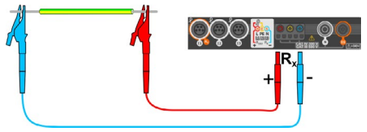
Resistance measurement

Connect the meter to the measured object.



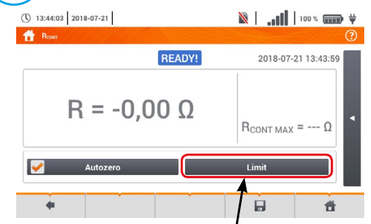
The measurement will start automatically.

Main result

Sonel®

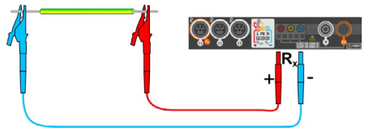
Find more information in the user manual and on our website www.sonel.pl/en

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.

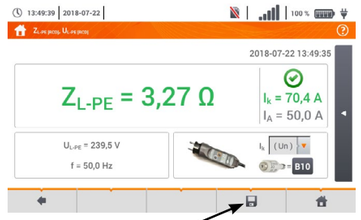
Main result

Evaluation of the result

Additional results

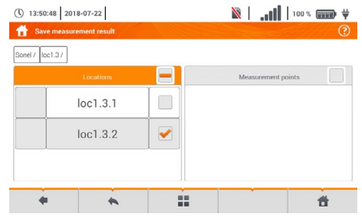
START To run new measurement press **START**.

Saving a result to the memory



Finish the measurement and select 💾.

Go to location you want to save the result in.

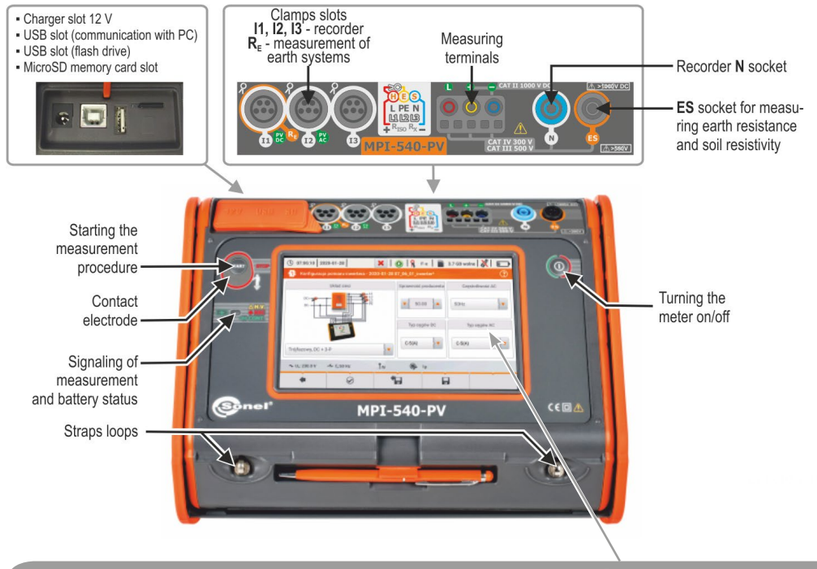


Save the result with icon 💾.

Sonel MPI-540 / MPI-540-PV

Meter for Electrical Installation Parameters

v2.00 | 11.12.2020



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

Z_{L-N}	L-N fault loop impedance
Z_{L-PE}	L-PE fault loop impedance
$Z_{L-PE[RCD]}$	L-PE fault loop impedance with RCD
R_{ISO}	Insulation resistance
RCD I_A	RCD tripping current
RCD t_A	RCD tripping time
RCD_{AUTO}	Automatic RCD measurements
R_X	Resistance measurement
R_{CONT}	Resistance measurement with I=±200 mA
1-2-3	Phase sequence
U-V-W	Motor rotation direction
R_E	Resistance-to-earth
Ωm	Soil resistivity
ΔU	Voltage drop
Lux	Illuminance

MPI-540-PV PV installations measurement

R_{ISO}	Insulation resistance
R_{CONT}	Resistance measurement with I=±200 mA
R_E	Resistance-to-earth
U_{OC}	Open circuit voltage
I_{SC}	Short circuit current
η, P, I	Test of the inverter panel

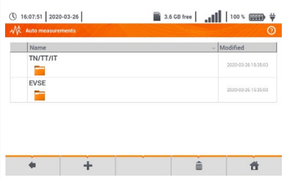
MPI-540 • MPI-540-PV Power quality recorder

- LIVE mode
  - Waveforms
  - Timeplot
  - Readings
  - Vector diagram
  - Harmonics
- Recording analysis
  - Timeplot
  - Harmonics
  - Energy costs calculator
- Energy loss calculator

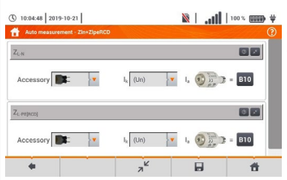
Auto measurements

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.

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

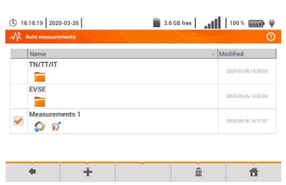
Select ✚ to add the desired measurement procedure.

Changing the order of the steps is performed by using ⬆⬇. Delete the step by using ✖ icon.

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.

$Z_{L-N,\ L-L}$ Z_{L-PE} $Z_{L-PE[RCD]}$ R_{ISO}
RCD I_A RCD t_A RCD_{AUTO} R_{CONT}
R_E Ωm Lux Statement
Visual inspection

Save the procedure by using 💾 icon. A window will be shown re-questing 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

1 Turn on the meter

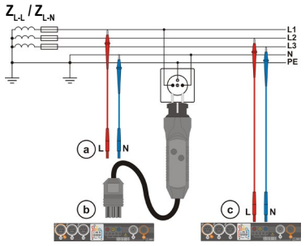
2 Measure

3 Save to the memory

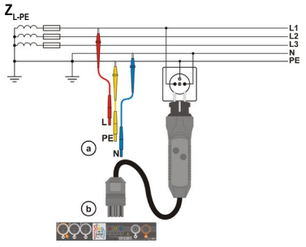
Fault loop impedance

Connect the meter to the measured circuit.

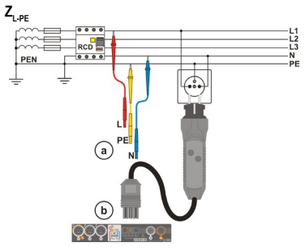
Z_{L-L} / Z_{L-N}

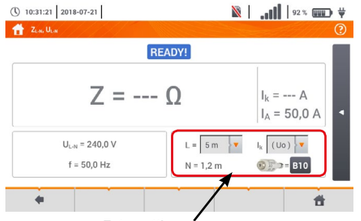


Z_{L-PE}



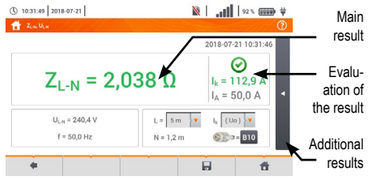
Z_{L-PE}





Enter settings
- test leads length L
- basic of calculating I_k current
- type and rated current of the circuit breaker

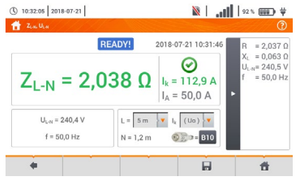
START Run the measurement with **START** button.



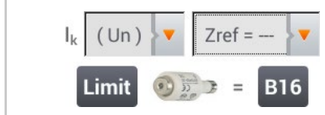
Main result

Evaluation of the result

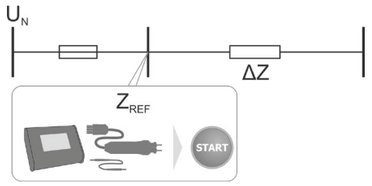
Additional results



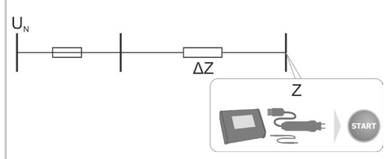
Voltage drop



- Use setting **Zref= ---** 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.



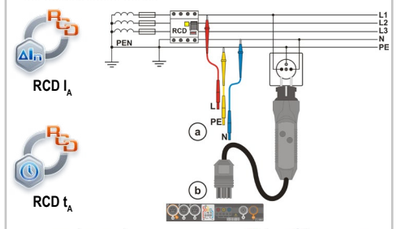
- Connect the meter to the reference point of the tested network, as for Z_{L-N} measurement.
- Press **START**.

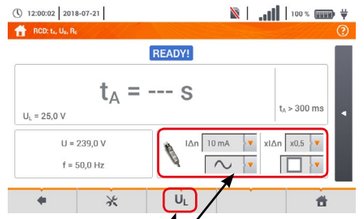


- Change the setting from **Zref** to **Z**.
- Connect the meter to the reference point, as for Z_{L-N} measurement.
- Press **START**.

RCD test

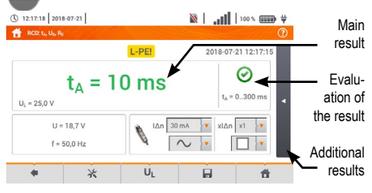
Connect the meter to the measured circuit and choose the measurement mode.





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

START Run the measurement with **START** button.



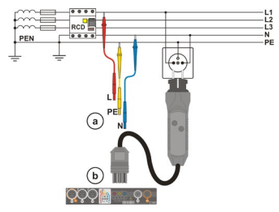
Main result

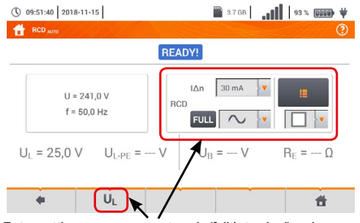
Evaluation of the result

Additional results

Auto measurements of RCDs

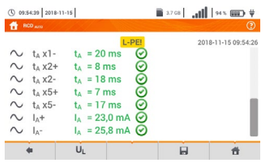
Connect the meter to the measured circuit.





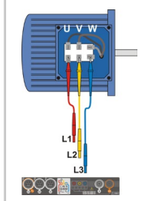
Enter settings - measurement mode (full / standard) and:
- residual operating current $I_{\Delta n}$
- a multiplicity of RCD rated current
- RCD type / waveform of the measuring current
- type of the RCD
- measuring voltage U_L

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



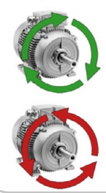
Eventually, measured parameters are displayed. The list of results may be scrolled on the screen.

Motor rotation direction



Connect the meter to the examined motor.

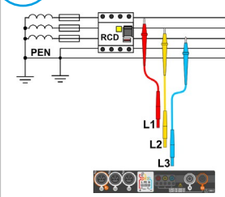
Vigorously rotate the motor shaft to the right.



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.

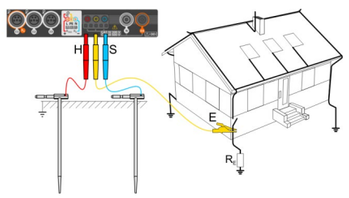
The phase sequence is **correct**, i.e. the phase sequence is in **clockwise** direction.

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

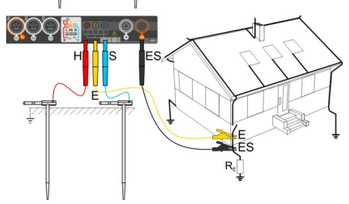
Resistance-to-earth

Choose the measurement method.

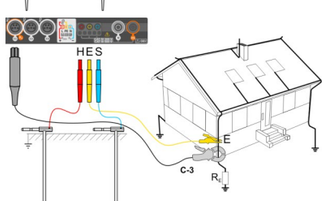
3P



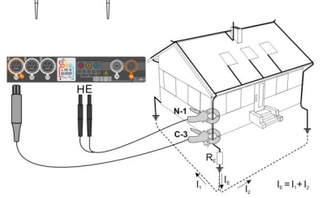
4P

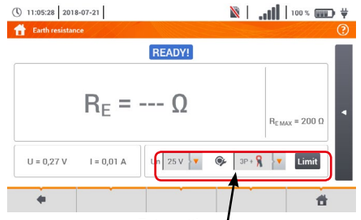


3P+



+





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

START Run the measurement with **START** button.

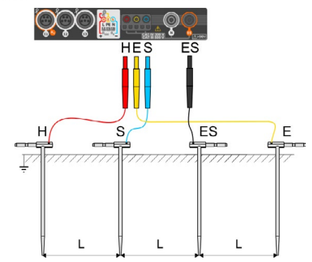
Main result

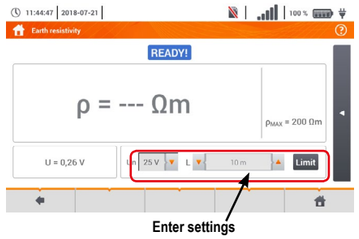
Evaluation of the result

Additional results

Soil resistivity

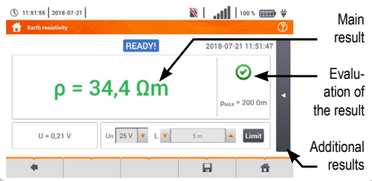
Connect the meter to the measured soil.





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

START Run the measurement with **START** button.



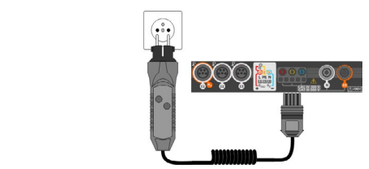
Main result

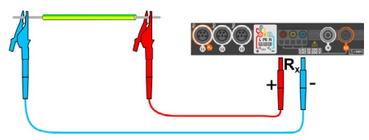
Evaluation of the result

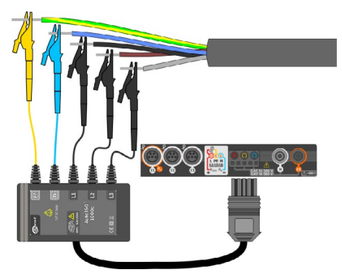
Additional results

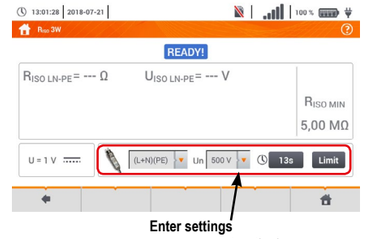
Insulation resistance

Choose the measurement method.



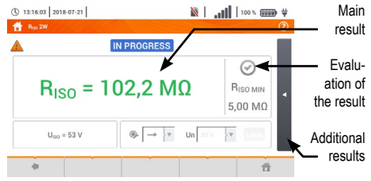






Enter settings
- measurement method
- measuring voltage
- duration of the measurement
- resistance limit to evaluate the result

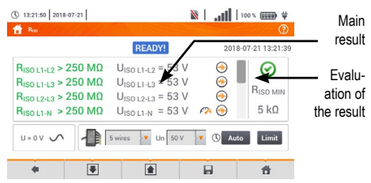
START Run the measurement with **START** button.



Main result

Evaluation of the result

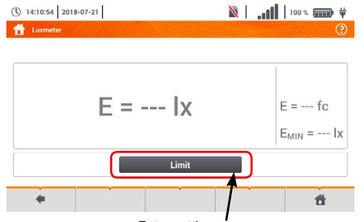
Additional results



Main result

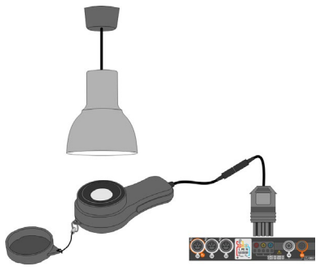
Evaluation of the result

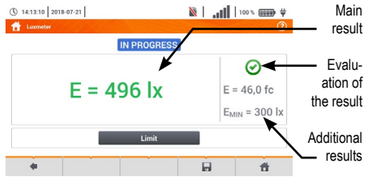
Illuminance



Enter settings
- illuminance limit to evaluate the result

Connect measuring probe to the meter.





Main result

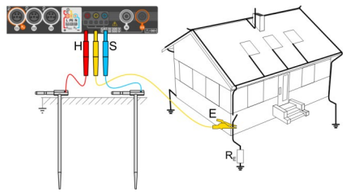
Evaluation of the result

Additional results

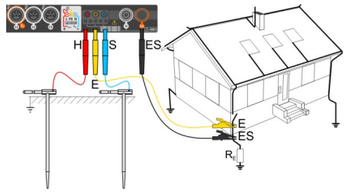
Resistance-to-earth (PV)

Choose the measurement method.

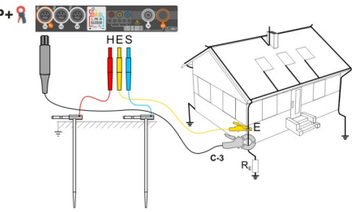
3P



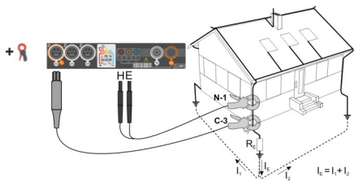
4P

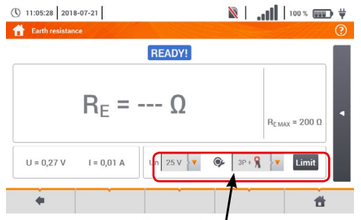


3P+



+





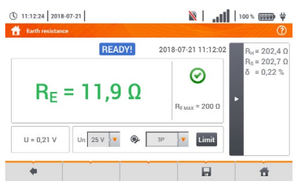
Enter settings
- measuring voltage
- measurement method
- resistance limit to evaluate the result

START Run the measurement with **START** button.

Main result

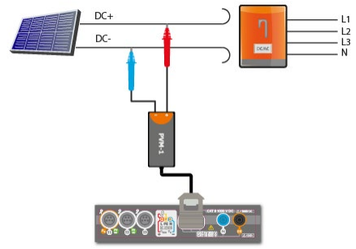
Evaluation of the result

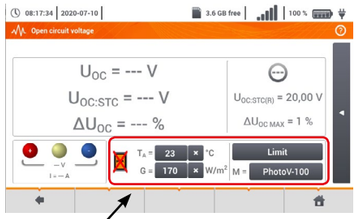
Additional results



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.





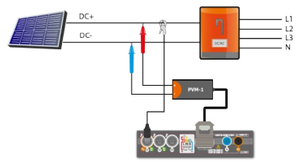
Enter settings
- T_A – ambient temperature, if the source of temperature measurement = air
- T_C – module temperature, if the source of temperature measurement = module
- **G** – irradiance
- **Limit** – setting of $\Delta U_{OC\,MAX}$ values
- **M** – photovoltaic module selected from the meter database

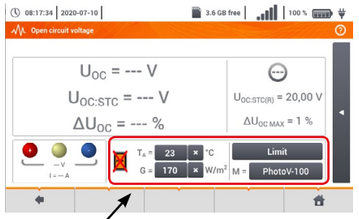
START Run the measurement with **START** button.

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

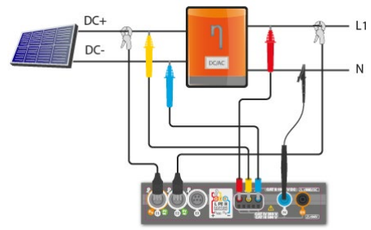
START If necessary, **reset the clamp** again.
Run the measurement with **START** button.

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

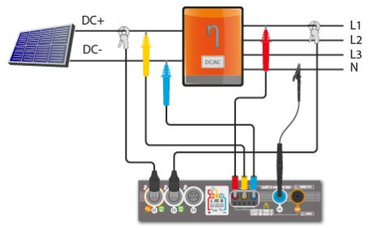
1 Initialize the measurement

Reset the clamp.

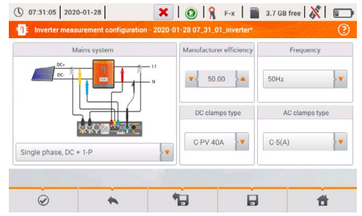
Connect the meter to the tested object.



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



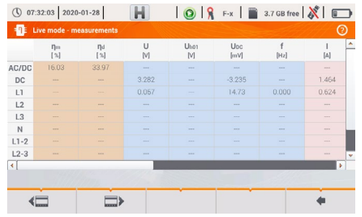
2 Configure the measurement



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:

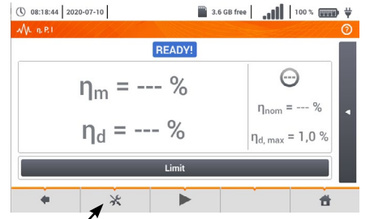
$$\eta_m[\%] = \frac{P_{AC}[W]}{P_{DC}[W]} \cdot 100\%$$

  - » 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.

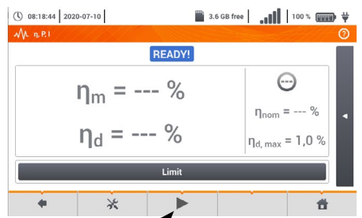
- Line **DC** presents the parameters of DC side of the inverter such as voltage, current, active power, active energy.
- Values related to AC side are displayed in lines: **L1** and **Σ**.



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.

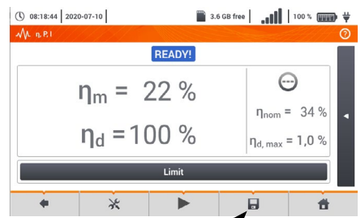
If necessary, reset the clamp again.



Use icon ▶ to go to the measurement configuration.

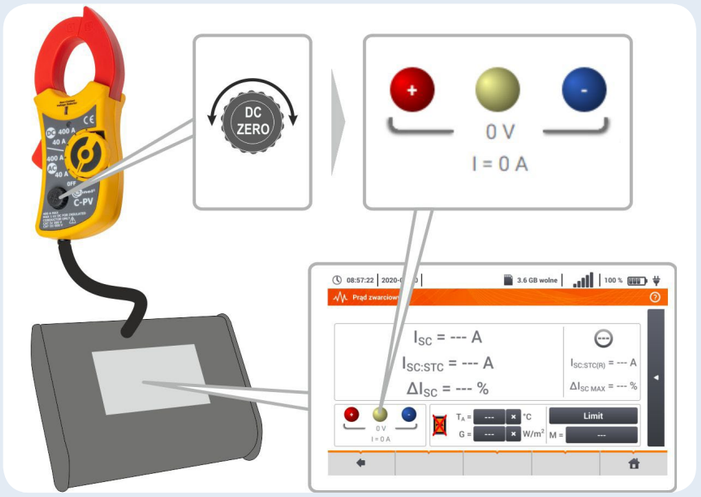
4 Capture and save the results

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



Save the result with icon 💾.

Resetting C-PV clamp

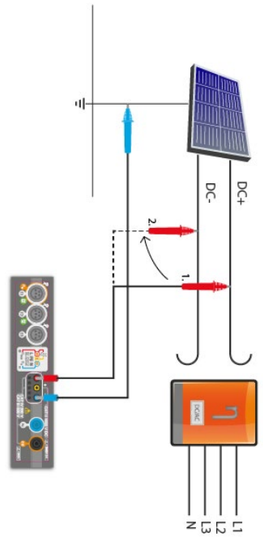


Before the I_{SC} measurement and testing the inverter reset C-PV clamp. To do this, connect the clamp to the meter. Set the **DC ZERO** knob on the housing of the clamp to make the voltage and current readings as close to zero as possible. Only then you can connect the clamp to the tested object.

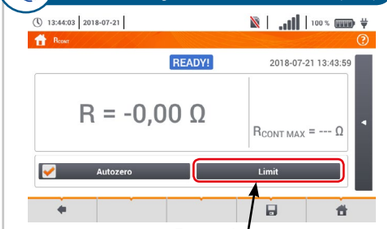
Insulation resistance (PV)

The test is performed similarly as in the usual insulation resistance measurement.

Measure the insulation resistance between the positive pole (DC+) and grounding, as well as between the negative pole (DC-) and grounding. For this purpose:
- connect the grounding with R_{ISO} socket of the meter, connect DC+ line with RISO+ meter, select **R_{ISO+}** method in the instrument and start the measurement,
- connect DC- line with R_{ISO-} socket, select **R_{ISO-}** method in the instrument and start the measurement.



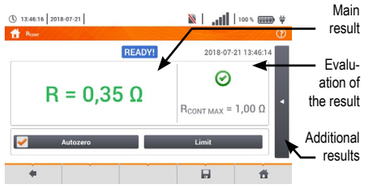
Continuity of connections (PV)



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

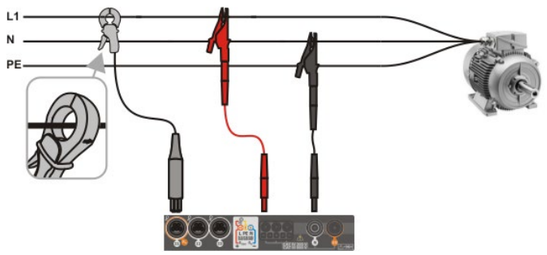
Additional results

START Run a new the measurement with **START** button.

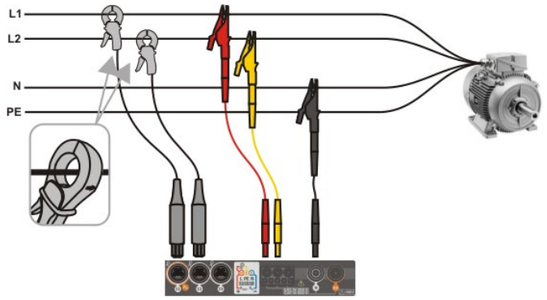
Recording the mains parameters

1 Connect the meter

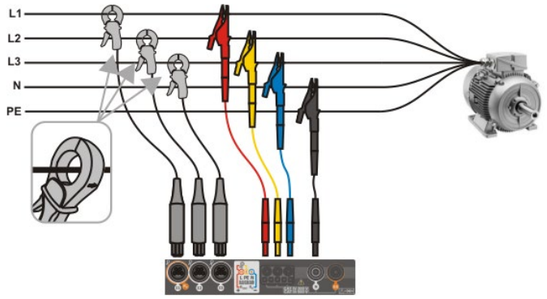
Single-phase



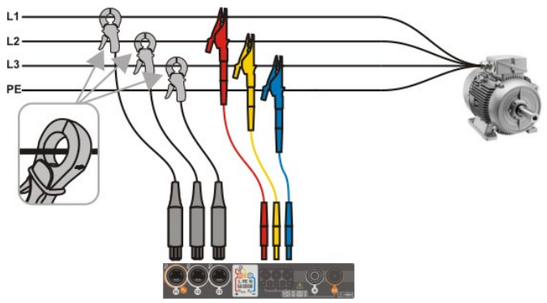
Split-phase



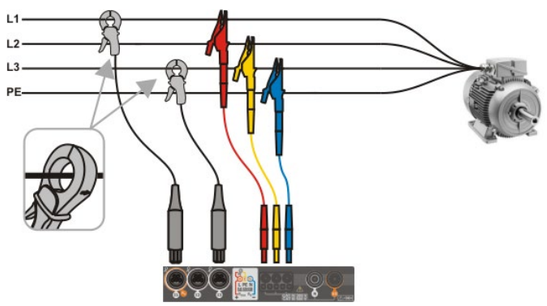
3-phase 4-wire



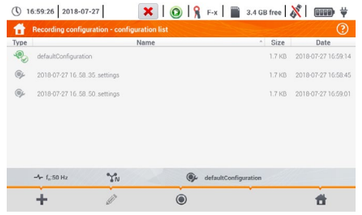
3-phase 3-wire



3-phase 3-wire Aron

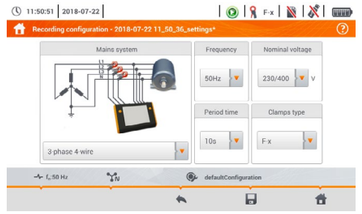


2 Configure the recording



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

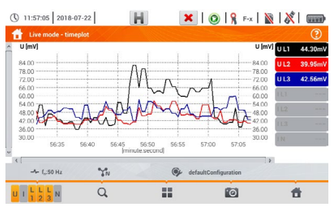
Using icon save recording configuration.

START To run/stop recording press **START**.

3 Browse current readings.

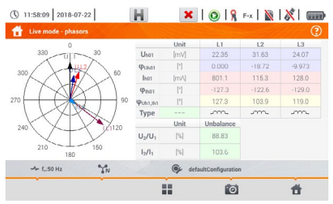
Waveforms

Timeplot



Readings

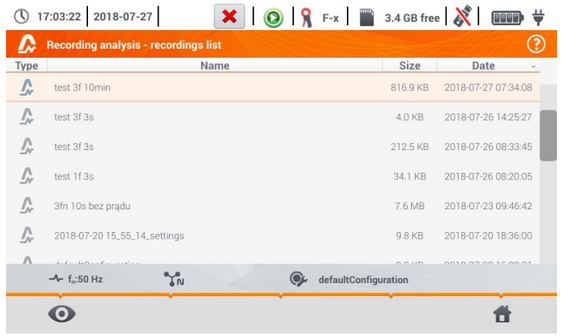
Vector diagram



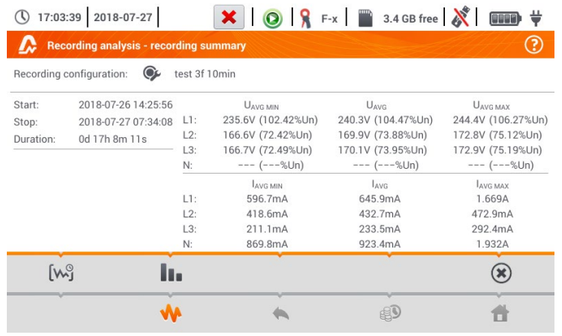
Harmonics

Recording analysis

Select the desired recording. Using icon go to summary.



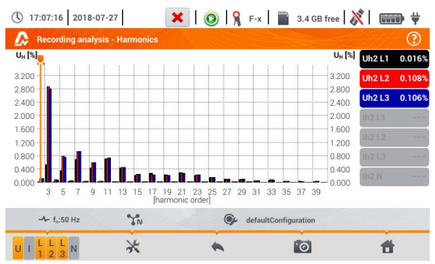
The display presents average values of voltage and current.
Choose a method of presenting the recordings.



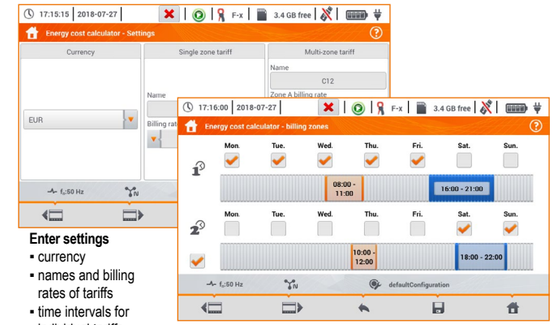
Timeplot

Select parameters for the presentation.
Using icon generate timeplot.

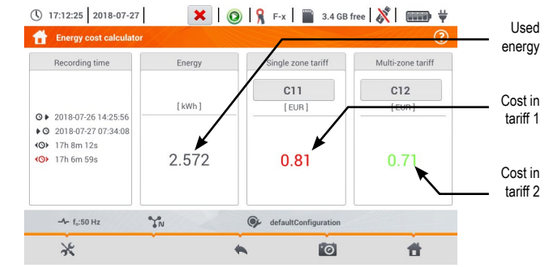
Harmonics



Energy costs calculator

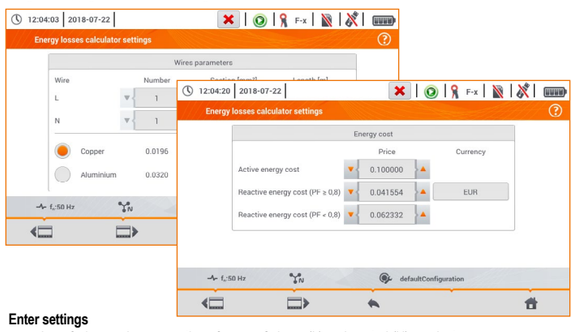


Enter settings
- currency
- names and billing rates of tariffs
- time intervals for individual tariffs

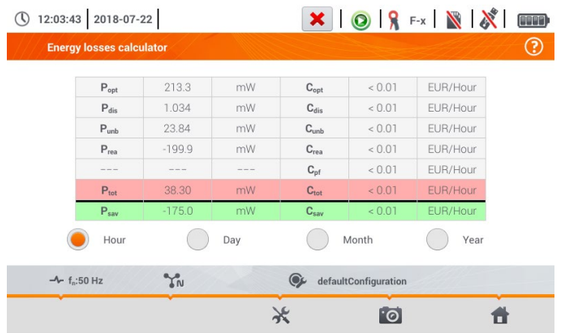


Energy loss calculator

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



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