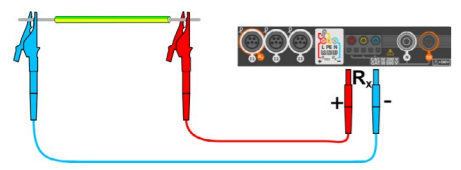


Resistance measurement

Connect the meter to the measured object.



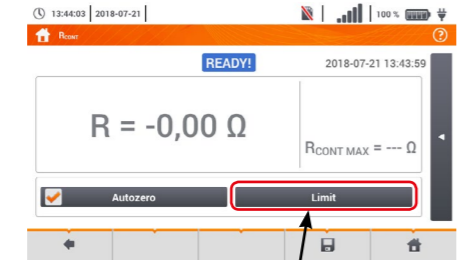
The measurement will start automatically.



Main result

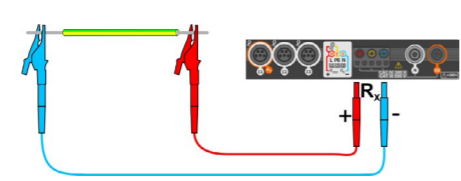
Find more information in the user manual and on our website www.sonel.pl/en

R measurement with I=±200 mA

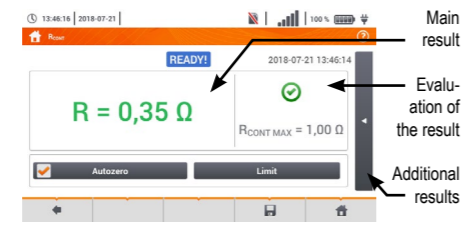


Enter settings
• limit to evaluate the result

Connect the meter to the measured object.



The measurement will start automatically.



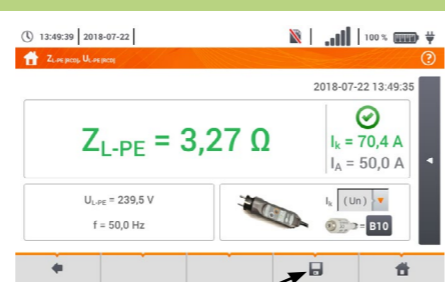
Main result

Evaluation of the result

Additional results

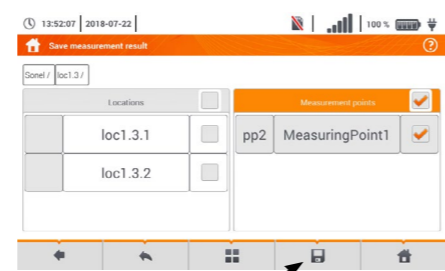
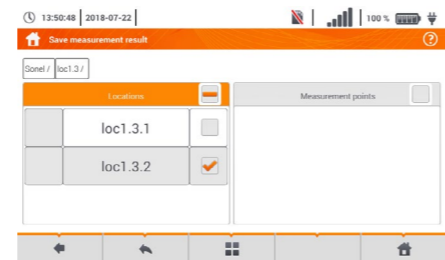
START To run new measurement press START.

Saving a result to the memory



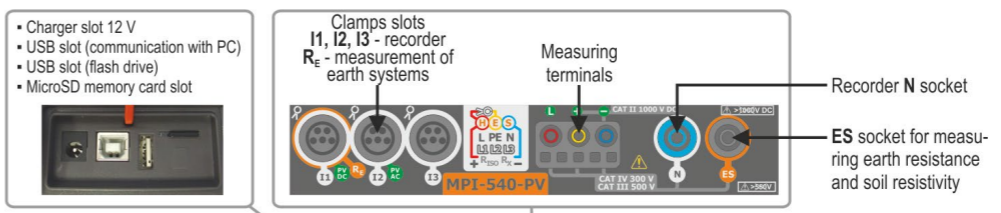
Finish the measurement and select .

Go to location you want to save the result in.



Save the result with icon .

Sonel MPI-540 / MPI-540-PV Meter for Electrical Installation Parameters



Function icons

- Back
- Save
- Show last measurement
- Return to main menu
- Select item
- Show more icons
- Add item
- Edit item
- Search
- Remove item
- Close menu

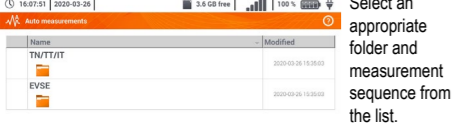
Touchscreen

MPI-540 · MPI-540-PV Electric installations measurements	MPI-540-PV PV installations measurement	MPI-540 · MPI-540-PV Power quality recorder
Z_{L-N} L-N fault loop impedance	R_{ISO} Insulation resistance	LIVE mode
Z_{L-PE} L-PE fault loop impedance	R_{CONT} Resistance measurement with I=±200 mA	Waveforms
Z_{L-PE(RCD)} L-PE fault loop impedance with RCD	R_E Resistance-to-earth	Timeplot
R_{ISO} Insulation resistance	U_{OC} Open circuit voltage	Readings
RCD I_A RCD tripping current	I_{SC} Short circuit current	Vector diagram
RCD t_A RCD tripping time	η, P, I Test of the inverter panel	Harmonics
RCD AUTO Automatic RCD measurements		Recording analysis
R_X Resistance measurement		Timeplot
R_{CONT} Resistance measurement with I=±200 mA		Harmonics
1-2-3 Phase sequence		Energy costs calculator
U-V-W Motor rotation direction		Energy loss calculator
R_E Resistance-to-earth		
Ωm Soil resistivity		
ΔU Voltage drop		
Lux Illuminance		

Auto measurements

Proceeding auto measurements

Connect the meter to the measured circuit.



Select an appropriate folder and measurement sequence from the list.



In each setting field, enter the type of measuring accessory, installation parameters and other required data.

START Press START to run the measurements. Follow the on-screen instructions.



In the end, a screen with a summary of the measurements will be displayed.

Creating measurement procedures



Select to go to the sequence wizard.



Select to add the desired measurement procedure.

From the available items select the one, which is to be a part of the procedure. In addition to standard measurements, the following are also available:

- text message,
- visual test.

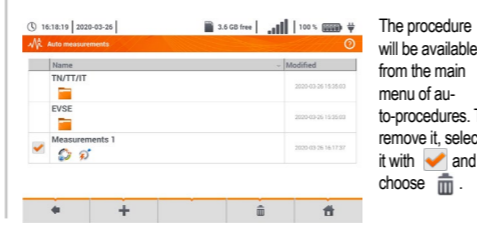


After each selection, the menu with step parameters will be shown.



Changing the order of the steps is performed by using . Delete the step by using .

Save the procedure by using . A window will be shown re-requesting the name of the procedure.



The procedure will be available from the main menu of auto-procedures. To remove it, select it with and choose .

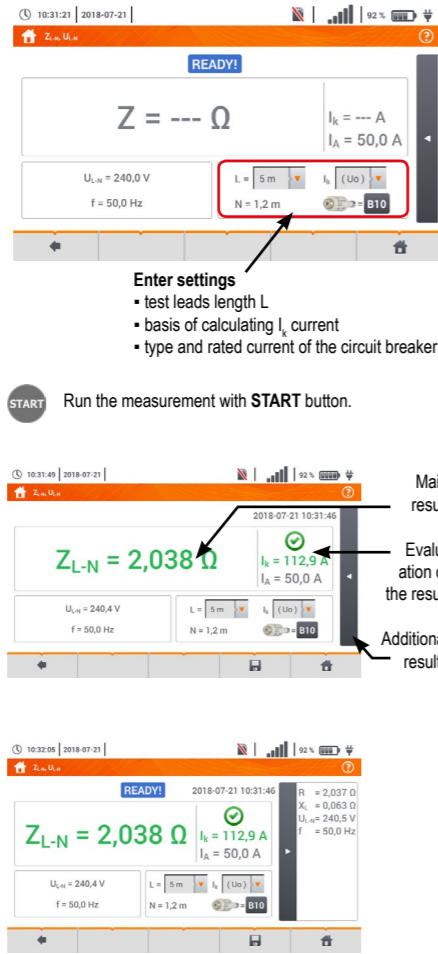
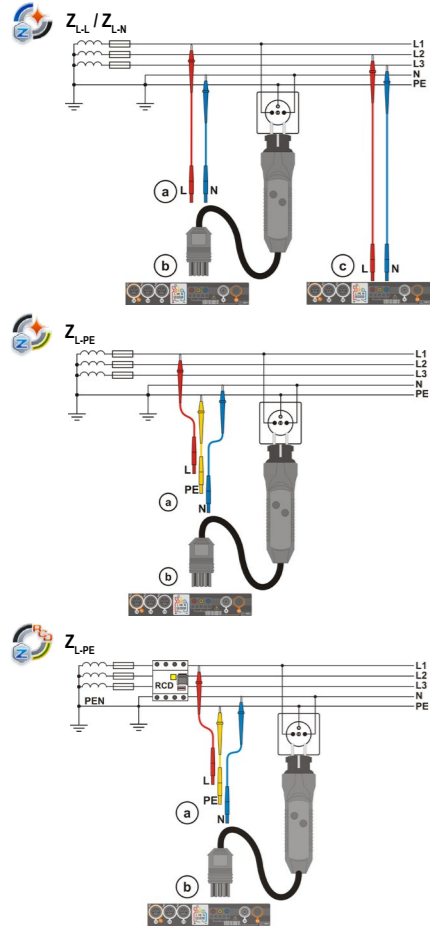
First steps

- Turn on the meter
- Measure
- Save to the memory



Fault loop impedance

Connect the meter to the measured circuit.



Enter settings

- test leads length L
- basis of calculating I_k current
- type and rated current of the circuit breaker

Run the measurement with START button.

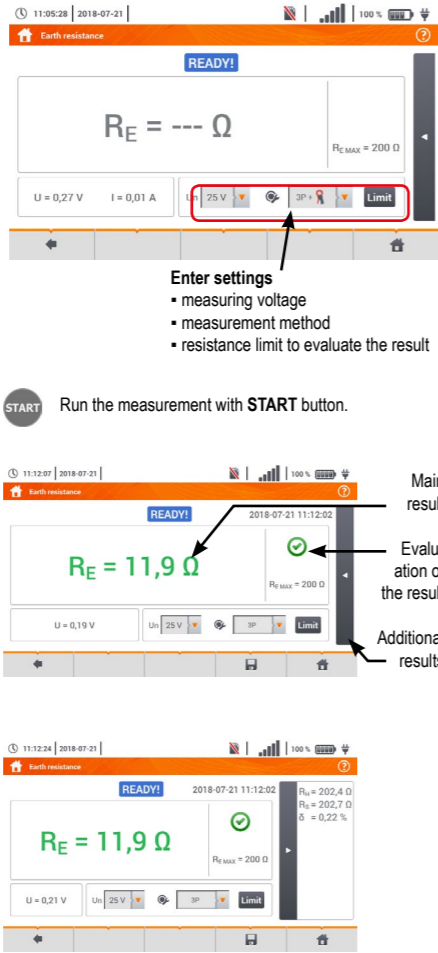
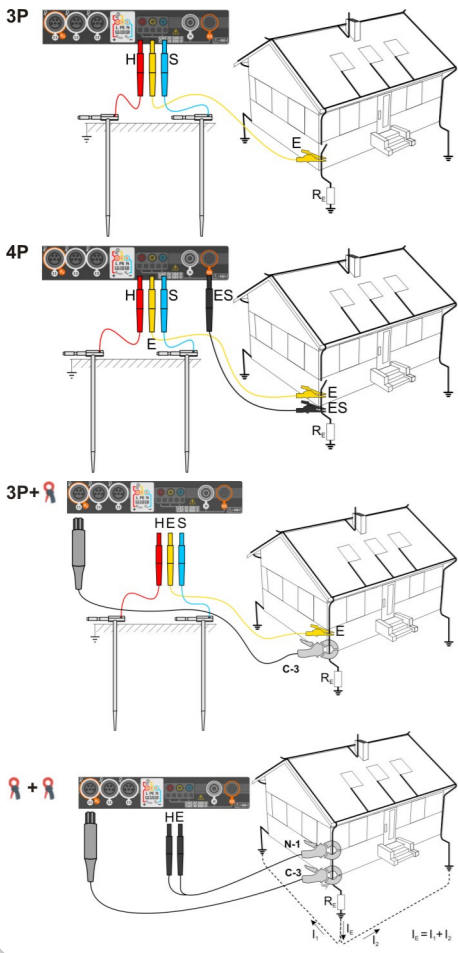
Main result

Evaluation of the result

Additional results

Resistance-to-earth

Choose the measurement method.



Enter settings

- measuring voltage
- measurement method
- resistance limit to evaluate the result

Run the measurement with START button.

Main result

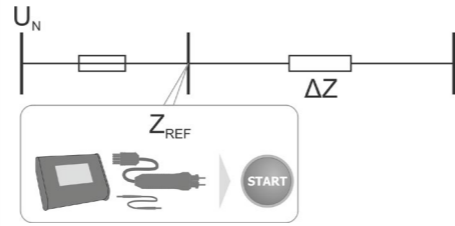
Evaluation of the result

Additional results

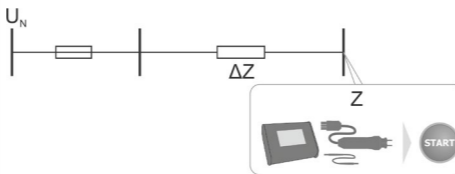
Voltage drop



- Use setting $Z_{ref} = \text{---}$ to reset previous measurement, if it has not been done yet.
- Enter the limit of voltage drop ΔU_{MAX} .
- Enter the fuse type, which protects the tested circuit.



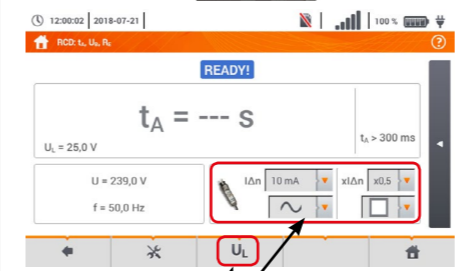
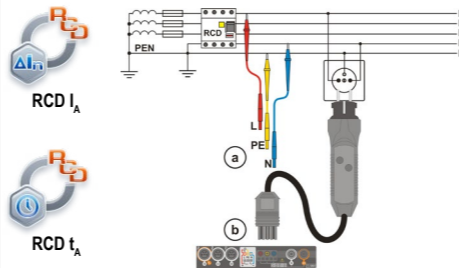
- Connect the meter to the reference point of the tested network, as for Z_{L-N} measurement.
- Press START.



- Change the setting from Z_{ref} to Z .
- Connect the meter to the reference point, as for Z_{L-N} measurement.
- Press START.

RCD test

Connect the meter to the measured circuit and choose the measurement mode.



Enter settings

- residual operating current $I_{\Delta n}$
- forced current
- waveform of the measuring current
- type of the RCD
- measuring voltage U_L

Run the measurement with START button.

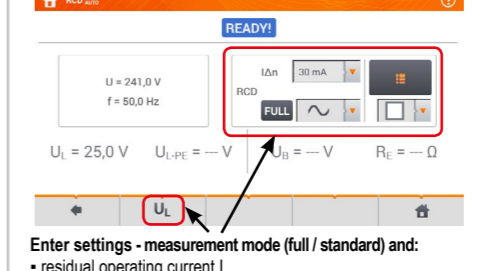
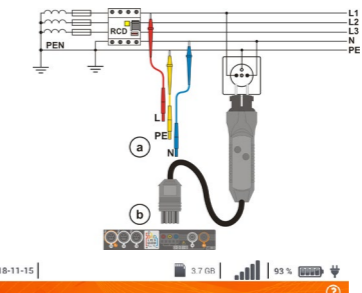
Main result

Evaluation of the result

Additional results

Auto measurements of RCDs

Connect the meter to the measured circuit.



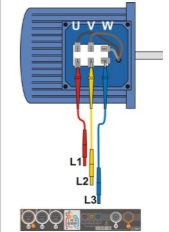
Enter settings - measurement mode (full / standard) and:

- residual operating current $I_{\Delta n}$
- a multiplicity of RCD rated current
- RCD type / waveform of the measuring current
- type of the RCD
- measuring voltage U_L

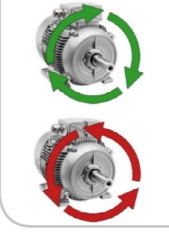
Run the measurement with START button. Tested RCD switch must be turned on after each triggering, until measurements are completed.

Eventually, measured parameters are displayed. The list of results may be scrolled on the screen.

Motor rotation direction



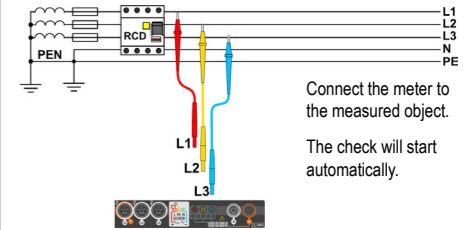
Connect the meter to the examined motor. Vigorously rotate the motor shaft to the right.



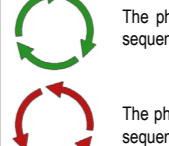
Arrows on the screen rotating to the right mean that the motor connected to a 3-phase network will rotate the shaft to the right.

Arrows on the screen rotating to the left mean that the motor connected to a 3-phase network will rotate the shaft to the left.

Phase sequence



Connect the meter to the measured object. The check will start automatically.

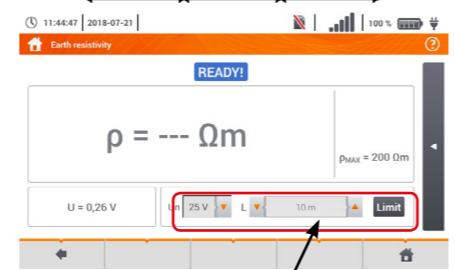
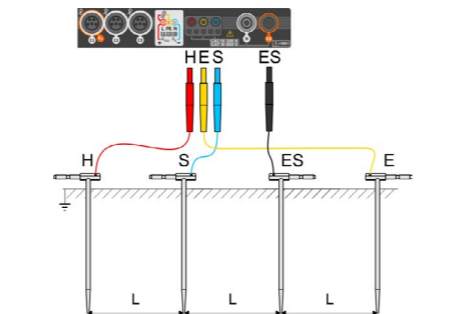


The phase sequence is correct, i.e. the phase sequence is in clockwise direction.

The phase sequence is incorrect, i.e. the phase sequence is in anticlockwise direction.

Soil resistivity

Connect the meter to the measured soil.



Enter settings

- measuring voltage
- L distance between electrodes
- resistivity limit to evaluate the result

Run the measurement with START button.

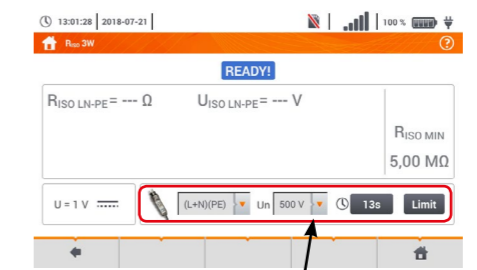
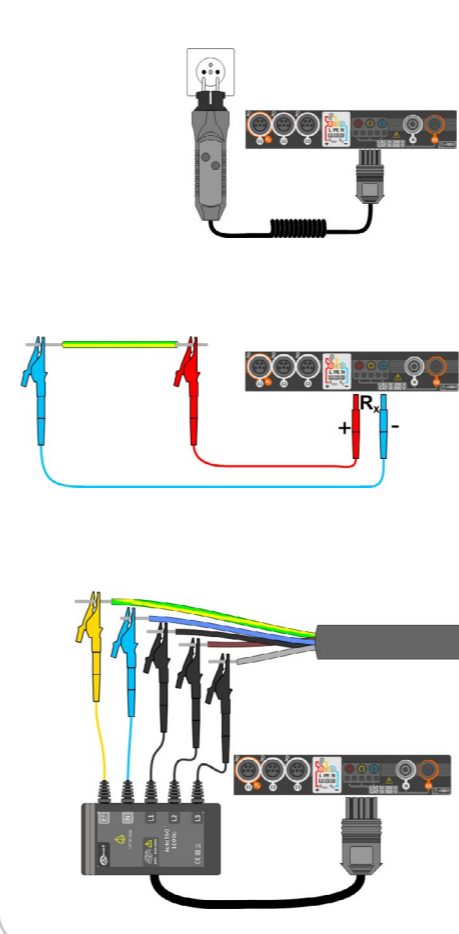
Main result

Evaluation of the result

Additional results

Insulation resistance

Choose the measurement method.



Enter settings

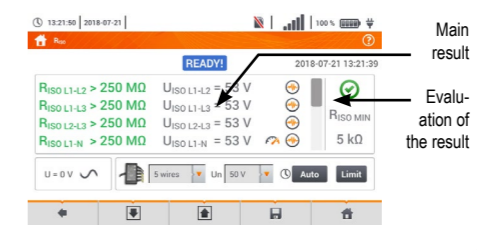
- measurement method
- measuring voltage
- duration of the measurement
- resistance limit to evaluate the result

Run the measurement with START button.

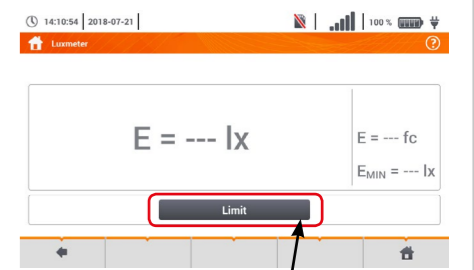
Main result

Evaluation of the result

Additional results



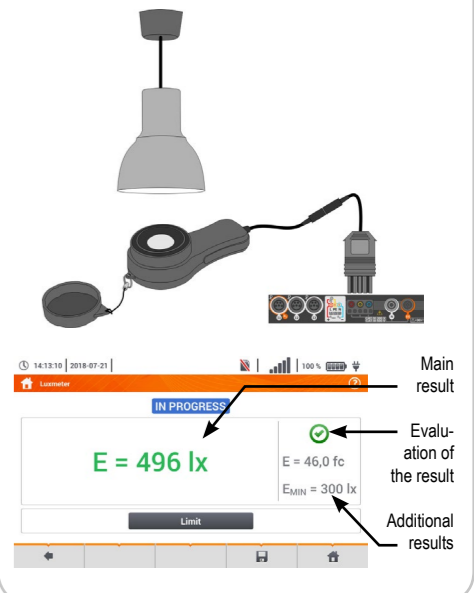
Illuminance



Enter settings

- illuminance limit to evaluate the result

Connect measuring probe to the meter.



Main result

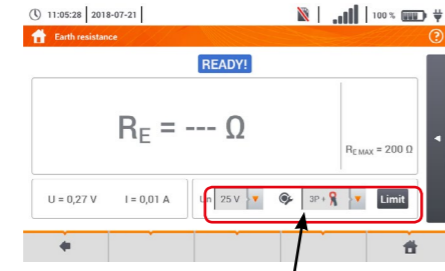
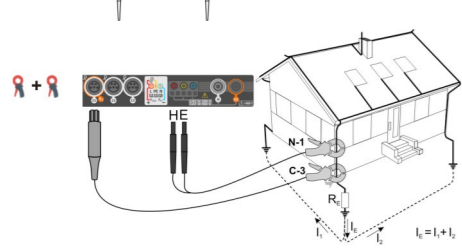
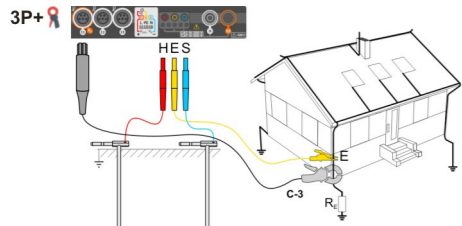
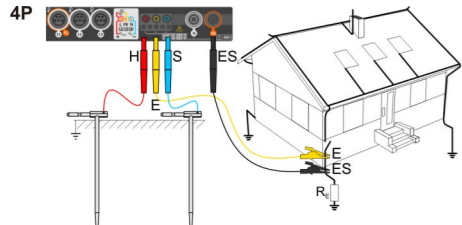
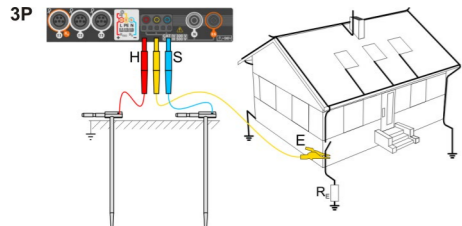
Evaluation of the result

Additional results



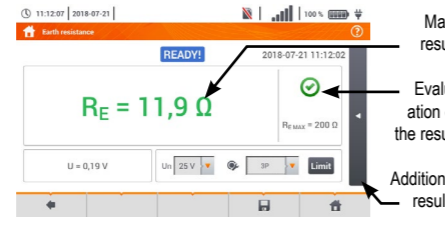
Resistance-to-earth (PV)

Choose the measurement method.



Enter settings
• measuring voltage
• measurement method
• resistance limit to evaluate the result

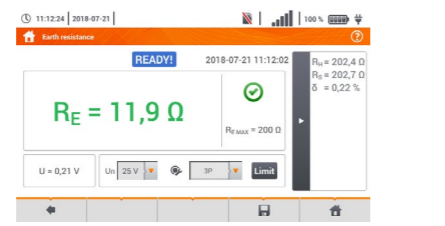
START Run the measurement with START button.



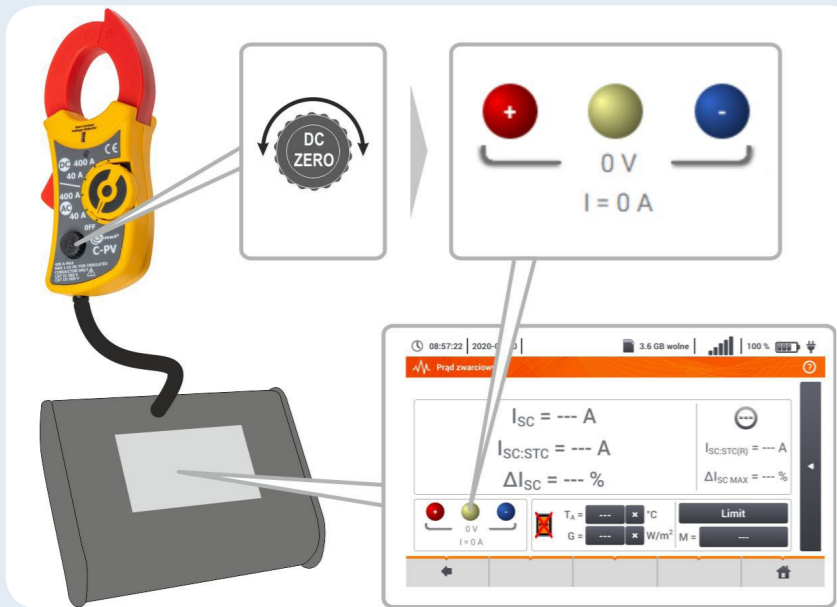
Main result

Evaluation of the result

Additional results



Resetting C-PV clamp

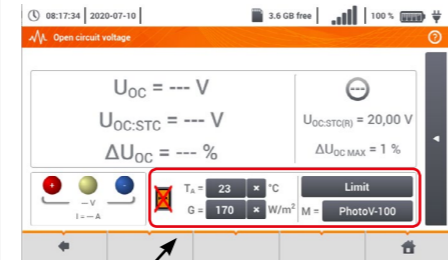
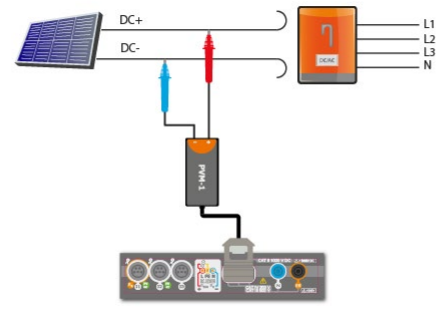


Before the I_{sc} measurement and testing the inverter reset C-PV clamp. To do this, connect the clamp to the meter. Set the DC ZERO knob on the housing of the clamp to make the voltage and current readings as close to zero as possible. Only then you can connect the clamp to the tested object.



Open circuit voltage U_{oc}

Turn off the inverter or disconnect it from the tested object. Connect the meter to the chain of PV modules using PVM-1 adapter and adapters of MC4 connectors.



Enter settings
• T_a – ambient temperature, if the source of temperature measurement = air
• T_c – module temperature, if the source of temperature measurement = module
• G – irradiance
• Limit – setting of $\Delta U_{oc\ MAX}$ values
• M – photovoltaic module selected from the meter database

START Run the measurement with START button.

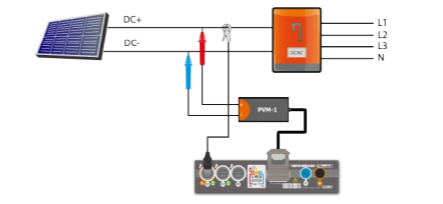


Short circuit current I_{sc}



Reset the clamp.

Turn off the inverter or disconnect it from the tested object. Connect the meter to the chain of PV modules using PVM-1 adapter and adapters of MC4 connectors



Enter settings
• T_a – ambient temperature, if the source of temperature measurement = air
• T_c – module temperature, if the source of temperature measurement = module
• G – irradiance
• Limit – setting of $\Delta U_{oc\ MAX}$ values
• M – photovoltaic module selected from the meter database

If necessary, reset the clamp again. Run the measurement with START button.



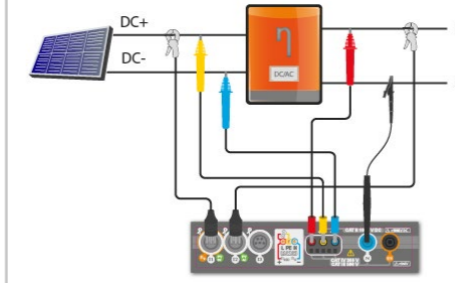
Test of the inverter panel, operating currents and powers at DC and AC sides - η, P, I (PV)

1 Initialize the measurement

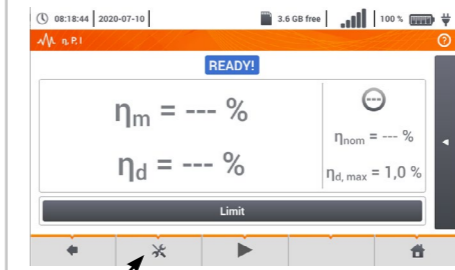
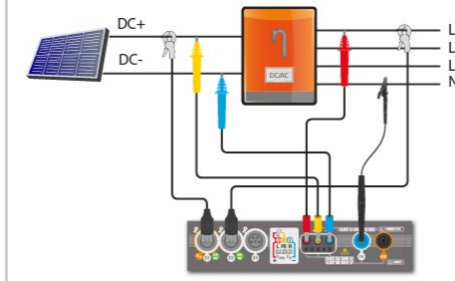


Reset the clamp.

Connect the meter to the tested object.



In the case of 3-phase inverter, the measurement is made assuming the symmetry of the output currents and voltages on the AC side.

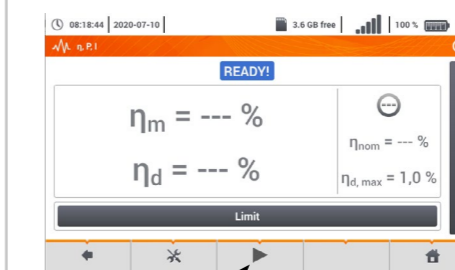


You may use * icon to select the data presented on the screen:
• currents at input (I_{DC}) and output (I_{AC}),
• power values at input (P_{DC}) and output (P_{AC}),
• inverter efficiency (η_m) and the difference between the efficiencies of the inverter: measured and declared by the manufacturer (η_d).

Select Limit to set the criterion of the maximum difference between the efficiencies of the inverter: measured and declared by the manufacturer.

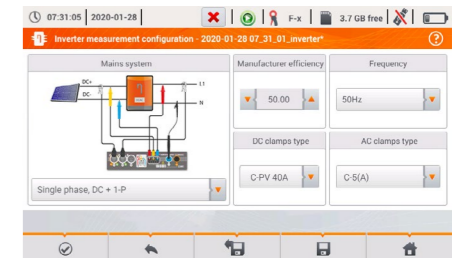


If necessary, reset the clamp again.



Use icon ▶ to go to the measurement configuration.

2 Configure the measurement



Set the parameters of the tested inverter on the displayed configuration screen:

- **Mains system** – there are two types to choose from:
 - » **Single phase, DC + 1-P**
Select this system type for inverters with single-phase AC output.
 - » **Three phase, DC + 4-P**
It is possible to measure only the efficiency of three-phase, 4-wire inverters (star configuration with neutral wire).
- **Manufacturer efficiency** – efficiency of the inverter declared by the manufacturer. This value is used to compare the measured efficiency with the declared value.
- **DC clamps type** – the user may use the list to select the type of clamps used for current measurements on DC side of the inverter.
- **AC clamps type** – the user may use the list to select the type of clamps used for current measurements on AC side of the inverter.
- **Frequency** – nominal frequency of the AC output of the inverter.

After confirming the required parameters using icon ✓, you can go directly to the required measurements

3 Go to live mode



• **AC/DC line:**
» column η_m displays the efficiency value η_m of the inverter as the ratio of the active power of AC side to active power of DC side:

$$\eta_m[\%] = \frac{P_{AC}[W]}{P_{DC}[W]} \cdot 100\%$$

» column η_d shows the difference between the measured and declared efficiency of the inverter:

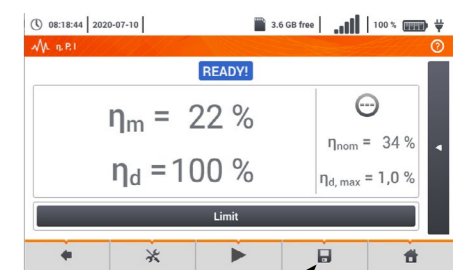
$$\eta_d = \eta_{nom}[\%] - \eta_m[\%]$$

where η_{nom} is the declared efficiency of the inverter entered to the configuration screen.

- Line DC presents the parameters of DC side of the inverter such as voltage, current, active power, active energy.
- Values related to AC side are displayed in lines: L1 and Σ.

4 Capture and save the results

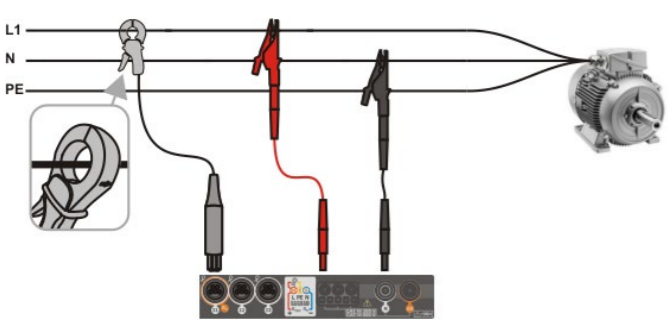
START Press START. The live mode readings will be captured and displayed in the main screen.



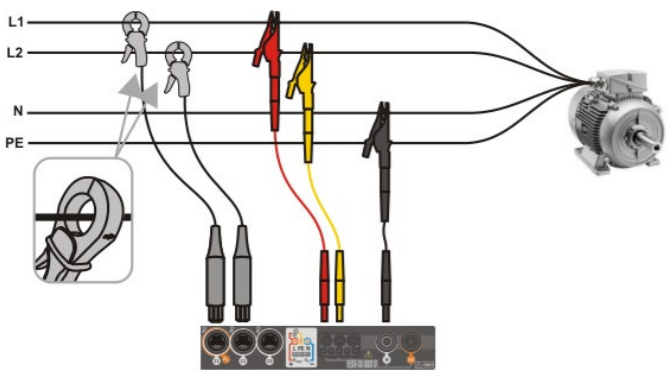
Save the result with icon 📄.

1 Connect the meter

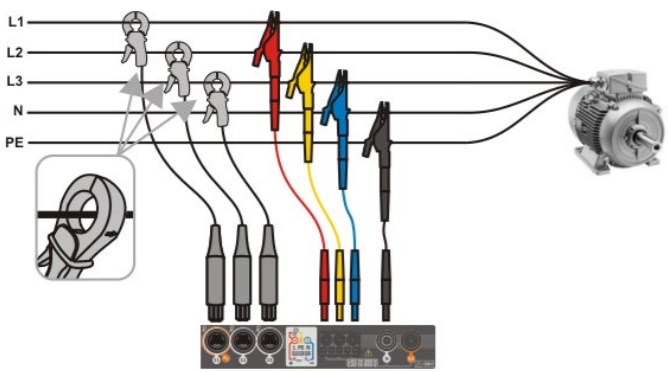
Single-phase



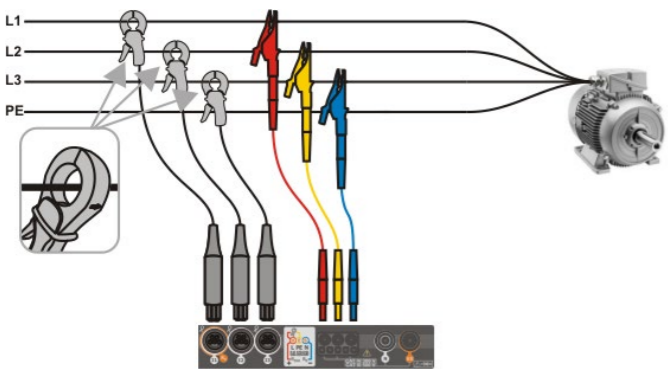
Split-phase



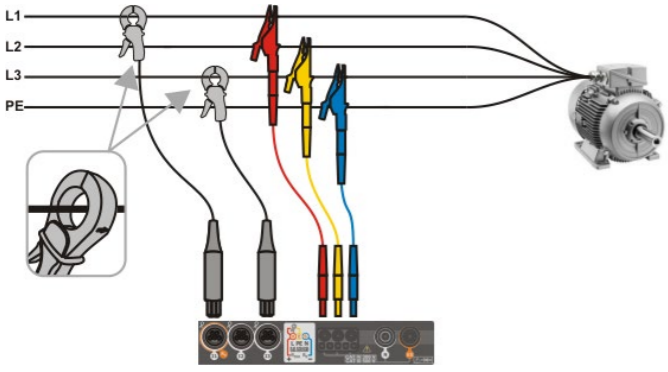
3-phase 4-wire



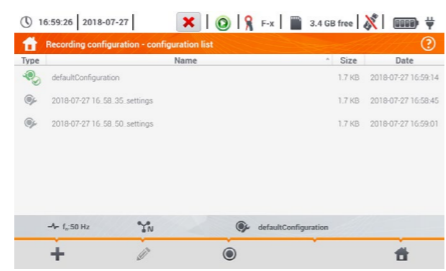
3-phase 3-wire



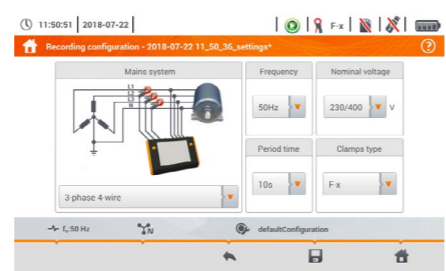
3-phase 3-wire Aron



2 Configure the recording



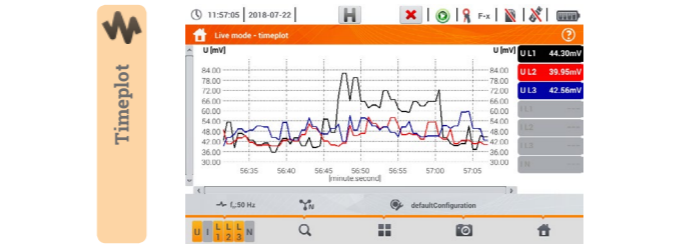
Enter the Recording configuration menu.
Using icon + create a new configuration.



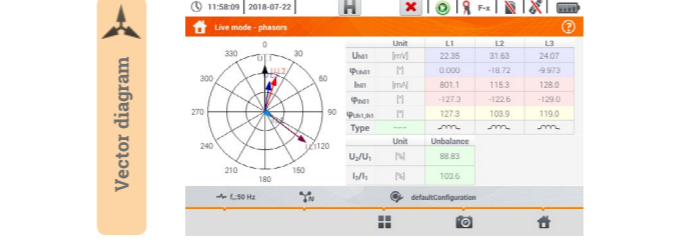
Enter settings
• mains system
• mains frequency
• period time
• nominal voltage
• type of clamps connected to the meter
Using icon save recording configuration.

START To run/stop recording press START.

3 Browse current readings.



U	U _{lin}	U _{lbc}	f	I	I _{lin}	I _{lbc}	PF
L1	56.97	21.82	-45.30	0.000	0.798	0.798	10.02
L2	45.21	29.26	23.23	---	0.143	0.134	-5.99
L3	41.33	23.79	-25.26	---	0.152	0.142	-4.87
N	---	---	---	---	1.077	1.072	17.80



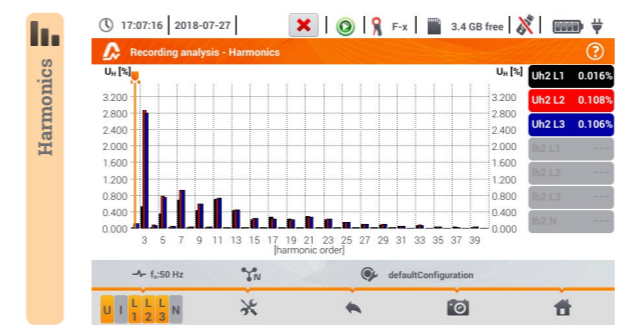
Select the desired recording. Using icon go to summary.

Type	Name	Size	Date
test 3f 10min		816.9 KB	2018-07-27 07:34:08
test 3f 3s		4.0 KB	2018-07-26 14:25:27
test 3f 3s		212.5 KB	2018-07-26 08:33:45
test 1f 3s		34.1 KB	2018-07-26 08:20:05
3fn 10s bez prądu		7.6 MB	2018-07-23 09:46:42
2018-07-20 15_55_14_settings		9.8 KB	2018-07-20 18:35:00

The display presents average values of voltage and current. Choose a method of presenting the recordings.

Start:	2018-07-26 14:25:56	U _{AVG} MIN	240.3V (104.47%Un)	U _{AVG} MAX	244.4V (106.27%Un)
Stop:	2018-07-27 07:34:08	L1: 235.6V (72.42%Un)	169.9V (73.88%Un)	L2: 166.6V (72.42%Un)	172.8V (75.12%Un)
Duration:	Od 17h 8m 11s	L3: 166.7V (72.49%Un)	170.1V (73.95%Un)	N: --- (---%Un)	---

Select parameters for the presentation. Using icon generate timeplot.



Energy costs calculator

Enter settings
• currency
• names and billing rates of tariffs
• time intervals for individual tariffs

Recording time	Energy [kWh]	Cost in tariff 1 [EUR]	Cost in tariff 2 [EUR]
2018-07-26 14:25:56	2.572	0.81	0.71

Energy loss calculator

Using icon go to calculator configuration.

Enter settings
• number of wires and cross section of cores of phase (L) and neutral (N) conductors
• length of the analyzed line in meters
• line material
• cost of 1 kWh of active energy
• cost of 1 kWh of reactive energy at power factor PF ≥ 0.8
• cost of 1 kWh of reactive energy at power factor PF < 0.8
• currency

Parameter	Value	Unit	Cost	Unit
P _{opt}	213.3	mW	C _{opt}	< 0.01 EUR/Hour
P _{dis}	1.034	mW	C _{dis}	< 0.01 EUR/Hour
P _{unb}	23.84	mW	C _{unb}	< 0.01 EUR/Hour
P _{rea}	-199.9	mW	C _{rea}	< 0.01 EUR/Hour
P _{tot}	38.30	mW	C _{tot}	< 0.01 EUR/Hour
P _{lav}	-175.0	mW	C _{lav}	< 0.01 EUR/Hour

C_{opt} cost related to power loss due to wire resistance
C_{dis} cost related to power losses due to higher harmonics
C_{unb} cost related to network unbalance
C_{rea} cost related to power loss due to presence of reactive power
C_{pf} cost related to a low power factor
C_{tot} cost of total losses