, A, F, B, B+ [] [G] [S]	AC, A [] [G] [S]	AC, A [] [G] [S]
Automatic measurement of the full set of RCD parameters - RCD Auto	✓	✓	✓	✓	✓	✓
Measurement of tripping current I_{Δ} with rising current	10, 30, 100, 300, 500, 1000	10, 30, 100, 300, 500, 1000	10, 30, 100, 300, 500, 1000	10, 30, 100, 300, 500, 1000	10, 15, 30, 100, 300, 500	10, 30, 100, 300, 500
Simultaneous measurement of I_{Δ} and t_{Δ} in one RCD trip	✓	✓	✓	✓	✓	✓
Measurement of tripping time for factor of rated current	$1/2^*$, 1, 2, 5	$1/2^*$, 1, 2, 5	$1/2^*$, 1, 2, 5	$1/2^*$, 1, 2, 5	$1/2^*$, 1, 2, 5	$1/2^*$, 1, 2, 5
Measurement of touch voltage U_B	✓	✓	✓	✓	✓	✓
Detection of L and N swapping	✓	✓	✓	✓	✓	✓
Measurement of insulation resistance	✓	✓	✓	✓	✓	–
Measurement voltages [V]	MPI-536 10 50, 100, 250, 500, 1000 MPI-536 1500, 2500	50, 100, 250, 500, 1000	50, 100, 250, 500, 1000, 2500	50, 100, 250, 500, 1000	100, 250, 500	–
Measuring range [Ω]	5G / 5G / 10G / 5G	10G	10G	3G	600M	–
Protection against appearance of voltage	✓	✓	✓	✓	✓	–
Automatic discharging of object after measurement	✓	✓	✓	✓	✓	–
Automatic measurement of multi-core cords with AutoISO-1000C adapter	✓ / ✓ / – / ✓	✓	✓	✓	–	–
Automatic measurement of multi-core cables with AutoISO-2500 adapter	– / – / ✓ / –	–	✓	–	–	–
Sound signalling of time intervals for characteristics	✓	✓	✓	✓	–	–
Calculation of absorption coefficients	– / – / ✓ / –	–	✓	–	–	–
Continuity testing with current $\geq 200\text{mA}$	✓	✓	✓	✓	✓	✓
Low-voltage resistance measurement	✓	✓	✓	✓	✓	✓
Earth resistance measurement	3p, 4p, 3p+clamps, double-clamp	3p, 4p, 3p+clamps, double-clamp	3p	3p	3p / –	–
Capability of setting limit for every function	✓	✓	–	–	–	–
Quick check of PE connection	✓	✓	✓	✓	✓	✓
Voltage measurement [V]	0...500	0...500	0...500	0...500	0...500	0...500
Frequency measurement [Hz]	✓	✓	✓	✓	✓	✓
Alternating current measurement [A]	optionally 0...3000	optionally 0...3000	–	optionally 0...400	–	–
Power and $\cos\varphi$ measurement	✓ / ✓ / – / –	✓	–	✓	–	–
Measurement of U harmonics: I up to the 40th	✓ / ✓ / – / –	✓	–	–	–	–
THD measurement for U and I	✓ / ✓ / – / –	✓	–	–	–	–
Phase sequence check [V]	95...500	95...500	95...500	95...500	100...440	–
Memory (records)	100 000	10 000 for every measurement type	990	990	990	990
Power supply	rechargeable battery	rechargeable battery / batteries	rechargeable battery / batteries	batteries / rechargeable battery	batteries / rechargeable batteries	batteries / rechargeable batteries
Built-in quick charger	✓	✓	✓	✓	–	–
Data transmission	USB, Bluetooth, Wi-Fi	USB, Bluetooth	USB	USB	Bluetooth	Bluetooth
Dimensions [mm]	288 x 223 x 75	288 x 223 x 75	288 x 223 x 75	288 x 223 x 75	220x102x61	220x102x61
Weight [kg]	2.5	2.2	2.2	2.2	0.8	0.8

Multi-function meter of electrical system parameters

SONEL MPI-540 / MPI-540-PV



Features

- » The largest touch screen on the market (7") – remarkable ergonomics and ease of use
- » Removable microSD memory card – easy increase of memory capacity
- » Li-Ion battery – longer operation of the meter
- » MPI-540-PV | Measurement of photovoltaic installations according to EN 62446 standard
- » MPI-540-PV | Cooperation with solar radiation and temperature meter
- » MPI-540-PV | Photovoltaic installation test report with **Soneil Reports Plus** software
- » Three-phase power recorder – advanced power quality diagnostics
- » Real time display of network parameters – immediate evaluation of the test site conditions
- » Parameters measured in accordance to class S of EN 61000-4-30 standard – high accuracy of measurements
- » Energy cost calculator – quick evaluation of potential savings
- » Measurement of all parameters related to earthing and protection against electric shock – one device instead of several
- » Quick measurement of the fault loop impedance in networks secured with RCD without triggering (up to several seconds) – time saver
- » Auto measurements – the ability to perform automatic measurements in sequence – simplified measurements
- » Fast path from measurements to report – time saver

Choose the best set for your needs

MPI-540-PV Solar

Multi-function meter of electrical and PV system parameters **with flexible coils, IRM-1 meter with accessories and backpack**
index: WMGBMPI540PVIRM1

MPI-540-PV

Multi-function meter of electrical and PV system parameters **with flexible coils**
index: WMGBMPI540PV

MPI-540-PV Start

Multi-function meter of electrical and PV system parameters **without flexible coils**
index: WMGBMPI540PVNC

MPI-540

Multi-function meter of electrical system parameters **with flexible coils**
index: WMGBMPI540

MPI-540 Start

Multi-function meter of electrical system parameters **without flexible coils**
index: WMGBMPI540NC

Capabilities

The meter has **above-average functionality**. It combines the measuring capabilities of several devices, while ensuring equally good accuracy.

- » The **MPI-540-PV** instrument can measure photovoltaic installations in accordance with the EN 62446 standard:
 - continuity of protective and equipotential bondings,
 - earth resistance,
 - insulation resistance on the DC side,
 - open circuit voltage U_{oc} ,
 - short circuit current I_{sc} ,
 - work currents and powers on both DC and AC side,
 - inverter efficiency.
- » **MPI-540 / MPI-540-PV** can record 50/60 Hz power quality parameters in accordance to S class of EN 61000-4-30:
 - voltage L1, L2, L3, – average values in the range up to 500 V,
 - L1, L2, L3 currents, – average values, current measurement in the range up to 3 kA (depending on the current probes used),
 - frequency in the range of 40 Hz – 70 Hz,
 - active (P), reactive (Q) and apparent (S) power,
 - power factor (PF), $\cos\phi$,
 - harmonics (up to 40th for voltage and current),
 - total harmonic distortion (THD) for current and voltage.
- » **MPI-540 / MPI-540-PV** can be used for all measurements for commissioning of electrical installations in accordance with applicable regulations:
 - short circuit loop impedance (also in circuits secured with RCDs),
 - RCD parameters,
 - insulation resistance,
 - earth resistance (4 measurement methods + soil resistivity measurement),
 - continuity of protective and equipotential bondings,
 - light intensity measurement,
 - phase sequence test,
 - motor rotation direction test.





Automatic installation safety test

MPI-540 / MPI-540-PV allow safety control of **residential, commercial and industrial electrical installations**. Measurements can be easily automated with:

- » auto mode of residual current devices (RCD) tests,
- » auto measurements – freely configurable measuring sequences,
- » AutoISO-1000C adapter for automatic insulation resistance test of 3-, 4- and 5-conductor cables, without switching.

Photovoltaics under supervision

MPI-540-PV is an extremely universal meter, designed in particular for testing photovoltaic installations. The device allows a complete set of tests on the DC and AC side – in accordance with the guidelines of EN 62446 standard.

Measuring parameters related to the photovoltaic installation, the instrument will automatically convert them to the STC (Standard Test Conditions) reference conditions. Measurements of voltage, current and power on the AC and DC side of the inverter allow to verify its efficiency. **Sonel Reports Plus** software enables creating PV installation test report with measurement results saved meter's in memory..

Three-phase power quality recorder

The device has a three-phase power quality recorder with the LIVE mode view and the possibility to register electrical network parameters such as voltage, current, power, harmonics and THD. The meter enables reading of selected parameters and their graphic presentation on the screen in real time. These parameters are measured and displayed concurrently with the recording on the memory card. In the LIVE mode, the user can see:

- » voltage and current waveforms (oscilloscope),
- » voltage and current timeplots,
- » a phasor graph,
- » display of multiple parameters in tabular form,
- » spectrum graph of current and voltage harmonics.

Fault loop impedance measurements:

- » impedance measurement with 23 A current (40 A for phase-to-phase voltage), max. resolution 0.001 Ω ,
- » fault current-limiting resistor: 10 Ω ,
- » range of measurement voltages: 95...440 V, frequencies 45...65 Hz,
- » **fast fault loop impedance measurement with resolution up to 0.01 Ω in systems protected with RCDs not tripping at $I_{\Delta n} \geq 30$ mA,**
- » automatic calculation of fault current on the basis of nominal or measured voltage; differentiation of phase-to-neutral and phase-to-phase voltage,
- » measurements using UNI-Schuko plug with measurement triggering button (including case with swapped L and N leads) or 1.2 m, 5 m, 10 m, 20 m test leads, with optional use of three-phase socket adapters (AGT),
- » selection of installation protections and automatic evaluation of measurement results.

Testing of AC, A, F, B, B+ and EV residual current devices:

- » **MPI-540 / MPI-540-PV also enables measurements in IT networks,**
- » measurement of general, short-time delay and selective RCDs with rated residual currents of 10, 30, 100, 300, 500 and 1000 mA,
- » function of automatic measurement of all RCD parameters (after pressing the "START" button once, the meter performs the entire defined cycle of measurements, including the capability of earth fault loop impedance measurement with 15 mA current),
- » shape of the input leakage current selected by the user: sinusoidal (start from rising or falling edge), unidirectional pulsating (positive or negative), unidirectional pulsating with direct current offset (positive or negative), constant (positive or negative),
- » measurement of tripping current I_A with rising current,
- » measurement of tripping time t_A with currents $0.5 I_{\Delta n}$, $1 I_{\Delta n}$, $2 I_{\Delta n}$ and $5 I_{\Delta n}$,
- » measurement of touch voltage U_B and protective conductor resistance R_E without tripping the RCD,
- » detection of L and N phase swapping in a socket; does not affect measurements,
- » capability of measuring tripping current I_A as well as actual tripping time t_A with just one RCD trip,
- » voltage measurements within the range of 95...270 V.

Insulation resistance measurement:

- » measurement voltages: 50 V, 100 V, 250 V, 500 V, 1000 V,
- » measurement of insulation resistance up to 10 G Ω ,
- » capability measurement in-socket by means of UNI-Schuko adapter,
- » sound signalling of five-second time intervals, facilitating capture of time characteristics,
- » meter protected against the presence of voltage on the object and the appearance of voltage during measurement,
- » automatic discharge of the measured object's capacitance after completion of measurement,
- » **automatic measurement of all resistance combinations of 3-, 4- and 5-core cords by means of the optional AutoISO-1000C adapter.**

Earth resistance measurements:

- » according to 3- or 4-lead technical method with 2 auxiliary electrodes,
- » according to 3-lead method with additional clamp,
- » **according to double-clamp method,**
- » internal power source with frequency appropriate for 50 Hz or 60 Hz power network.

Soil resistivity measurements according to the Wenner method:

- » measuring range: 0.5 Ω m...9.99 k Ω m,
- » distances between electrodes can be set in meters (1...30 m) or feet (1...90 ft).

Low-voltage continuity testing of protective conductors and equipotential bonding:

- » measuring range according to EN 61557-4: 0.12...400 Ω , max. resolution 0.01 Ω ,
- » measurement of protective conductor continuity with current ≥ 200 mA in two directions,
- » low-current measurement with sound signaling,
- » voltage on open terminals: 4...9 V,
- » automatic calibration of test leads - leads of any length can be used.

Illuminance measurement:

- » display range: 0.001/0.01/0.1 lx...399.9 klx,
- » measurement in lux (lx) or foot-candles (fc),
- » measurement by means of external photodetectors (optional)

Additional functions of the meter:

- » real time display of network parameters,
- » autotests - pre-programmed measurement sequences,
- » quick check of correct connection of PE conductor by means of contact electrode,
- » check of phase sequence and direction of motor rotation,
- » tree-like memory structure with dynamic management
- » data transmission to PC via USB or Bluetooth®,
- » replaceable microSD memory card,
- » power supply from rechargeable battery, built-in quick charger,
- » capability of charging from the power grid or 12 V car lighter socket.

Other technical specifications:

- » type of insulation double, as per EN 61010-1 and EN 61557
- » power supply Li-Ion battery 11.1 V 3.4 Ah 37.7 Wh
- » operating temperature range 0...+50°C



Choose the best set for your needs

F-3A flexible coils

IRM-1 meter
with accessories

L-19 backpack



MPI-540-PV Solar
includes flexible coils, IRM-1
meter with accessories and
backpack



MPI-540-PV Solar Start
includes IRM-1 meter with
accessories and backpack



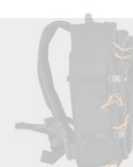
MPI-540-PV
includes flexible coils



MPI-540-PV Start
does not include flexible coils



MPI-540
includes flexible coils



MPI-540 Start
does not include flexible coils



Standard accessories:

		MPI-540-PV Solar	MPI-540-PV Solar Start	MPI-540-PV	MPI-540-PV Start	MPI-540	MPI-540 Start
		WMGBMPI540PV/IRM1	WMGBMPI540PV/Start	WMGBMPI540PV	WMGBMPI540PV/NC	WMGBMPI540	WMGBMPI540/NC
IRM-1 solar radiation and temperature meter	WMGBIRM1	✓	✓				
IRM-1 mounting&measuring set	WASONTVPCKPL	✓	✓				
5 V power supply with USB 2.0 output and a detachable micro-USB cable	WAZASZ24	✓	✓				
LORA-S1 USB adapter for data transmission	WAADAUSBLORA	✓	✓				
PVM-1 adapter	WAADAPVM1	✓	✓	✓	✓		
C-PV clamp	WACEGCPVOKR	✓	✓	✓	✓		
Adapter for C-PV clamp	WAADACPV	✓	✓	✓	✓		
MC4-banana sockets adapter (set of 2 pcs.)	WAADAMC4	✓	✓	✓	✓		
L-19 backpack	WAFUTL19	✓	✓				
M-13 carrying case	WAFUTM13			✓	✓		
F-3A flexible coil (Ø120 mm)	WACEGF3AOKR	✓		✓		✓	
WS-03 adapter with START button with UNI-Schuko plug	WAADAWS03	✓	✓	✓	✓	✓	✓
Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB	✓	✓	✓	✓	✓	✓
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB	✓	✓	✓	✓	✓	✓
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB	✓	✓	✓	✓	✓	✓
Test lead 1.2 m, black, 1 kV (banana plugs)	WAPRZ1X2BLBBN	✓	✓	✓	✓	✓	✓
Test lead 15 m, blue (on a reel)	WAPRZ015BUBBSZ	✓	✓	✓	✓	✓	✓
Test lead 30 m, red (banana plugs, on a reel)	WAPRZ030REBBSZ	✓	✓	✓	✓	✓	✓
USB cable	WAPRZUSB	✓	✓	✓	✓	✓	✓
Crocodile clip, red, 1 kV, 20 A	WAKRORE20K02	✓	✓	✓	✓	✓	✓
Crocodile clip, blue, 1 kV, 20 A	WAKROBU20K02	✓	✓	✓	✓	✓	✓
Crocodile clip, yellow, 1 kV, 20 A	WAKROYE20K02	✓	✓	✓	✓	✓	✓
Crocodile clip, black, 1 kV, 20 A	WAKROBL20K01	✓	✓	✓	✓	✓	✓
Pin probe, red 1 kV (banana socket)	WASONREOGB1	✓	✓	✓	✓	✓	✓
Pin probe, blue 1 kV (banana socket)	WASONBUOGB1	✓	✓	✓	✓	✓	✓
Pin probe, yellow 1 kV (banana socket)	WASONYEOGB1	✓	✓	✓	✓	✓	✓
2x earth contact test probe (rod), 30 cm	WASONG30	✓	✓	✓	✓	✓	✓
Voltage adapter with M4/M6 thread (5 pcs.)	WAADAM4M6	✓	✓	✓	✓	✓	✓
Z-7 power supply	WAZASZ7	✓	✓	✓	✓	✓	✓
230 V mains cable (IEC C7 plug)	WAPRZLAD230	✓	✓	✓	✓	✓	✓
Cable for battery charging from car cigarette lighter socket (12 V)	WAPRZLAD12SAM	✓	✓	✓	✓	✓	✓
L-2 carrying case	WAFUTL2			✓	✓	✓	✓
L-2 hanging straps (set)	WAPOZSZEKPL	✓	✓	✓	✓	✓	✓
Li-Ion battery 11.1 V 3.4 Ah	WAAKU15	✓	✓	✓	✓	✓	✓
MicroSD card		✓	✓	✓	✓	✓	✓
Touchscreen pen	WAPOZTPEN	✓	✓	✓	✓	✓	✓
Factory calibration certificate		✓	✓	✓	✓	✓	✓



Solar radiation and temperature meter

SONEL IRM-1

index: WMGBIRM1

Features

- » Measurement of solar radiation and temperature.
- » The LoRa interface for communication with the meter - offers a larger range than the Bluetooth technology!
- » Automatic data synchronization with the meter.
- » Built-in compass and inclination sensor.
- » Built-in recorder that can be used to record solar radiation before constructing PV systems, as well as to measure the shading of existing systems.
- » Large measurement memory: 999 cache memory cells and 5000 recorder records available (one-time recording) with the option of overwriting them (continuous recording).

Measured parameters

- » Solar radiation intensity (irradiance) in W/m² or BTU/ft²h.
- » PV panel temperature in °C or °F.
- » Ambient temperature in °C or °F.
- » Inclination angle of panels
- » Orientation of the panels with the built-in compass.

For more information see page 42.

Measurement of fault loop impedance Z_{L-PE} , Z_{L-N} , Z_{L-L} in 23/40 A mode

Measurement with 23/40 A current - measuring range according to EN 61557: 0.130 ...1999 Ω (for 1.2 m test lead):

Display range	Resolution	Accuracy
0.00...19.999 Ω	0.001 Ω	$\pm(5\% \text{ m.v.} + 0.03 \Omega)$
20.00...199.99 Ω	0.01 Ω	$\pm(5\% \text{ m.v.} + 0.3 \Omega)$
200.00...1999.9 Ω	0.1 Ω	$\pm(5\% \text{ m.v.} + 3 \Omega)$

- » Nominal voltage: 95...270 V (for Z_{L-PE} and Z_{L-N}) or 95...440 V (for Z_{L-L} - only mode 23/40 A). Frequency: 45...65 Hz.

Measurement of the Z_{L-PE} fault loop impedance in the RCD mode

Measurement with 15 mA current - measuring range according to EN 61557: 0.50...1999 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(6\% \text{ m.v.} + 10 \text{ digits})$
20.00...199.99 Ω	0.1 Ω	$\pm(6\% \text{ m.v.} + 5 \text{ digits})$
200...1999 Ω	1 Ω	

- » Nominal voltage: 95...270 V
- » Frequency: 45...65 Hz

Earthing resistance measurement with two clamps

Display range	Resolution	Accuracy
0.00...9.99 Ω	0.01 Ω	±(10% m.v. + 4 digits)
10.0...19.9 Ω	0.1 Ω	
20.0...99.9 Ω		±(20% m.v. + 4 digits)

Measurement of insulation resistance

Measuring range according to EN 61557-2:

- » for $U_n = 50 \text{ V}$: 50 k Ω ...250 M Ω
- » for $U_n = 100 \text{ V}$: 100 k Ω ...500 M Ω
- » for $U_n = 250 \text{ V}$: 250 k Ω ...99 M Ω
- » for $U_n = 500 \text{ V}$: 500 k Ω ...2 G Ω
- » for $U_n = 1000 \text{ V}$: 1000 M Ω ...9.99 G Ω

Display range	Resolution	Accuracy
0...1999 kΩ	1 kΩ	±(3% m.v. + 8 digits)
2.00...19.99 MΩ	0.01 MΩ	
20.0...199.9 MΩ		
200...999 MΩ	1 MΩ	±(4% m.v. + 6 digits)
1.00...4.99 GΩ	0.01 GΩ	
5...9.99 GΩ	0.01 GΩ	(non-specified)

Indication of phase sequence

- » Indication of phase sequence: compliant, non-compliant, display of phase-to-phase voltages
- » U_{L-L} power system voltage range: 95...500 V (45...65 Hz)

AC current measurement (True RMS) with clamp

Clamp	Display range	Resolution	Accuracy
F-1A, F-2A, F-3A	0...3000 A (10 kA _{pp} @ 50Hz)	0.01% I_{nom}	$\pm 0.1\%$
C-4A	0...1000 A (3600 A _{pp})	0.01% I_{nom}	0.1...10 A: $\pm(3\% + 0.1 \text{ A})$ 10 A: $\pm 3\%$ 50 A: $\pm 1.5\%$ 200 A: $\pm 0.75\%$ 1000...1200 A: $\pm 0.5\%$
C-5A	0...1000 A (3600 A _{pp})	0.01% I_{nom}	0.5...100 A: $\leq(1.5\% + 1 \text{ A})$ 100...800 A: $\leq 2.5\%$ 800...1000 A AC: $\leq 4\%$ 800...1400 A DC: $\leq 4\%$
C-6A	0...10 A (36 A _{pp})	0.01% I_{nom}	0.01...0.1 A: $\pm(3\% + 1 \text{ mA})$ 0.1...1 A: $\pm 2.5\%$ 1...12 A: $\pm 1\%$
C-7A	0...100 A (360 A _{pp})	0.01% I_{nom}	0...100 A: $\pm(0.5\% + 0.02 \text{ A})$ (45...65 Hz) 0...100 A: $\pm(1.0\% + 0.04 \text{ A})$ (40...1000 Hz)

Illuminance measurement*

Display range [lx]	Resolution [lx]	Spectral uncertainty	Accuracy
0...3.999	0.001	f1 < 2%	$\pm(2\% \text{ m.v.} + 5 \text{ digits})$
4.00...39.99	0.01		
40.0...399.9	0.1		
400...3999	1		
4.00 k...39.99 k	0.01 k		
40.0 k...399.9 k	0.1 k		

*) for the LP-10A measuring probe

Measurements of RCD parameters (working voltage range 95...270V):

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

RCD type	Factor	Range	Resolution	Accuracy
• General • Short-time delay • AC module in EV type	0.5 I _{Δn}	0...300 ms	1 ms	±(2% m.v. + 2 digits) for RCD of I _{Δn} = 10 mA of the measurement with 0,5 I _{Δn} accuracy: ±(2% m.v. + 3 digits)
	1 I _{Δn}			
	2 I _{Δn}			
	5 I _{Δn}			
Selective	0.5 I _{Δn}	0...500 ms	0.1 s	±(2% m.v. + 3 digits)
	1 I _{Δn}			
	2 I _{Δn}			
	5 I _{Δn}			
• EV 6 mA DC • RCM	1 I _{Δn}	0.0...10.0 s	0.1 s	±(2% m.v. + 3 digits)
	10 I _{Δn}	0...300 ms		
	33 I _{Δn}	0...100 ms		
	50 I _{Δn}	0...40 ms		

- » Residual current input accuracy: for 0.5 $I_{\Delta n}$ 8...0%
for 1 $I_{\Delta n}$, 2 $I_{\Delta n}$, 5 $I_{\Delta n}$ 0...8%

Measurement of RCD trip current I_A for sinusoidal residual current (AC type)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.0...10.0 mA	0.1 mA	0.3 I _{Δn} ...1.0 I _{Δn}	± 5% I _{Δn}
30 mA	9.0...30.0 mA			
100 mA	30...100 mA	1 mA		
300 mA	90...300 mA			
500 mA	150...500 mA			
1000 mA	300...1000 mA			

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for uni-directional residual current and uni-directional current with 6 mA direct current offset (type A)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.5...20.0 mA	0.1 mA	0.35 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	10.5...42.0 mA		1 mA	
100 mA	35...140 mA			
300 mA	105...420 mA			
500 mA	175...700 mA			

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for residual direct current (type B)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
6 mA	1.0...6.0 mA	0.1 mA	1.0...6.0 mA 0.2 I _{Δn} ...2.0 I _{Δn}	± 6% I _{Δn}
10 mA	2.0...20.0 mA	0.1 mA		
30 mA	6...60 mA	1 mA		
100 mA	20...200 mA			
300 mA	60...600 mA			
500 mA	100...1000 mA			

- » Measurement is possible for positive or negative input leakage current
- » $I_{\Delta n}$ - nominal value of residual current

Measurement of R_E earth resistance using 3-lead, 4-lead, or 3-lead + clamp technical method

Measuring range according to EN 61557-5: 0.50 Ω ...1.99 k Ω for $U = 50 \text{ V}$ (3-lead, 4-lead):

Display range	Resolution	Accuracy 3p, 4p	Accuracy 3-lead with clamp
0.00...9.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 4 \text{ digits})$	$\pm(8\% \text{ m.v.} + 4 \text{ digits})$
10.0...99.9 Ω	0.1 Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$	
100...999 Ω	1 Ω		
1.00...1.99 k Ω	0.01 k Ω		

"m.v." = "measured value"

The instrument meets the requirements set forth in the standards:

- » EN 61010-1 (general and particular requirements related to safety)
- » EN 61010-031 (general and particular requirements related to safety)
- » EN 61326 (electromagnetic compatibility)
- » EN 61557 (requirements for measurement instruments)
- » HD 60364-6 (performance of measurements - checking)
- » HD 60364-4-41 (performance of measurements - shock protection)
- » PN-E 04700 (performance of measurements - commissioning tests)
- » EN 12464 (lighting workplaces)
- » EN 62446 (testing of PV panels) (MPI-540-PV only)

Three-phase power network data logger

» Measured parameters:

- voltages L1, L2, L3, N (four measurement inputs), minimum and maximum values within the range up to 550 V, interoperability with voltage transformers,
- currents L1, L2, L3 (three measurement inputs), average, minimum and maximum values, current measurement within the range up to 3 kA (depends on used clamps), interoperability with current transformers,
- frequency within the range of 40 Hz...70 Hz,
- active power (P), reactive power (Q), apparent power (S), inactive power S_n
- power registration: IEEE 1459,
- active energy (E_p), reactive energy (E_Q), apparent energy (E_S),
- power factor (PF), $\cos\phi$,
- harmonics up to the 40th in voltage and current, total harmonic distortion THD for current and voltage,
- unbalance of voltages (in compliance with IEC 61000-4-30 class S) and currents,
- energy cost calculator,
- energy losses calculator.

» The instrument is intended for operation in networks:

- with rated frequency 50/60 Hz,
- with rated voltages: 64/110 V; 110/190 V; 115/200 V; 127/220 V; 220/380 V; 230/400 V; 240/415 V; 254/440 V; 290/500 V,
- with direct current.

» Supported network configurations:

- single-phase,
- two-phase with common N,
- three-phase - star with and without N conductor,
- three-phase - delta.



MPI-540 / MPI-540-PV meter enables estimation of power losses and related costs of poor power quality, through built-in energy loss calculator.

Recorder parameters

Parameter		Measuring range	Max. resolution	Accuracy
Alternating voltage (TRMS)	—	0.0...500 V	0.01% U_{nom}	$\pm 0.5\% U_{nom}$
Alternating voltage TRMS	—	depending on clamp*	0.01% I_{nom}	$\pm 2\% m.v.$ if $m.v. \geq 10\% I_{nom}$ $\pm 2\% I_{nom}$ if $m.v. < 10\% I_{nom}$ error does not account for clamp error)
Frequency	—	40.00...70.00 Hz	0.01 Hz	± 0.05 Hz
Active, reactive, apparent and distortion power	—	depending on configuration (instrument transformers, clamp)	up to four places after the decimal point	depending on configuration (instrument transformers, clamp)
Active, reactive apparent energy	—	depending on configuration (instrument transformers, clamp)	up to four places after the decimal point	as power error
$\cos\phi$ and power factor (PF)	—	0.00...1.00	0.01	± 0.03
Harmonics	Voltage	as for alternating voltage True RMS	as for alternating voltage True RMS	$\pm 5\% m.v.$ if $m.v. \geq 3\% U_{nom}$ $\pm 0.15\% U_{nom}$ if $m.v. < 3\% U_{nom}$
	Current	as for alternating voltage True RMS	as for alternating voltage True RMS	$\pm 5\% m.v.$ if $m.v. \geq 10\% I_{nom}$ $\pm 0.5\% I_{nom}$ if $m.v. < 10\% I_{nom}$
THD	Voltage	0.0...100.0% (relative to RMS value)	0.1%	$\pm 5\%$
	Current			
Unbalance factor	Voltage and current	0.0...10.0%	0.1%	$\pm 0.15\%$ (absolute error)

*Clamp F-1A, F-2A, F-3A: 0...3000 AAC (10 000 A_{pp}) • Clamp C-4A: 0...1000 AAC (3600 A_{pp}) • Clamp C-5A: 0...1000 AAC/DC (3600 A_{pp}) • Clamp C-6A: 0...100 A AC (36 A_{pp}) • Clamp C-7A: 0...100 A AC (360 A_{pp})

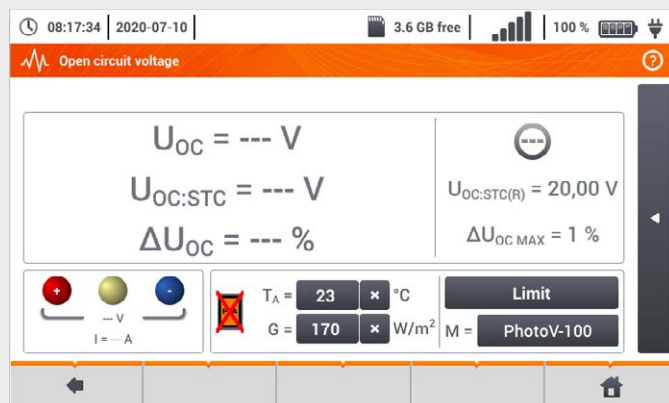
MPI-540-PV | Specifications – photovoltaic installation parameters

Open circuit voltage U_{oc} measurement

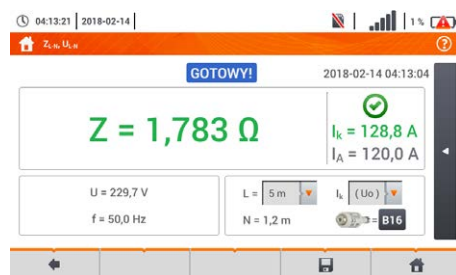
Display range	Resolution	Accuracy
0.0 V...299.9 V	0.1 V	$\pm(3\% m.v. + 5 \text{ digits})$
300 V...1000 V	1 V	$\pm(3\% m.v. + 2 \text{ digits})$

Short circuit current I_{sc} measurement

Display range	Resolution	Accuracy
0.00 A...20.00 A	0.01 A	$\pm(3\% m.v. + 0.10 \text{ A})$



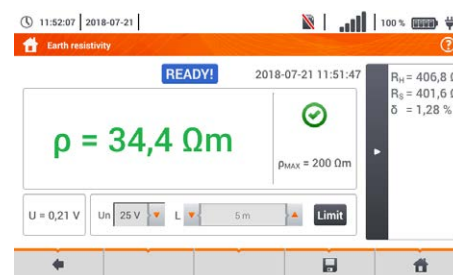
Selected features of the Sonel MPI-540 / MPI-540-PV meter



Fault loop impedance measurement



Network parameters recorder



Ground resistivity measurement

SONEL MPI-536 / MPI-535

index: WMGBMPI536 / WMGBMPI535



Fault loop impedance measurements:

- » impedance measurement with 23 A current (40 A for phase-to-phase voltage), max. resolution 0.001 Ω ,
- » fault current-limiting resistor: 10 Ω ,
- » range of measurement voltages: 95...440 V, frequencies 45...65 Hz,
- » **fast fault loop impedance measurement with resolution up to 0.01 Ω in systems protected with RCDs not tripping at $I_{\Delta n} \geq 30$ mA,**
- » automatic calculation of fault current on the basis of nominal or measured voltage; differentiation of phase-to-neutral and phase-to-phase voltage,
- » measurements using UNI-Schuko plug with measurement triggering button (including for swapped L and N leads) or 1.2 m, 5 m, 10 m, 20 m test leads, with optional use of three-phase socket adapters (AGT),
- » selection of installation protections and automatic evaluation of measurement results.

Testing of AC, A, F, B, B+ and EV residual current devices:

- » measurement of general, short-time delay and selective RCDs with rated residual currents of 10, 30, 100, 300, 500 and 1000 mA,
- » function of automatic measurement of all RCD parameters (after pressing the "START" button once, the meter performs the entire defined cycle of measurements, including the capability of earth fault loop impedance measurement with 15 mA current),
- » shape of the input leakage current selected by the user: sinusoidal (start from rising or falling edge), unidirectional pulsating (positive or negative), unidirectional pulsating with direct current offset (positive or negative), constant (positive or negative),
- » measurement of tripping current I_A with rising current,
- » measurement of tripping time t_A with currents 0.5 $I_{\Delta n}$, 1 $I_{\Delta n}$, 2 $I_{\Delta n}$ and 5 $I_{\Delta n}$,
- » measurement of touch voltage U_b and protective conductor resistance R_E without tripping the RCD,
- » detection of L and N phase swapping in a socket; does not affect measurements,
- » capability of measuring tripping current I_A as well as actual tripping time t_A with just one RCD trip,
- » voltage measurements within the range of 95...270 V.

Insulation resistance measurement:

- » measurement voltages:
 - MPI-535 | 50 V, 100 V, 250 V, 500 V, 1000 V,
 - MPI-536 | 10 V, 50 V, 100 V, 250 V, 500 V, 1000 V, 1500 V, 2500 V,
- » measurement of insulation resistance up to:
 - MPI-535 | 5 G Ω ,
 - MPI-536 | 10 G Ω ,
- » capability measurement in-socket by means of UNI-Schuko adapter,
- » sound signalling of five-second time intervals, facilitating capture of time characteristics,
- » meter protected against the presence of voltage on the object and the appearance of voltage during measurement,
- » automatic discharge of the measured object's capacitance after completion of measurement,
- » **automatic measurement of all resistance combinations of 3-, 4- and 5-core cords by means of the optional adapter:**
 - MPI-535 | AutoISO-1000C,
 - MPI-536 | AutoISO-2500.

Earth resistance measurements:

- » according to 3- or 4-lead technical method with 2 auxiliary electrodes,
- » according to 3-lead method with additional clamp,
- » according to double-clamp method,
- » internal power source with frequency appropriate for 50 Hz or 60 Hz power network.

Standard accessories:

		MPI-536	MPI-535
WS-03 adapter with START button with UNI-Schuko plug	WAADWS03	1	1
Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB	1	1
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB	1	1
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB	1	1
Test lead 1.8 m, red, 5 kV (banana plugs)	WAPRZ1X8REBB	1	
Test lead 1.8 m, black, 5 kV (banana plugs)	WAPRZ1X8BLBB	1	
Test lead 15 m, blue (on a reel)	WAPRZ015BUBBSZ	1	1
Test lead 30 m, red (banana plugs, on a reel)	WAPRZ030REBBSZ	1	1
USB cable	WAPRZUSB	1	1
Crocodile clip, red, 1 kV, 20 A	WAKRORE20K02	1	1
Crocodile clip, blue, 1 kV, 20 A	WAKROBU20K02	1	1
Crocodile clip, yellow, 1 kV, 20 A	WAKROYE20K02	1	1
Crocodile clip, black, 11 kV, 32 A	WAKROBL32K09	1	
Pin probe, red 1 kV (banana socket)	WASONREOGB1	1	1
Pin probe, blue 1 kV (banana socket)	WASONBUOGB1	1	1
Pin probe, yellow 1 kV (banana socket)	WASONYEGB1	1	1
Pin probe, red 5 kV (banana socket)	WASONYEGB2	1	
Earth contact test probe (rod), 30 cm	WASONG30	2	2
Z-7 power supply	WAZASZ7	1	1
230 V mains cable (IEC C7 plug)	WAPRZLAD230	1	1
Cable for battery charging from car cigarette lighter socket (12 V)	WAPRZLAD12SAM	1	
L-2 carrying case	WAFUTL2	1	1
L-2 hanging straps (set)	WAPOZSZEKPL	1	1
Li-Ion battery 11.1 V 3.4 Ah	WAAKU15	1	1
Touchscreen pen	WAPOZTPEN	1	1
Factory calibration certificate		1	1

Soil resistivity measurements according to the Wenner method:

- » measuring range: 0.5 Ω m...9.99 k Ω m,
- » distances between electrodes can be set in meters (1...30 m) or feet (1...90 ft).

Low-voltage continuity testing of protective conductors and equipotential bonding:

- » measuring range according to EN 61557-4: 0.12...400 Ω , max. resolution 0.01 Ω ,
- » measurement of protective conductor continuity with current ≥ 200 mA in two directions,
- » low-current measurement with sound signalling,
- » voltage on open terminals: 4...9 V,
- » automatic calibration of test leads - leads of any length can be used.

Illuminance measurement:

- » display range: 0.001/0.01/0.1 lx...399.9 klx,
- » measurement in lux (lx) or foot-candles (fc),
- » measurement by means of external photodetectors (optional)

Additional functions of the meter:

- » autotests - pre-programmed measurement sequences,
- » quick check of correct connection of PE conductor by means of contact electrode,
- » check of phase sequence and direction of motor rotation,
- » tree-like memory structure with dynamic management
- » data transmission to PC via USB or Bluetooth[®],
- » replaceable microSD memory card,
- » power supply from rechargeable battery, built-in quick charger,
- » capability of charging from the power grid or 12 V car lighter socket.

Other technical specifications:

- » type of insulation double, as per EN 61010-1 and EN 61557
- » power supply Li-Ion rechargeable battery 11.1 V 3.4 Ah 37.7 Wh
- » operating temperature range 0...+50°C

Measurement of fault loop impedance Z_{L-PE} , Z_{L-N} , Z_{L-L} in 23/40 A mode

Measurement with 23/40 A current - measuring range according to EN 61557: 0.130 ...1999 Ω (for 1.2 m test lead):

Display range	Resolution	Accuracy
0.00...19.999 Ω	0.001 Ω	$\pm(5\% \text{ m.v.} + 0.03 \Omega)$
20.00...199.99 Ω	0.01 Ω	$\pm(5\% \text{ m.v.} + 0.3 \Omega)$
200.00...1999.9 Ω	0.1 Ω	$\pm(5\% \text{ m.v.} + 3 \Omega)$

- » Nominal voltage: 95...270 V (for Z_{L-PE} and Z_{L-N}) or 95...440 V (for Z_{L-L} - only mode 23/40 A). Frequency: 45...65 Hz.

Measurement of the Z_{L-PE} fault loop impedance in the RCD mode

Measurement with 15 mA current - measuring range according to EN 61557: 0.50...1999 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(6\% \text{ m.v.} + 10 \text{ digits})$
20.00...199.99 Ω	0.1 Ω	$\pm(6\% \text{ m.v.} + 5 \text{ digits})$
200...1999 Ω	1 Ω	

- » Nominal voltage: 95...270 V
- » Frequency: 45...65 Hz

Earthing resistance measurement with two clamps

Display range	Resolution	Accuracy
0.00...9.99 Ω	0.01 Ω	±(10% m.v. + 4 digits)
10.0...19.9 Ω	0.1 Ω	
20.0...99.9 Ω		±(20% m.v. + 4 digits)

Measurement of insulation resistance

Measuring range according to EN 61557-2:

- » MPI-536 | for $U_n = 10 \text{ V}$: 10 k Ω ...99.9 M Ω
- » for $U_n = 50 \text{ V}$: 50 k Ω ...250 M Ω
- » for $U_n = 100 \text{ V}$: 100 k Ω ...500 M Ω
- » for $U_n = 250 \text{ V}$: 250 k Ω ...999 M Ω
- » for $U_n = 500 \text{ V}$: 500 k Ω ...2.00 G Ω
- » MPI-535 | for $U_n = 1000 \text{ V}$: 1000 k Ω ...4.99 G Ω
- » MPI-536 | for $U_n = 1000 \text{ V}$: 1000 k Ω ...3.00 G Ω
- » MPI-536 | for $U_n = 1500 \text{ V}$: 1500 k Ω ...5.00 G Ω
- » MPI-536 | for $U_n = 2500 \text{ V}$: 2500 k Ω ...9.99 G Ω

Display range	Resolution	Accuracy
0...1999 kΩ	1 kΩ	±(3% m.v. + 8 digits)
2.00...19.99 MΩ	0.01 MΩ	
20.0...199.9 MΩ		
200...999 MΩ	1 MΩ	
MPI-535 1.00...4.99 GΩ MPI-536 1.00...9.99 GΩ	0.01 GΩ	±(4% m.v. + 6 digits)

Indication of phase sequence

- » Indication of phase sequence: compliant, non-compliant, display of phase-to-phase voltages
- » U_{L-L} power system voltage range: 95...500 V (45...65 Hz)

Measurements of RCD parameters (operating voltage range 95...270 V):

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

RCD type	Factor	Range	Resolution	Accuracy
• General • Short-time delay • AC module in EV type	0.5 $I_{\Delta n}$	0...300 ms	1 ms	$\pm(2\% \text{ m.v.} + 2 \text{ digits})$ for RCD of $I_{\Delta n} = 10 \text{ mA}$ of the measurement with 0.5 $I_{\Delta n}$ accuracy: $\pm(2\% \text{ m.v.} + 3 \text{ digits})$
	1 $I_{\Delta n}$	0...150 ms		
	2 $I_{\Delta n}$	0...40 ms		
	0.5 $I_{\Delta n}$	0...500 ms		
Selective	1 $I_{\Delta n}$	0...200 ms	0.1 s	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$
	2 $I_{\Delta n}$	0...150 ms		
	5 $I_{\Delta n}$	0...10.0 s		
• EV 6 mA DC • RCM	1 $I_{\Delta n}$	0...300 ms	1 ms	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$
	10 $I_{\Delta n}$	0...100 ms		
	33 $I_{\Delta n}$	0...40 ms		
	50 $I_{\Delta n}$	0...40 ms		

- » Residual current input accuracy:
for 0.5 $I_{\Delta n}$ 8...0%
for 1 $I_{\Delta n}$, 2 $I_{\Delta n}$, 5 $I_{\Delta n}$ 0...8%

Measurement of RCD trip current I_A for sinusoidal residual current (AC type)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.0...10.0 mA	0.1 mA	0.3 I _{Δn} ...1.0 I _{Δn}	±5% I _{Δn}
30 mA	9.0...30.0 mA			
100 mA	30...100 mA	1 mA		
300 mA	90...300 mA			
500 mA	150...500 mA			
1000 mA	300...1000 mA			

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for uni-directional residual current and uni-directional current with 6 mA direct current offset (type A)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.5...20.0 mA	0.1 mA	0.35 I _{Δn} ... 2.0 I _{Δn}	±10% I _{Δn}
30 mA	10.5...42.0 mA		0.35 I _{Δn} ... 1.4 I _{Δn}	
100 mA	35...140 mA			
300 mA	105...420 mA			
500 mA	175...700 mA			
		1 mA		

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for residual direct current (type B)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
6 mA	1.0...6.0 mA	0.1 mA	1.0...6.0 mA	± 6% I _{Δn}
10 mA	2.0...20.0 mA	0.1 mA	0.2 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	6...60 mA	1 mA		
100 mA	20...200 mA			
300 mA	60...600 mA			
500 mA	100...1000 mA			

- » Measurement is possible for positive or negative input leakage current
- » $I_{\Delta n}$ - nominal value of residual current

Measurement of R_E earth resistance using 3-lead, 4-lead or 3-lead + clamp technical method

Measuring range according to EN 61557-5:

0.50 Ω ...1.99 k Ω for $U = 50 \text{ V}$ (3-lead, 4-lead):

Display range	Resolution	Accuracy 3p, 4p	Accuracy 3-lead with clamp
0.00...9.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 4 \text{ digits})$	$\pm(8\% \text{ m.v.} + 4 \text{ digits})$
10.0...99.9 Ω	0.1 Ω		
100...999 Ω	1 Ω		
1.00...1.99 k Ω	0.01 k Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$	

"m.v." = "measured value"

The instrument meets the requirements set forth in the standards:

- » EN 61010-1 (general and particular requirements related to safety)
- » EN 61010-031 (general and particular requirements related to safety)
- » EN 61326 (electromagnetic compatibility)
- » EN 61557 (requirements for measurement instruments)
- » HD 60364-6 (performance of measurements - checking)
- » HD 60364-4-41 (performance of measurements - shock protection)
- » PN-E 04700 (performance of measurements - commissioning tests)
- » EN 12464 (lighting workplaces)



SONEL MPI-530 / MPI-530-IT

index: WMGBMPI530 / WMGBMPI530IT


CAT III
600 V

CAT IV
300 V

IP54

BLUETOOTH

WORK IN IT MEANS
MPI-530-IT

Fault loop impedance measurements:

- » impedance measurement with 23 A current (40 A for phase-to-phase voltage), max. resolution 0.001 Ω ,
- » fault current-limiting resistor: 10 Ω ,
- » range of measurement voltages: 95...440 V, frequencies 45...65 Hz,
- » **fault loop impedance measurement with resolution up to 0.01 Ω in systems protected with RCDs not tripping at $I_{\Delta n} \geq 30$ mA,**
- » automatic calculation of fault current on the basis of nominal or measured voltage; differentiation of phase-to-neutral and phase-to-phase voltage,
- » measurements using UNI-Schuko plug with measurement triggering button (including for swapped L and N leads) or 1.2 m, 5 m, 10 m or 20 m test leads, with optional use of three-phase socket adapters (AGT),
- » selection of installation protections and automatic evaluation of measurement results.

Testing of AC, A, F, B and B+ residual current devices:

- » **MPI-530-IT also enables measurements in IT networks,**
- » measurement of general, short-time delay and selective RCDs with rated residual currents of 10, 30, 100, 300, 500 and 1000 mA,
- » function of automatic measurement of all RCD parameters (after pressing the "START" button once, the meter performs the entire defined cycle of measurements, including the capability of earth fault loop impedance measurement with 15 mA current),
- » shape of the input leakage current selected by the user: sinusoidal (start from rising or falling edge), unidirectional pulsating (positive or negative), unidirectional pulsating with direct current offset (positive or negative), constant (positive or negative),
- » measurement of tripping current I_{Δ} with rising current,
- » measurement of tripping time t_{Δ} with currents 0.5 $I_{\Delta n}$, 1 $I_{\Delta n}$, 2 $I_{\Delta n}$ and 5 $I_{\Delta n}$,
- » measurement of touch voltage U_b and protective conductor resistance R_E without tripping the RCD,
- » detection of L and N phase swapping in a socket; does not affect measurements,
- » capability of measuring tripping current I_{Δ} as well as actual tripping time t_{Δ} with just one RCD trip,
- » voltage measurements within the range of 95...270 V.

Insulation resistance measurement:

- » measurement voltages: 50 V, 100 V, 250 V, 500 V, 1000 V,
- » measurement of insulation resistance up to 10 G Ω ,
- » capability measurement in-socket by means of UNI-Schuko adapter,
- » sound signalling of five-second time intervals, facilitating capture of time characteristics,
- » meter protected against the presence of voltage on the object and the appearance of voltage during measurement,
- » automatic discharge of the measured object's capacitance after completion of measurement,
- » **automatic measurement of all resistance combinations of 3-, 4- and 5-core cords by means of the optional AutoISO-1000C adapter**

Earth resistance measurements:

- » according to 3- or 4-lead technical method with 2 auxiliary electrodes,
- » according to 3-lead method with additional clamp,
- » **according to double-clamp method,**
- » internal power source with frequency appropriate for 50 Hz or 60 Hz power network.



SONEL MPI MOBILE

A mobile version of the program cooperating with a multifunctional Sonei instrument: **MPI-530-IT / MPI-530** meters of electrical system parameters. It can be downloaded from **Google Play**.

Standard accessories:

WS-03 adapter with START button with UNI-SCHUKO plug	WAADAWS03
NiMH battery 4.8 V 4.2 Ah	WAAKU07
L-2 carrying case	WAFUTL2
Crocodile clip, red, 1 kV, 20 A	WAKRORE20K02
Crocodile clip, blue, 1 kV, 20 A	WAKROBU20K02
Crocodile clip, yellow, 1 kV, 20 A	WAKROYE20K02
Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB
Test lead 15 m, blue (on a reel)	WAPRZ015BUBBSZ
Test lead 30 m, red (banana plugs, on a reel)	WAPRZ030REBBSZ
Cable for battery charging from car cigarette lighter socket (12 V)	WAPRZLAD12SAM
USB cable	WAPRZUSB
230 V mains cable (IEC C7 plug)	WAPRZLAD230
2x earth contact test probe (rod), 30 cm	WASONG30
Pin probe, red 1 kV (banana socket)	WASONREOGB1
Pin probe, blue 1 kV (banana socket)	WASONBUOGB1
Pin probe, yellow 1 kV (banana socket)	WASONYEOGB1
L-2 hanging straps (set)	WAPRZSZSEKPL
Z-7 power supply	WAZASZ7
Factory calibration certificate	

Soil resistivity measurements according to the Wenner method:

- » measuring range: 0.5 Ω m...9.99 k Ω m,
- » distances between electrodes can be set in meters (1...30 m) or feet (1...90 ft).

Low-voltage continuity testing of protective conductors and equipotential bonding:

- » measuring range according to EN 61557-4: 0.12...400 Ω , max. resolution 0.01 Ω ,
- » measurement of protective conductor continuity with current ≥ 200 mA in two directions,
- » low-current measurement with sound signaling,
- » voltage on open terminals: 4...9 V,
- » automatic calibration of test leads - leads of any length can be used.

Illuminance measurement:

- » display range: 0.001/0.01/1 lx...399.9 klx,
- » measurement in lux (lx) or foot-candles (fc),
- » measurement by means of external photodetectors (optional).

Additional functions of the meter:

- » Analysis and registration of single-phase network parameters (U, I, cos ϕ , P, PF, Q, S, Sn),
- » THD of voltage and current harmonics up to the 40th,
- » Quick check of correct connection of PE conductor by means of contact electrode,
- » Check of phase sequence and direction of motor rotation,
- » Power supply from rechargeable battery or batteries (optional), built-in quick charger,
- » Capability of charging from the power grid or 12 V car lighter socket,
- » Tree-structure memory with dynamic management (max. 10,000 entries for each type of measurement),
- » Data transmission to PC via USB or Bluetooth®.

Other technical specifications:

- » type of insulation double, as per EN 61010-1 and EN 61557
- » power supply of the meter Ni-MH rechargeable battery
- » LR14 alkaline batteries (4 pcs.) (optional)
- » operating temperature range 0...+50°C

Measurement of fault loop impedance Z_{L-PE} , Z_{L-N} , Z_{L-L} in 23/40A mode

Measurement with 23/40 A current - measuring range according to EN 61557: 0.130 ...1999 Ω (for 1.2 m lead):

Display range	Resolution	Accuracy
0.00...19.999 Ω	0.001 Ω	$\pm(5\% \text{ m.v.} + 0.03 \Omega)$
20.00...199.99 Ω	0.01 Ω	$\pm(5\% \text{ m.v.} + 0.3 \Omega)$
200.00...1999.9 Ω	0.1 Ω	$\pm(5\% \text{ m.v.} + 3 \Omega)$

- » Nominal voltage: 95...270 V (for Z_{L-PE} and Z_{L-N}) or 95...440 V (for Z_{L-L} - only mode 23/40 A). Frequency: 45...65 Hz.

Measurement of the Z_{L-PE} fault loop impedance in the RCD mode

Measurement with 15 mA current - measuring range acc. to EN 61557: 0.50...1999 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(6\% \text{ m.v.} + 10 \text{ digits})$
20.00...199.9 Ω	0.1 Ω	$\pm(6\% \text{ m.v.} + 5 \text{ digits})$
200...1999 Ω	1 Ω	

- » Rated voltage: 95...270 V; frequency: 45...65 Hz

Earthing resistance measurement with two clamps

Display range	Resolution	Accuracy
0.00...9.99 Ω	0.01 Ω	$\pm(10\% \text{ m.v.} + 4 \text{ digits})$
10.0...19.9 Ω	0.1 Ω	
20.0...99.9 Ω	0.1 Ω	$\pm(20\% \text{ m.v.} + 4 \text{ digits})$

Measurement of insulation resistance

Measuring range according to EN 61557-2:

- » for $U_n = 50 \text{ V}$: 50 k Ω ...250 M Ω
- » for $U_n = 100 \text{ V}$: 100 k Ω ...500 M Ω
- » for $U_n = 250 \text{ V}$: 250 k Ω ...99 M Ω
- » for $U_n = 500 \text{ V}$: 500 k Ω ...2 G Ω
- » for $U_n = 1000 \text{ V}$: 1000 M Ω ...9.99 G Ω

Display range	Resolution	Accuracy
0...1999 kΩ	1 kΩ	±(3% m.v. + 8 digits)
2.00...19.99 MΩ	0.01 MΩ	
20.0...199.9 MΩ		
200...999 MΩ	1 MΩ	
1.00...9.99 GΩ	0.01 GΩ	±(4% m.v. + 6 digits)

Indication of phase sequence

- » Indication of phase sequence: compliant, non-compliant, display of phase-to-phase voltages
- » U_{L-L} power system voltage range: 95...500 V (45...65 Hz)

Analysis and recording of single-phase system

- » Measurement of voltage U_{L-N} : 0...500 V, power measurement P, Q, S: 0...1.5 M (W, var, VA).
- » Frequency range of measured voltages: 45...65 Hz.
- » Frequency measurement within range 45.0...65.0 Hz for voltages 50...500 V (Accuracy within a maximum of $\pm 0.1\% \text{ m.v.} + 1 \text{ digit}$).
- » $\cos\phi$ measurement: 0.00...1.00 (resolution 0.01).
- » Measurement of current and voltage harmonics (up to the 40th).
- » THD measurement relative to first harmonic (for U and I).
- » AC current measurement (True RMS) with clamp:

Clamp	Display range	Resolution	Accuracy
C-3, C-6	0.0...99.9 mA	0.1 mA	$\pm(5\% \text{ m.v.} + 3 \text{ digits})$
	100...999 mA	1 mA	
	1.00...9.99 A	0.01 A	$\pm(5\% \text{ m.v.} + 5 \text{ digits})$ (C-3, C-6)
C-3, C-6, F-2, F-3	10.0...99.9 A	0.1 A	
	100...999 A	1 A	$\pm(0.1\% \text{ In} + 2 \text{ digits})$ (F-1, F-2, F-3)
F-1, F-2, F-3	1.00...3.00 kA	0.01 kA	

Illuminance measurement*

Display range [lx]	Resolution [lx]	Spectral uncertainty	Accuracy
0...3.999	0.001	$f_1 < 2\%$	$\pm(2\% + 5 \text{ digits})$
4.00...39.99	0.01		
40.0...399.9	0.1		
400...3999	1		
4.00 k...39.99 k	0.01 k		
40.0 k...399.9 k	0.1 k		

*) for LP-10A measuring probe.



MPI-530 / MPI-530-IT meters enable accurate measurement of fault loop impedance, including in L-PE loops in networks equipped with RCDs, as well as measurements in sockets with swapped L and N conductors.

Measurements of RCD parameters (working voltage range 95...270 V):

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

RCD type	Factor	Range (general and short-time delay)	Range (selective)	Resolution	Accuracy
General, short-time delay and selective	0.5 $I_{\Delta n}$	0...300 ms	0...500 ms	1 ms	$\pm(2\% \text{ m.v.} + 2 \text{ digits})$ (for RCD of $I_{\Delta n} = 10 \text{ mA}$ and the measurement with 0.5 $I_{\Delta n}$ error: $\pm(2\% \text{ m.v.} + 3 \text{ digits})$)
	1 $I_{\Delta n}$	0...150 ms	0...200 ms		
	5 $I_{\Delta n}$	0...40 ms	0...150 ms		

- » Residual current input accuracy: for 0.5 $I_{\Delta n}$ 8...0%, for 1 $I_{\Delta n}$, 2 $I_{\Delta n}$, 5 $I_{\Delta n}$ 0...8%

Measurement of RCD trip current I_A for sinusoidal residual current (AC type)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.3...10.0 mA	0.1 mA	0.3 I _{Δn} ...1.0 I _{Δn}	±5% I _{Δn}
30 mA	9.0...30.0 mA			
100 mA	33...100 mA	1 mA		
300 mA	90...300 mA			
500 mA	150...500 mA			
1000 mA	330...1000 mA			

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for uni-directional residual current and uni-directional current with 6mA direct current offset (type A)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.5...20.0 mA	0.1 mA	0.35 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	10.5...42.0 mA			
100 mA	35...140 mA	1 mA	0.35 I _{Δn} ...1.4 I _{Δn}	
300 mA	105...420 mA			
500 mA	175...700 mA			

- » Measurement can be started from a positive or negative half-period of the input leakage current



MPI-530 / MPI-530-IT meters enable automatic insulation resistance measurement of 3-, 4- and 5-core cords with optional AutoISO-1000C adapter.

Measurement of RCD trip current I_A for residual direct current (type B)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	2.0...20.0 mA	0.1 mA	0.2 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	6...60 mA	1 mA		
100 mA	20...200 mA			
300 mA	60...600 mA			
500 mA	100...1000 mA			

- » Measurement is possible for positive or negative input leakage current
- » $I_{\Delta n}$ - nominal value of residual current

Measurement of RE earth resistance using 3-lead, 4-lead, or 3-lead + clamp technical method

Measuring range according to EN 61557-5:

0.50 Ω ...1.99 k Ω for $U = 50 \text{ V}$ (3-lead, 4-lead):

Display range	Resolution	Accuracy 3-lead, 4-lead	Accuracy 3-lead with clamp
0.00...9.99 Ω	0.01 Ω	±(2% m.v. + 4 digits)	±(8% m.v. + 4 digits)
10.0...99.9 Ω	0.1 Ω		
100...999 Ω	1 Ω	±(2% m.v. + 3 digits)	
1.00...1.99 kΩ	0.01 kΩ		

"m.v." = "measured value"



MPI-530 / MPI-530-IT meters enable measurement of the actual tripping time and trip current of an RCD with just one trip.

The instrument meets the requirements set forth in the standards:

- » EN 61010-1 (general and particular requirements related to safety)
- » EN 61010-031 (general and particular requirements related to safety)
- » EN 61326 (electromagnetic compatibility)
- » EN 61557 (requirements for measurement instruments)
- » HD 60364-6 (performance of measurements - checking)
- » HD 60364-4-41 (performance of measurements - shock protection)
- » PN-E 04700 (performance of measurements - commissioning tests)
- » EN 12464 (lighting workplaces)

SONEL MPI-525

index: WMGBMPI525



CAT III

600 V

CAT IV

300 V

IP54

2.5 kV

maximum
R_{SO} measuring
voltage

Fault loop impedance measurements:

- » impedance measurement with 23 A current (40 A for phase-to-phase voltage),
- » fault current-limiting resistor: 10 Ω ,
- » range of measurement voltages: 95...440 V, frequencies 45...65 Hz,
- » **fault loop impedance measurement with resolution up to 0.01 Ω in systems protected with RCDs not tripping at $I_{\Delta n} \geq 30$ mA,**
- » automatic fault current calculation; differentiation of phase and phase-to-phase voltage,
- » measurements using UNI-Schuko plug with measurement triggering button (including for swapped L and N leads) or 1.2 m, 5 m, 10 m, 20 m test leads, with optional use of three-phase socket adapters (AGT).

Testing of AC, A, F, B and B+ residual current devices:

- » measurement of general, short-time delay and selective RCDs with rated residual currents of 10, 30, 100, 300, 500 and 1000 mA,
- » **function of automatic measurement of all RCD parameters (after pressing the "START" button once, the meter performs the entire defined cycle of measurements, including the capability of earth fault loop impedance measurement with 15 mA current),**
- » shape of the input leakage current selected by the user: sinusoidal (start from rising or falling edge), unidirectional pulsating (positive or negative), unidirectional pulsating with direct current offset (positive or negative), constant (positive or negative),
- » measurement of tripping current I_{Δ} with rising current,
- » measurement of tripping time t_{Δ} for currents: $0.5I_{\Delta n}$, $1I_{\Delta n}$, $2I_{\Delta n}$ and $5I_{\Delta n}$,
- » measurement of touch voltage U_b and protective conductor resistance R_e without tripping the RCD,
- » detection of L and N phase swapping in a socket; does not affect measurements,
- » capability of measuring tripping current I_{Δ} as well as actual tripping time t_{Δ} with just one RCD trip,
- » voltage measurements within the range of 95...270 V.

Insulation resistance measurement:

- » measurement voltages: 50 V, 100 V, 250 V, 500 V, 1000 V and 2500 V,
- » measurement of insulation resistance up to 10 G Ω ,
- » sound signalling of five-second time intervals, facilitating capture of time characteristics,
- » measurement of 2 absorption coefficients (DAR, PI or Ab1, Ab2)
- » timing of T_1 , T_2 , T_3 within the range of 1...600 s,
- » meter protected against the presence of voltage on the object and the appearance of voltage during measurement,
- » automatic discharge of the measured object's capacitance after completion of measurement,
- » **automatic measurement of all resistance combinations of 3-, 4- and 5-core cords and power cords by means of the optional AutoISO-2500 adapter.**

Earth resistance measurements:

- » measurement according to 3- or 4-lead technical method with 2 auxiliary electrodes,
- » internal power source with frequency appropriate for 50 Hz or 60 Hz power network (selected in the meter).

Standard accessories:

WS-03 adapter with START button with UNI-SCHUKO plug	WAADAWS03
NiMH battery 4.8 V 4.2 Ah	WAAKU07
L-2 carrying case	WAFUTL2
Crocodile clip, black, 11 kV, 32 A	WAKROBL32K09
Crocodile clip, yellow, 1 kV, 20 A	WAKROYE20K02
Crocodile clip, black, 1 kV, 20 A	WAKROBL20K01
Test lead 1.2 m, red, 1 kV (banana plugs)	WAPRZ1X2REBB
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB
Test lead 1.8 m, black, 5 kV (banana plugs, shielded)	WAPRZ1X8BLBB
Test lead 1.8 m, red, 5 kV (banana plugs)	WAPRZ1X8REBB
Test lead 15 m, blue (on a reel)	WAPRZ015BUBBSZ
Test lead 30 m, red (banana plugs, on a reel)	WAPRZ030REBBSZ
USB cable	WAPRZUSB
230 V mains cable (IEC C7 plug)	WAPRZLAD230
2x earth contact test probe (rod), 30 cm	WASONG30
Pin probe, red 1 kV (banana socket)	WASONREOGB1
Pin probe, red 5 kV (banana socket)	WASONREOGB2
Pin probe, blue 1 kV (banana socket)	WASONBUOGB1
Pin probe, yellow 1 kV (banana socket)	WASONYEGB1
L-2 hanging straps (set)	WAPOZSZEKPL
Z-7 power supply	WAZASZ7
Factory calibration certificate	



The MPI-525 meter is one of the few multi-function meters capable of measuring insulation resistance with 2500 V voltage.

Low-voltage resistance measurement of protective conductors and equipotential bonding:

- » measurement of protective conductor continuity with current ≥ 200 mA in two directions (according to standard EN 61557-4),
- » low-current measurement with sound and light signaling,
- » automatic calibration of test leads - leads of any length can be used.

Additional functions of the meter:

- » Quick check of correct connection of PE conductor by means of contact electrode,
- » Check of phase sequence,
- » Memory storing up to 990 records (57,500 individual results), data transmission to PC via USB,
- » Power supply from rechargeable battery or battery (optional), built-in quick charger,
- » Real-time clock (RTC) - time of measurement saved to memory.



MPI-525 enables measurements in sockets with swapped L and N conductors.

Other technical specifications:

- » type of insulation double, as per EN 61010-1 and EN 61557
- » power supply of the meter Ni-MH battery or LR14 alkaline batteries (4 pcs. - optional)
- » operating temperature range 0...+50°C

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

Measurement with 23 / 40 A current - measuring range according to EN 61557-3: 0.13...1999 Ω (for 1.2 m test lead):

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(5\% \text{ m.v.} + 3 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...1999 Ω	1 Ω	

- » Nominal voltage: 95...270V (for Z_{L-PE} and Z_{L-N}) or 95...440 V (for Z_{L-L})
- » Frequency: 45...65Hz

Measurement of the Z_{L-PE} fault loop impedance in the RCD mode

Measurement with 15 mA current, measuring range according to EN 61557-3: 0.50...1999 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(6\% \text{ m.v.} + 10 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...1999 Ω	1 Ω	$\pm(6\% \text{ m.v.} + 5 \text{ digits})$

- » Rated voltage: 95...270 V
- » Frequency: 45...65 Hz

Earth resistance R_E measurement

Measuring range according to EN 61557-5:

0.50 Ω ...1.99 k Ω for 50 V measurement voltage
0.56 Ω ...1.99 k Ω for 25 V measurement voltage

Display range	Resolution	Accuracy
0.00...9.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 4 \text{ digits})$
10.0...99.9 Ω	0.1 Ω	
100...999 Ω	1 Ω	
1.00...1.99 k Ω	0.01 k Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$

Measurement of insulation resistance

Measuring range according to EN 61557-2:

for $U_n = 50 \text{ V}$: 50 k Ω ...250 M Ω for $U_n = 500 \text{ V}$: 500 k Ω ...2.00 G Ω
for $U_n = 100 \text{ V}$: 100 k Ω ...500 M Ω for $U_n = 1000 \text{ V}$: 1000 k Ω ...3.00 G Ω
for $U_n = 250 \text{ V}$: 250 k Ω ...999 M Ω for $U_n = 2500 \text{ V}$: 2.50 M Ω ...9.99 G Ω

Display range *)	Resolution	Accuracy
0...1999 k Ω	1 k Ω	$\pm(3\% \text{ m.v.} + 8 \text{ digits})$
2.00...19.99 M Ω	0.01 k Ω	
20.0...199.9 M Ω	0.1 k Ω	
200...999 M Ω	1 k Ω	
1.00...9.99 G Ω	0.01 G Ω	$\pm(4\% \text{ m.v.} + 6 \text{ digits})$

**) no greater than the measuring range for a given voltage.



The MPI-525 meter enables automatic insulation resistance measurement of cables and 3-, 4- and 5-core cords by means of the optional AutoISO-2500 adapter.

Indication of phase sequence

- » Indication of phase sequence: compliant, non-compliant
- » U_{L-L} power system voltage range: 95...500 V (45...65 Hz)
- » Display of phase-to-phase voltage values

Low-voltage measurement of circuit continuity and resistance

Testing of protective conductor continuity with $\pm 200 \text{ mA}$ current measuring range according to EN 61557-4: 0.12...400 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...400 Ω	1 Ω	

- » voltage on open terminals: 4...9 V
- » Output current at $R < 2 \text{ } \Omega$: min. 200 mA
- » Automatic calibration of test leads
- » Measurements for both current polarities



The MPI-525 meter is one of the few meters capable of accurately measuring fault loop impedance, including in L-PE loops, in networks equipped with residual current devices (measurement with 15 mA current).

Measurements of RCD parameters (working voltage range 95...270 V):

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

RCD type	Factor	Range	Resolution	Accuracy	
General and short-time delay	0.5 $I_{\Delta n}$	0...300 ms	1 ms	$\pm(2\% \text{ m.v.} + 2 \text{ digits})$ (for RCD of $I_{\Delta n} = 10\text{mA}$ and the measurement 0.5 $I_{\Delta n}$ error: $\pm(2\% \text{ m.v.} + 3 \text{ digits})$)	
	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			

- » Residual current input accuracy: for 0.5 $I_{\Delta n}$ 8...0%
for 1 $I_{\Delta n}$, 2 $I_{\Delta n}$, 5 $I_{\Delta n}$ 0...8%

Measurement of RCD trip current I_A for sinusoidal residual current (AC type)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.3...10.0 mA	0.1 mA	0.3 I _{Δn} ...1.0 I _{Δn}	±5% I _{Δn}
30 mA	9.0...30.0 mA			
100 mA	30...100 mA	1 mA		
300 mA	90...300 mA			
500 mA	150...500 mA			
1000 mA	300...1000 mA			

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for uni-directional residual current and uni-directional current with 6 mA direct current offset (type A, F)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.5...20.0 mA	0.1 mA	0.35 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	10.5...42.0 mA			
100 mA	35...140 mA	1 mA	0.35 I _{Δn} ...1.4 I _{Δn}	
300 mA	105...420 mA			
500 mA	175...700 mA			

- » Measurement can be started from a positive or negative half-period of the input leakage current

Measurement of RCD trip current I_A for residual direct current (type B, B+)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	2.0...20.0 mA	0.1 mA	0.2 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	6...60 mA	1 mA		
100 mA	20...200 mA			
300 mA	60...600 mA			
500 mA	100...1000 mA			

- » Measurement is possible for both a positive or negative input leakage current
- » $I_{\Delta n}$ - nominal value of residual current

"m.v." = "measured value"



The MPI-525 meter enables measurement of the actual tripping time and trip current of an RCD with just one trip.

The instrument meets the requirements set forth in the standards:

- » EN 61010-1 (general and particular requirements related to safety)
- » EN 61010-031 (general and particular requirements related to safety)
- » EN 61326 (electromagnetic compatibility)
- » EN 61557 (requirements for measurement instruments)
- » HD 60364-6 (performance of measurements - checking)
- » HD 60364-4-41 (performance of measurements - shock protection)
- » PN-E 04700 (performance of measurements - commissioning tests)

SONEL MPI-520



CAT III

600 V

CAT IV

300 V

IP54

Fault loop impedance measurements:

- » impedance measurement with 23 A current (40 A for phase-to-phase voltage),
- » fault current-limiting resistor: 10 Ω ,
- » range of measurement voltages: 95...440 V, frequencies 45...65 Hz,
- » **fault loop impedance measurement with resolution up to 0.01 Ω in systems protected with RCDs not tripping at $I_{\Delta n} \geq 30$ mA,**
- » automatic fault current calculation; differentiation of phase and phase-to-phase voltage,
- » measurements using UNI-Schuko plug with measurement triggering button (including for swapped L and N leads) or 1.2 m, 5 m, 10 m, 20 m test leads, with optional use of three-phase socket adapters (AGT).

Testing of AC, A, F, B and B+ residual current devices:

- » measurement of general, short-time delay and selective RCDs with rated residual currents of 10, 30, 100, 300, 500 and 1000 mA,
- » function of automatic measurement of all RCD parameters (after pressing the "START" button once, the meter performs the entire defined cycle of measurements, including the capability of earth fault loop impedance measurement with 15 mA current),
- » shape of the input leakage current selected by the user: sinusoidal (start from rising or falling edge), unidirectional pulsating (positive or negative), unidirectional pulsating with direct current offset (positive or negative), constant (positive or negative),
- » measurement of tripping current I_{Δ} with rising current,
- » measurement of tripping time t_{Δ} for currents: 0.5 $I_{\Delta n}$, 1 $I_{\Delta n}$, 2 $I_{\Delta n}$ and 5 $I_{\Delta n}$,
- » measurement of touch voltage U_b and protective conductor resistance R_E without tripping the RCD,
- » detection of L and N phase swapping in a socket; does not affect measurements,
- » capability of measuring tripping current I_{Δ} as well as actual tripping time t_{Δ} with just one RCD trip,
- » voltage measurements within the range of 95...270 V.

Insulation resistance measurement:

- » measurement voltages: 50 V, 100 V, 250 V, 500 V, 1000 V,
- » measurement of insulation resistance up to 3 G Ω ,
- » capability of in-socket measurement by means of UNI-Schuko adapter,
- » sound signalling of five-second time intervals, facilitating capture of time characteristics,
- » meter protected against the presence of voltage on the object and the appearance of voltage during measurement,
- » automatic discharge of the measured object's capacitance after completion of measurement,
- » automatic measurement of all resistance combinations of 3-, 4- and 5-core cords by means of the optional AutoISO-1000C adapter.

Earth resistance measurements:

- » measurement according to 3-lead technical method with 2 auxiliary electrodes,
- » internal power source with frequency appropriate for 50 Hz or 60 Hz power network (selected in the meter).

Choose the best set for your needs

MPI-520

Multi-function meter of electrical system parameters

index: WMGBMPI520

MPI-520 Start

Multi-function meter of electrical system parameters
without accessories for earth resistance measurement

index: WMGBMPI520S

Standard accessories:

WS-03 adapter for triggering measurement (UNI-Schuko plug)	WAADAWS03
L-2 carrying case (only MPI-520)	WAFUTL2
L-4 carrying case (only MPI-520 Start)	WAFUTL4
Red "crocodile" clip 1 kV 20 A	WAKRORE20K02
Yellow "crocodile" clip 1 kV 20 A	WAKROYE20K02
Battery container	WAPOJ1
Test lead with banana plugs; 1 kV; 1.2 m; red	WAPRZ1X2REBB
Test lead with banana plugs; 1 kV; 1.2 m; blue	WAPRZ1X2BUBB
Test lead with banana plugs; 1 kV; 1.2 m; yellow	WAPRZ1X2YEBB
Earthing measurement test lead with banana plugs on reel; 15 m; blue (only MPI-520)	WAPRZ015BUBBSZ
Earthing measurement test lead with banana plugs on reel; 30 m; red (only MPI-520)	WAPRZ030REBBSZ
USB data transmission cable	WAPRZUSB
2x earth contact test probe (30 cm) (only MPI-520)	WASONG30
Test probe with banana socket; 1 kV; red	WASONREOGB1
Test probe with banana socket; 1 kV; blue	WASONBUOGB1
Test probe with banana socket; 1 kV; yellow	WASONYEGB1
Meter strap (type L-2)	WAPOZSZEKPL
Factory calibration certificate	



The MPI-520 and MPI-520 Start meters enable automatic insulation resistance measurement of 3-, 4- and 5-core cords with optional AutoISO-1000C adapter.

Low-voltage resistance measurement of protective conductors and equipotential bonding:

- » measurement of protective conductor continuity with current ≥ 200 mA in two directions (according to standard EN 61557-4),
- » low-current measurement with sound signaling,
- » automatic calibration of test leads - leads of any length can be used.

Additional functions of the meters:

- » measurement of voltage, frequency and - additionally with a clamp - alternating current, $\cos\phi$ and power (active, reactive, apparent).
- » quick check of correct connection of PE conductor by means of contact electrode.
- » check of phase sequence.
- » memory storing up to 990 records (57,500 individual results), data transmission to PC via USB,
- » power supply from batteries or rechargeable batteries (optional), built-in quick charger.

Other technical specifications:

- » type of insulation double, as per EN 61010-1 and EN 61557
- » power supply of the meter alkaline batteries (4 pcs.) or Ni-MH rechargeable battery (optional)
- » operating temperature range 0...+50°C



MPI-520 and MPI-520 Start enable measurements in sockets with swapped L and N conductors.

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

Measurement with 23/40 A current - measuring range according to EN 61557-3: 0.13...1999 Ω (for 1.2 m test lead):

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(5\% \text{ m.v.} + 3 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...1999 Ω	1 Ω	

- » Nominal voltage: 95...270 V (for Z_{L-PE} and Z_{L-N}) or 95...440 V (for Z_{L-L})
- » Frequency: 45...65 Hz

Measurement of the Z_{L-PE} fault loop impedance in the RCD mode

Measurement with 15 mA current, measuring range according to EN 61557-3: 0.50...1999 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(6\% \text{ m.v.} + 10 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	$\pm(6\% \text{ m.v.} + 5 \text{ digits})$
200...1999 Ω	1 Ω	

- » Rated voltage: 95...270 V
- » Frequency: 45...65 Hz

Earth resistance R_E measurement

Measuring range according to EN 61557-5:

0.50 Ω ...1.99 k Ω for 50 V measurement voltage

0.56 Ω ...1.99 k Ω for 25 V measurement voltage

Display range	Resolution	Accuracy
0.00...9.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 4 \text{ digits})$
10.0...99.9 Ω	0.1 Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$
100...999 Ω	1 Ω	
1.00...1.99 k Ω	0.01 k Ω	

Measurement of insulation resistance

Measuring range according to EN 61557-2:

for $U_n = 50 \text{ V}$: 50 k Ω ...250 M Ω

for $U_n = 500 \text{ V}$: 500 k Ω ...2.00 G Ω

for $U_n = 100 \text{ V}$: 100 k Ω ...500 M Ω

for $U_n = 1000 \text{ V}$: 1000 k Ω ...3.00 G Ω

for $U_n = 250 \text{ V}$: 250 k Ω ...999 k Ω

Display range *	Resolution	Accuracy
0...1999 k Ω	1 k Ω	$\pm(3\% \text{ m.v.} + 8 \text{ digits})$
2.00...19.99 M Ω	0.01 M Ω	
20.0...199.9 M Ω	0.1 M Ω	
200...999 M Ω	1 M Ω	
1.00...3.00 G Ω	0.01 G Ω	$\pm(4\% \text{ m.v.} + 6 \text{ digits})$

**) no greater than the measuring range for a given voltage.

**) an additional error of $\pm 2\%$ is present in measurements when the UNI-Schuko plug is used.

Low-voltage measurement of circuit continuity and resistance

Testing of protective conductor continuity with $\pm 200 \text{ mA}$ current measuring range according to EN 61557-4: 0.12...400 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...400 Ω	1 Ω	

- » Voltage on open terminals: 4...9 V
- » Output current at $R < 2 \Omega$: min. 200 mA
- » Automatic calibration of test leads
- » Measurements for both current polarities

Indication of phase sequence

- » Indication of phase sequence: compliant, non-compliant
- » U_{L-L} power system voltage range: 95...500 V (45...65 Hz)
- » Display of phase-to-phase voltage values

Measurement of alternating voltage and current, cos ϕ and power

- » Power measurement P, Q, S: 0...200k (W, var, VA).
- » Measurement of alternating current (True RMS) using clamp (0...400 A), max. resolution 0.1 mA
- » Measurement of voltage U_{L-N} : 0...500 V
- » Frequency range of measured voltages: 45.0...65.0 Hz
- » Frequency measurement for voltages 50...500 V within the range of 45.0...65.0 Hz (Accuracy to a maximum of $\pm 0.1\% \text{ m.v.} + 1 \text{ digit}$)
- » cos ϕ measurement: 0.00...1.00 (resolution 0.01)

Measurements of RCD parameters (working voltage range 95...270 V):

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

RCD type	Factor	Range	Resolution	Accuracy	
General and short-time delay	0.5 $I_{\Delta n}$	0...300 ms	1 ms	$\pm(2\% \text{ m.v.} + 2 \text{ digits})$ (for RCD of $I_{\Delta n}$ =10 mA and the measurement 0.5 $I_{\Delta n}$ error: $\pm(2\% \text{ m.v.} + 3 \text{ digits})$)	
	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			

- » Residual current input accuracy: for 0.5 $I_{\Delta n}$ 8...0%
for 1 $I_{\Delta n}$, 2 $I_{\Delta n}$, 5 $I_{\Delta n}$ 0...8%

Measurement of RCD trip current I_A for sinusoidal residual current (AC type)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.3...10.0 mA	0.1 mA	0.3 I _{Δn} ...1.0 I _{Δn}	±5% I _{Δn}
30 mA	9.0...30.0 mA			
100 mA	30...100 mA	1 mA		
300 mA	90...300 mA			
500 mA	150...500 mA			
1000 mA	300...1000 mA			

- » Measurement can be started from the positive or negative half-period of the input leakage current (AC)

Measurement of RCD trip current I_A for uni-directional residual current and uni-directional current with 6 mA direct current offset (type A, F)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.5...20.0 mA	0.1 mA	0.35 I _{Δn} ... 2.0 I _{Δn}	±10% I _{Δn}
30 mA	10.5...42.0 mA			
100 mA	35...140 mA	1 mA	0.35 I _{Δn} ... 1.4 I _{Δn}	
300 mA	105...420 mA			
500 mA	175...700 mA			

- » Measurement can be started from a positive or negative half-period of the input leakage current

Measurement of RCD trip current I_A for residual direct current (type B, B+)

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	2.0...20.0 mA	0.1 mA	0.2 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
30 mA	6...60 mA	1 mA		
100 mA	20...200 mA			
300 mA	60...600 mA			
500 mA	100...1000 mA			

- » Measurement is possible for both a positive or negative input leakage current
- » $I_{\Delta n}$ - nominal value of residual current



The MPI-520 and MPI-520 Start meters enable measurement of the actual tripping time and trip current of an RCD with just one trip.

"m.v." = "measured value"

The instrument meets the requirements set forth in the standards:

- » EN 61010-1 (general and particular requirements related to safety)
- » EN 61010-031 (general and particular requirements related to safety)
- » EN 61326 (electromagnetic compatibility)
- » EN 61557 (requirements for measurement instruments)
- » HD 60364-6 (performance of measurements - checking)
- » HD 60364-4-41 (performance of measurements - shock protection)
- » PN-E 04700 (performance of measurements - commissioning tests)



The MPI-520 and MPI-520 Start meters are two of the few meters capable of accurately measuring fault loop impedance, including in L-PE loops, in networks equipped with residual current devices (measurement with 15 mA current).

SONEL MPI-507 / MPI-506 / MPI-502F

index: WMGBMPI507 / WMGBMPI506 / WMGBMPI502F



Measurement of short circuit loop parameters:

- » measurement of short circuit loop impedance in networks with rated voltage: 220/380 V, 230 V/400 V, 240/415 V and frequency 45...65 Hz, operating voltage range: 180...460 V
- » indication of short circuit loop resistance R and short circuit loop reactance X
- » **measurements of short circuit loop impedance with 15 mA current, without tripping the RCD circuit breaker**
- » maximum test current: 7.6 A (at 230 V), 13.3 A (at 400 V).

Testing RCD breakers of AC, A types:

- » testing of prompt, short-delay and selective RCDs with rated current values: 10 mA, 15 mA, 30 mA, 100 mA, 300 mA, 500 mA,
- » measurement of I_A trip current and tripping time t_A for currents $0.5 I_{\Delta n}$, $1 I_{\Delta n}$, $2 I_{\Delta n}$, $5 I_{\Delta n}$
- » R_E and U_0 measurement without RCD tripping,
- » extended AUTO function of RCD measurement, with the possibility of measuring Z_{L-PE} with low current,
- » measurement of I_A and t_A during one RCD tripping.

MPI-506 • MPI-507 | Insulation resistance measurement:

- » test voltage 100 V, 250 V, 500 V.

MPI-507 | Earth resistance measurements:

- » measurement according to 3-lead technical method with 2 auxiliary electrodes,
- » internal power source with frequency appropriate for 50 Hz or 60 Hz power network (selected in the meter).

Measurement of resistance of earth connection and equipotential bondings:

- » measurement of protective connections continuity with a ± 200 mA current in accordance with EN 61557-4,
- » autocalibration of test leads - any leads can be used,
- » low current resistance measurement with sound signaling.

MPI-506 • MPI-507 | Phase sequence indication:

- » phase sequence indication: compliant, not compliant,
- » network voltage range: 100...440 V,
- » displaying the values of phase-to-phase voltages.

Additional functions of the meter:

- » Detection of L and N phase swapping in a socket and automatic unswapping.
- » Check of correct connection of PE conductor by means of contact electrode.
- » Measurement of network voltage (0...500 V) and frequency.
- » Power supply from LR6 batteries, NiMH rechargeable batteries can optionally be applied.
- » Memory storing up to 990 results, wireless data transmission to computer.
- » Backlit keyboard.

Standard accessories:

WS-03 adapter with START button with UNI-Schuko plug	WAADAWS03
M-6 carrying case	WAFUTM6
Red "crocodile" clip 1 kV 20 A (only MPI-506, MPI-507)	WAKRORE20K02
Yellow "crocodile" clip 1 kV 20 A	WAKROYE20K02
Test lead with banana plugs; 1 kV; 1.2 m; red	WAPRZ1X2REBB
Test lead with banana plugs; 1 kV; 1.2 m; blue	WAPRZ1X2BUBB
Test lead with banana plugs; 1 kV; 1.2 m; yellow	WAPRZ1X2YEBB
Test lead 30 m, red (banana plugs, on H-frame reel) (only MPI-507)	WAPRZ030REBBN
Test lead 15 m, blue (banana plugs, on H-frame reel) (only MPI-507)	WAPRZ015BUBBN
Test probe with banana socket; 1 kV; red	WASONREOGB1
Test probe with banana socket; 1 kV; blue	WASONBUOGB1
Test probe with banana socket; 1 kV; yellow	WASONYEOGB1
2x earth contact test probe (rod), 25 cm (only MPI-507)	WASONG25
Meter strap (type M-1)	WAPZSZSE4
M-1 housing holder - hanger	WAPZUCH1
4x LR6 1,5 V battery	
Factory calibration certificate	



The instrument meets the requirements set forth in the standards:

- » EN 61010-1 (general and particular requirements related to safety)
- » EN 61010-031 (general and particular requirements related to safety)
- » EN 61326 (electromagnetic compatibility)
- » EN 61557 (requirements for measurement instruments)
- » HD 60364-6 (performance of measurements - checking)
- » HD 60364-4-41 (performance of measurements - shock protection)
- » PN-E 04700 (performance of measurements - commissioning tests)

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

Measurement with 7.6/13.3 A current - measuring range according to EN 61557-3: 0.13...1999 Ω :

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(5\% \text{ m.v.} + 3 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...1999 Ω	1 Ω	

Measurement of earth fault loop impedance Z_{L-PE} in RCD mode

Measurement with 15 mA current, measuring range according to EN 61557-3: 0.50...1999 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(6\% \text{ m.v.} + 10 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...1999 Ω	1 Ω	$\pm(6\% \text{ m.v.} + 5 \text{ digits})$

MPI-507 | Earth resistance R_E measurement

Measuring range according to EN 61557-5:
0.63 Ω ...1999 Ω for 50 V measurement voltage

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(3\% \text{ m.v.} + 5 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...1999 Ω	1 Ω	$\pm 5\% \text{ m.v.}$

MPI-506 • MPI-507 | Insulation resistance measurement

Test range according to IEC 61557-2:

$U_{ISO} = 100 \text{ V}$: 100 k Ω ...99.9 M Ω $U_{ISO} = 250 \text{ V}$: 250 k Ω ...199.9 M Ω

$U_{ISO} = 500 \text{ V}$: 500 k Ω ...599.9 M Ω

Measurements of RCD parameters (operating voltage range 180...270 V):

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

RCD type	Factor	Range	Resolution	Accuracy		
General type	0.5 $I_{\Delta n}$	0...300 ms	1 ms	$\pm(2\% \text{ m.v.} + 2 \text{ digits})$		
	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				

Measurement of RCD trip current I_A for sinusoidal residual current

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.0...10.0 mA	0.1 mA	0.3 I _{Δn} ...1.0 I _{Δn}	±5% I _{Δn}
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			

- » Measurement can be started from the positive or negative half-period of the input current

Measurement of RCD trip current I_A for uni-directional pulsating residual current

Nominal current	Measuring range	Resolution	Measurement current	Accuracy
10 mA	3.5...20.0 mA	0.1 mA	0.35 I _{Δn} ...2.0 I _{Δn}	±10% I _{Δn}
15 mA	5.3...21.0 mA			
30 mA	10.5...42.0 mA			
100 mA	35...140 mA	1 mA		
300 mA	105...420 mA			

- » Measurement for positive or negative half-periods of the input leakage current

Low-voltage measurement of circuit continuity and resistance

Testing of protective conductor continuity with $\pm 200 \text{ mA}$ current
measuring range according to EN 61557-4: 0.12...400 Ω

Display range	Resolution	Accuracy
0.00...19.99 Ω	0.01 Ω	$\pm(2\% \text{ m.v.} + 3 \text{ digits})$
20.0...199.9 Ω	0.1 Ω	
200...400 Ω	1 Ω	

- » Voltage on open terminals: 4...20 V
- » Output current at $R < 2 \Omega$: min. 200 mA
- » Automatic calibration of test leads
- » Measurements for both current polarities

MPI-506 • MPI-507 | Indication of phase sequence

- » Indication of phase sequence: compliant, non-compliant
- » U_{L-L} power system voltage range: 100...440 V (45...65 Hz)
- » Display of phase-to-phase voltage values



SONEL EVSE-100

index: WMGBEVSE100



Tests

- » Simulation of PP cable parameters:
 - open circuit,
 - 13 A, 20 A, 32 A, 63 A, 80 A.
- » Simulation of 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} time,
 - t_{on} time.
- » EVSE analysis - simulation of errors (ICCB, EVSC):
 - CPsh - short circuit of CP to PE,
 - Dsh - diode short circuit,
 - PEOp - interruption of the PE circuit.
- » EVSE analysis - simulation of errors (ICCB):
 - L1op - break in L1 circuit,
 - L2op - break in L2 circuit,
 - L3op - break in L3 circuit,
 - Nop - break in N circuit,
 - PEOp - break in PE circuit,
 - Nop - break in N circuit,
 - L<->PE - interchanged L and PE wires,
 - Uext PE - voltage on PE circuit.
- » EVSE analysis - state transitions.

Electrical safety:

- » type of insulation double, as per EN 61010-1 and EN 61557
- » measurement category CAT III 300 V according to EN IEC 61010-2-030
- » housing protection rating according to EN 60529 IP54

Other technical specifications:

- » power supply of the meter mains
- » rechargeable battery: Li-Ion 7.2 V 9.8 Ah
- » weight ca. 8.7 kg
- » operating temperature 0...+45°C
- » dimensions 429 x 328 x 236 mm
- » display LCD 5" 1280 x 720
- » memory 9999 entries
- » transmission of results USB, RJ-45, Bluetooth, Wi-Fi

The meter is a part of the **Soneil 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.



MeasureEffect™

Standard accessories:

AEV-100 adapter	WAADAAEV100
Test lead 1.2 m, blue, 1 kV (banana plugs)	WAPRZ1X2BUBB
Test lead 1.2 m, yellow, 1 kV (banana plugs)	WAPRZ1X2YEBB
Test lead 1.2 m, black, 1 kV (banana plugs)	WAPRZ1X2BLBB
BNC transmission cable	WAPRZBNC
Pin probe, blue 1 kV (banana socket)	WASONBUOGB1
Pin probe, yellow 1 kV (banana socket)	WASONYEGB1
Pin probe, black 1 kV (banana socket)	WASONBLOGB1
Crocodile clip, yellow, 1 kV, 20 A	WAKROYE20K02
230 V mains cable (16 A 5P socket)	WAPRZZAS16P
EV charging cable 2.2 m (type 2 male/type 2 female)	WAKABEV2T2
L-4 carrying case	WAFUTL4
USB cable	WAPRZUSB

Factory calibration certificate

Capabilities

Multifunctional analyzer EVSE-100 is an instrument dedicated to diagnostics of electric vehicle charging stations and cables. Using a single device, we will perform a set of tests on these objects, ending with the generation of a professional report. Through appropriate simulation of CP and PP circuits, the meter can put the station into various operating states. This allows us to verify the correctness of the control system and perform measurements in the field of electric shock protection. We can complete the verification of functionality and safety by simulating errors on both the power and charging sides of the vehicle (CP circuit).

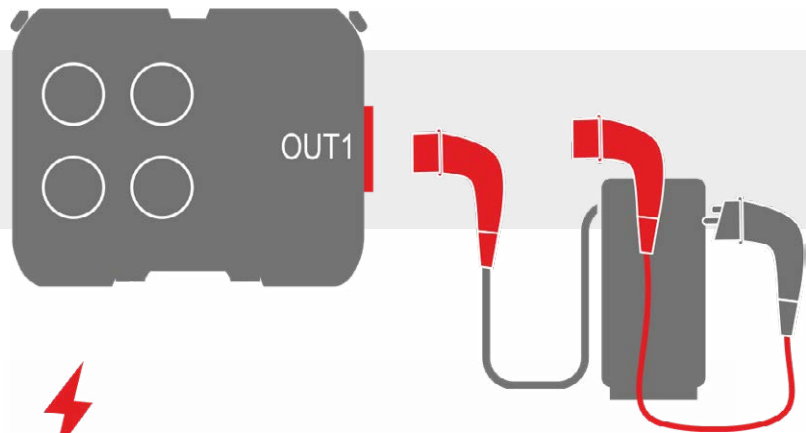
Applications

The meter makes it possible to carry out diagnostics on:

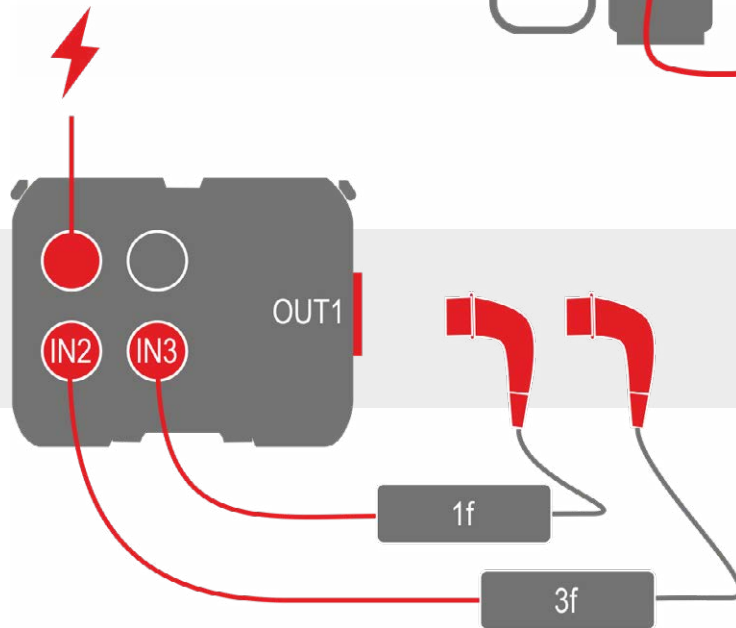
- » AC electric vehicle charging stations with type 2 connector with socket or fixed charging cable (1-phase and 3-phase),
- » portable electric vehicle charging stations with type 2 connector (1-phase and 3-phase),
- » charging cables.



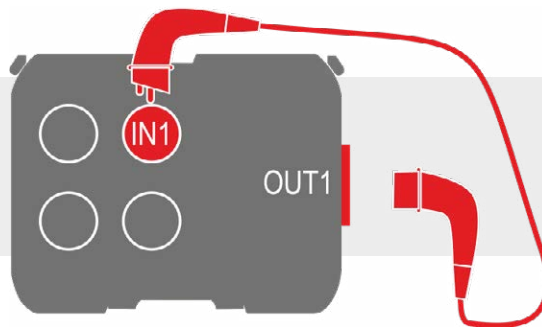
Diagnostics and measurements of stationary AC charging stations (EVCS)



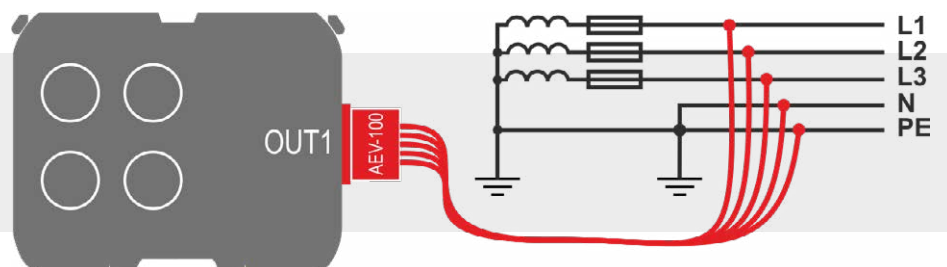
Diagnostics and measurements of portable AC charging stations (ICCB)



Testing of charging cables



Complex measurements of installations



Adapter for testing vehicle charging stations

SONEL EVSE-01

index: WAADAEVSE01



Capabilities

Adapter allows to perform comprehensive **measurements of electric vehicle charging stations** - quickly and in accordance with applicable regulations. Simulating the charging cable (proximity pilot line - PP) and vehicle connection status (control pilot line - CP), it will bring the station into different operating states. This will enable **measurements in the field of electric shock protection**: Z_s fault loop impedance, R_{iso} insulation resistance and checking the parameters of RCD residual current devices.

To facilitate diagnostics, one of the EVSE-01 sockets is provided with **pulse width modulation signal (PWM)**.

Application

The EVSE-01 adapter enables measurements of AC electric vehicle charging stations with **type 2 connector**. Tests for 1-phase and 3-phase stations are available - both with and without ventilation.

Standard accessories:

M-6 carrying case	WAFUTM6
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Technical specifications

- » type of insulation according to EN 61010-1 double
- » measurement category according to EN 61010-1 CAT II 300 V
- » ingress protection according to EN 60529 IP40
- » pollution degree 2
- » input voltage 400 V (3-phase)
- » frequency 50 Hz, 60 Hz
- » simulation of charging cable PP open circuit, 13 A, 20 A, 32 A, 63 A
- » vehicle connection simulation CP
 - 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
 - state E error - CP short to PE
- » socket types measuring sockets L1, L2, L3, N, PE
 - 1-phase socket
 - CP signal socket - PWM communication
- » test lead (length)
 - EVSE 1 m
 - MPI 0.5 m
- » operating temperature -5...+45°C
- » storage temperature -20...+60°C
- » dimensions 220 x 100 x 60 mm
- » weight 1.4 kg
- » the product meets EMC requirements acc. to standards EN 61326-1 and EN 61326-2-2

Works with*

MPI-540-PV
MPI-540
MPI-536
MPI-535

MPI-530-IT
MPI-530
MPI-525
MPI-520

MPI-507
MPI-506
MPI-502F



* the scope of measurements depends on the capabilities and technical parameters of each model.

Functional comparison

	MPI-540-PV MPI-540 MPI-536 MPI-535	MPI-530-IT MPI-530 MPI-525 MPI-520	MPI-507 MPI-506	MPI-502F
auto measurements	✓	-	-	-
automatic three-phase measurement via multiplug	✓	-	-	-
visual inspection	✓	-	-	-
fault loop $Z_{s,PEV}$ Z_{L-N} parameters measurement	✓	✓	✓	✓
6 mA RCD test	✓	-	-	-
RCD test	AC, A, F, B, B+, EV	AC, A, F, B, B+	AC, A	AC, A
insulation resistance R_{iso} measurement	✓	✓	✓	-
measurements report	✓	✓	✓	✓

