

MD 9273 Bluetooth® TRMS Leakage Clamp with Power Functions



MD 9273 Instruction manual *Version 1.1.7; Code 20753096*

Distributor:

METREL d.o.o.

Ljubljanska cesta 77

1354 Horjul

Slovenia

E-mail: metrel@metrel.si

Website: <http://www.metrel.si/>

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Elma Instruments A/S
Ryttermarken 2
DK-3520 Farum
T: +45 7022 1000
F: +45 7022 1001
info@elma.dk
www.elma.dk

Elma Instruments AS
Garver Ytteborgsvei 83
N-0977 Oslo
T: +47 22 10 42 70
F: +47 22 21 62 00
firma@elma-instruments.no
www.elma-instruments.no

Elma Instruments AB
Pepparvägen 27
S-123 56 Farsta
T: +46 (0)8-447 57 70
F: +46 (0)8-447 57 79
info@elma-instruments.se
www.elma-instruments.se



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1 General Instructions

This instrument has been designed in accordance with IEC 61010 series standards that regulates safety requirements for the electronic measuring equipment and current measuring clamps. Present user manual shall be read carefully in order to get the best out of this equipment. Safety instructions shall always be complied with.

1.1 Safety measures


General

- If the clamp-meter is used in a manner not specified in this user's manual, the protection provided by the equipment may be impaired!
- This equipment can be used to carry out measurements in the CAT III¹ 600V environment.
- When using this clamp meter, the user should comply with all the safety measures regarding:
 - Protection against the electric current hazards.
 - Protection of the clamp A-meter against incorrect use.
 - Protection against electric shock hazard.
- For operator security, only the test probes supplied with the instrument shall be used.
- Do not use the clamp-meter and its accessories if any damage is noticed on them!

During use







- Before carrying out any measurements, the instrument shall be warmed up for at least 30 seconds.
- If the clamp-meter is used near any high level noise generating equipment, the reading might become unstable or show significant errors.
- The maximum limits of the input values stated in the technical specifications tables shall not be exceeded to avoid damage to the equipment.
- The rotary switch shall be in the correct position before starting a new measurement.
- Practice extreme caution when working near bare conductors.
- Any accidental contact with the bare conductor may cause an electric shock.
- Use caution when working with voltages higher than 60V DC or 30V AC RMS to avoid a risk of electric shock.
- The test probe(s) shall be disconnected from the circuit under test before changing the function.
- During measurement fingers shall always be kept behind the protection ring, see Chapter *Instrument Description*.

¹ Measurement category III is for measurements performed in the building installation. Examples are measurements on distribution boards, circuit-breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to the fixed installation.

- The battery shall be changed when the symbol  is shown in order to avoid incorrect measurement readings.

Symbols

The symbols used in this manual and in the equipment are as follows:

-  Warning: check the instruction manual. Any incorrect use may cause damage to the equipment or its components.
-  Earth
-  Complies with European Union Directives.
-  Complies with UK regulations.
-  This equipment has double insulation.
-  Allows use with dangerous voltage conductors.

Instructions

- Before opening the equipment, the instrument shall be disconnected from any source of electric supply and it shall be ensured that the operator is free from static electricity, as it could destroy the internal components.
- Before using this equipment it shall be checked for proper operation; by turning the rotary switch to A or V position and verifying a double beep and the display activity.
- Any adjustment, repair or maintenance work on the clamp meter must only be carried out by a qualified person, always taking into account the instructions included in this manual.
- A “qualified person” means one familiar with the installation, construction and operation of the equipment, and with the risks implied. This person should be trained and authorized to charge and discharge energy from the circuits and the equipment in accordance with established practice.
- When the equipment is open, some internal components can retain dangerous power, even after the equipment has been disconnected from the mains electricity supply.
- In the case of abnormal operation and/or performance, the equipment shall not be used until it has been repaired/verified.
- The battery shall be removed from the clamp-meter if it is not going to be used for a long period, and shall not be stored in a hot or humid environment.

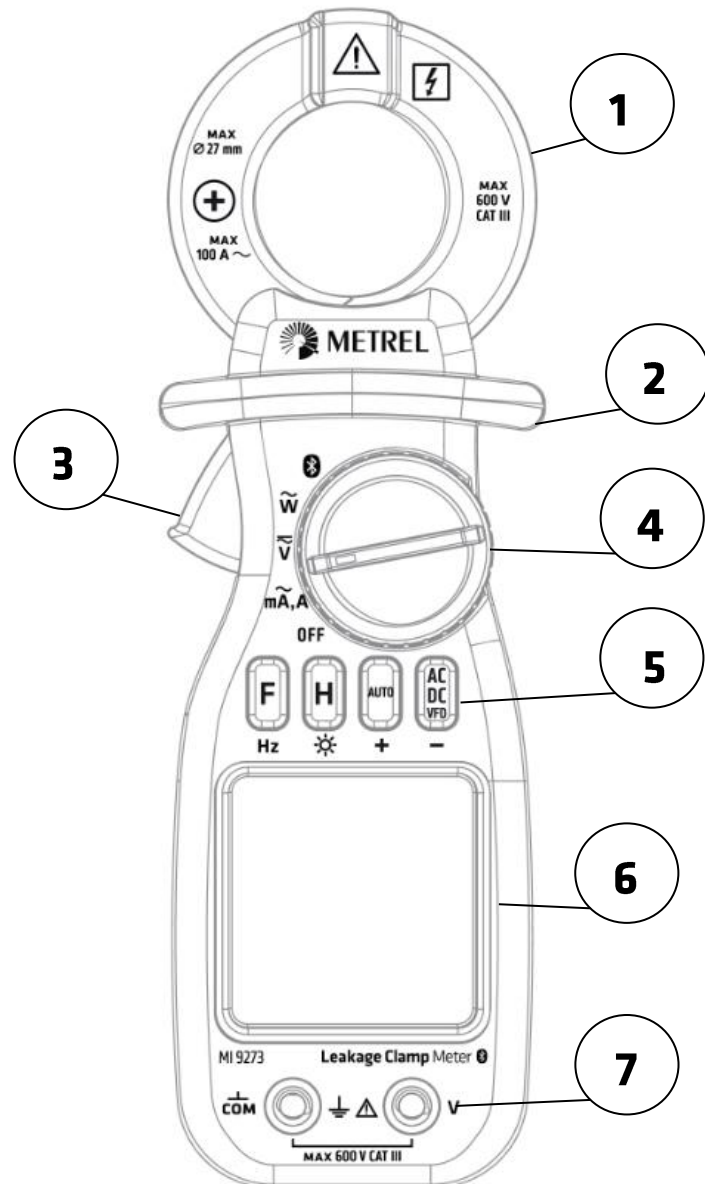
WARNING

This equipment is designed according to EMC standards for portable test and measurement instruments. However, it is recommended to disconnect the test leads during current measurements, as a high level of radiofrequency electromagnetic field might be present, which can negatively affect the accuracy of the measurement.

2 Instrument Description

Becoming familiar with the equipment

1. Transformer jaws
2. Protection ring
3. Jaw opening trigger
4. Rotary function switch
5. Keyboard
6. LCD display
7. Terminals



Transformer clamps

Capture the AC current flowing through the conductor. DC current cannot be measured.

2.1 Rotary Function switch

It is intended to switch-on clamps and select basic test function or activate BT communication as described in *Table 1*.



Position	Function
OFF	OFF position.
A	Measurement of AC current up to 100 A.
V	Measurement of AC or DC voltage up to 600 V.
W	Measurement of power of up to 60 kVA, with limits of 100 A and 600 V.
	Activates the Bluetooth® Mode to communicate with Metrel instruments.

Table 1: Rotary switch position functions

Keyboard

The keyboard consists of four multifunctional push buttons. *Table 2* describes the function of each one.

Key	Use	Function
F - Function	Any position of the rotary switch	Function selection key. Depending on the rotary switch position, the functions will vary. See Chapter <i>Description of Test Functions</i> for details. Pressing this button cycles through the various functions.
Hz - Frequency	A and V position of the rotary switch, in the RMS function only	When pressed for more than 2 s, it alternates the second display information between THD and Hz.
H - Hold	Any position of the rotary switch and all the functions except in PEAK function	When pressed the data hold mode is turned on and the screen information stops updating. On next press, the MAX mode is turned on for the register of maximum values. On third press, the MIN mode is accessed for the register of minimum values. Press again to return to the normal mode.
Light 	Any position of the rotary switch, in all the functions	With a long press of the key (more than 2 s) the LCD screen back-light is lit. 30 s after any button was pressed, it switches off automatically.
Auto	A and V position of	Cycles through the different manual ranges until

	the rotary switch, in the RMS function only	the Autorange is active again.
+	A and V position, in the harmonic measurement function	Increases the displayed harmonic number.
AC/DC	V position, in the RMS function only	Alternates between V AC or V DC measurements.
VFD	V position, in the RMS function only	Calculates the RMS voltage of Variable Frequency Drive generators.
-	A and V positions, in the harmonic measurement function	Decreases the number of harmonic to be measured.

Table 2: Keyboard push buttons function description

LCD Screen

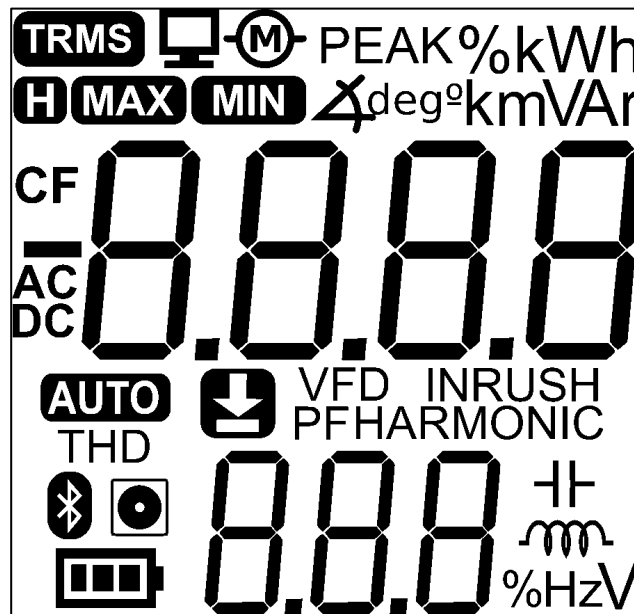











Figure 2.1: Test results and indication presentation on LCD screen

H	Data hold indication.
MAX	Maximum reading indication.
MIN	Minimum reading indication.
PEAK	Peak reading indication. See chapter Description of Test Functions.

	Phase angle measurement function of the current in reference to the voltage.
	Indicates that the current is ahead the voltage.
	Indicates that the current is behind the voltage.
	Indicates a loss, possibly due to insulation defects; only in the mA measurement mode.
	Indicates a loss, possibly due to insulation defects and accumulation of non-linear loads; only in the mA measurement mode.
	Indicates a loss, possibly due to a high accumulation of non-linear loads; only in the mA measurement mode.
	Indicates that the measured magnitude is expressed as a true effective value.
CF	Measuring the crest factor.
AC	AC input indication.
DC	DC input indication.
mA, A	Milliamperes, amperes.
V	Volts.
VAR, kVAR	Reactive volt-amperes, reactive kilovolt-amperes; reactive power measuring units.
VA, kVA	Volt-amperes, kilovolt-amperes; apparent power measuring units.
W, kW	Watts, kilowatts; active power measuring units.
%	Indicates the measurement of a percent value.
THD	Total harmonic distortion ratio.
PF	Power factor.
INRUSH	Inrush current measurement function.
VFD	Voltage Frequency Drive filter function.
HARMONIC	Harmonic measurement function.
Hz	Frequency measurement function.
	Instrument paired (Bluetooth® Mode)
	Recording function (Bluetooth® Mode)







	Data available to be downloaded (Bluetooth® Mode)
	Indicates that range is selected automatically.
	Full battery.
	Medium battery.
	Low battery.
 BLINK	Battery is close to empty.

Table 3: LCD screen indications

Inputs

Table 4 describes the inputs' function.

Input	Description
COM	Common reference for voltage and power measurements; use black probe.
V	Voltage and power measurements active line input; use red probe.

Table 4: Inputs

Standby Mode


If the clamp-meter is not in use for a period of 15 minutes, the screen goes blank and the clamp-meter goes into standby mode. To wake the meter from standby mode, turn the rotary switch to OFF position and then back to the desired function to reactivate the screen. The Standby mode is disabled during active Bluetooth® connection with other instrument.

Standard accessories

- Test probes,
- Crocodile clamps,
- Batteries (2 AA 1,5V batteries),
- Instruction manual,
- Carrying Case.

3 Description of Test Functions

Main Test Functions of the Leakage Clamps, selectable with rotary switch position, are:

- Current test measurement - position mA, A
- Voltage test measurement - position V
- Power test measurement - position W
- In the  position of the rotary switch, clamps are controlled by the connected device.

Beside Main test function, sub function test can be selected with keyboard buttons. See Chapter Flowcharts of sub-function selection for details.

3.1 Main Test function connection schemes

Appropriate jaws and test leads connection schemes for each selected main function are presented on *Figure 3.1: Test function connection schemes* below.

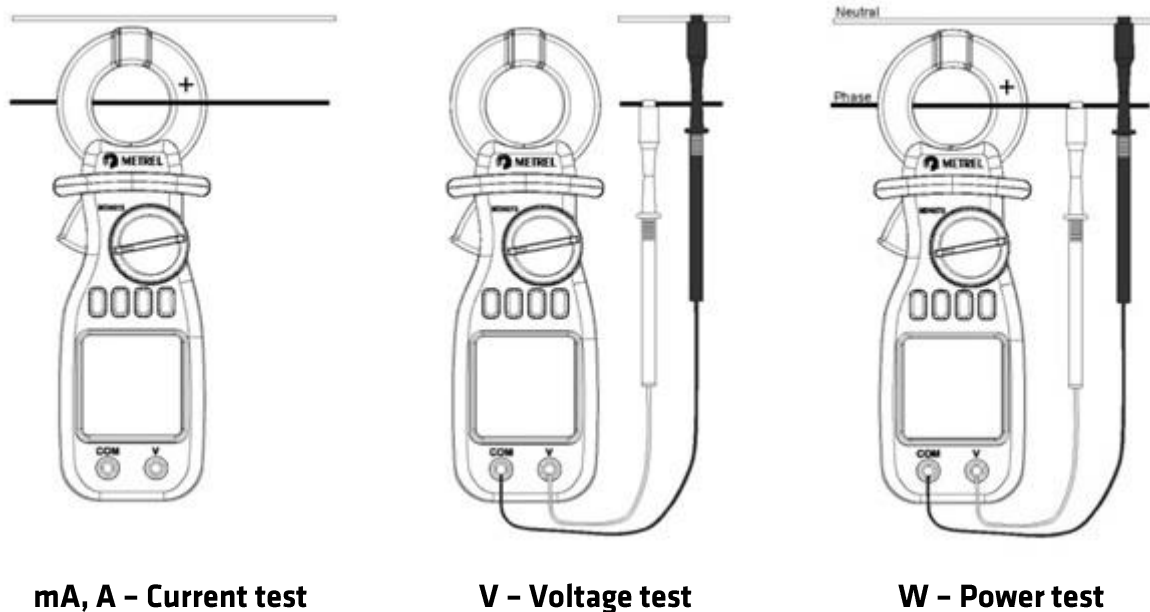


Figure 3.1: Test function connection schemes

3.2 Flowcharts of sub-function selection

The Figure 3.2: Flowcharts of sub function selection shows a flowchart of the keyboard navigation through the different measuring sub functions for each of the three main function selected with rotary switch.

Sub-functions represented with squares are selected with sequentially pressing the F key and can be further defined by pressing the keys marked with text next to the squares.

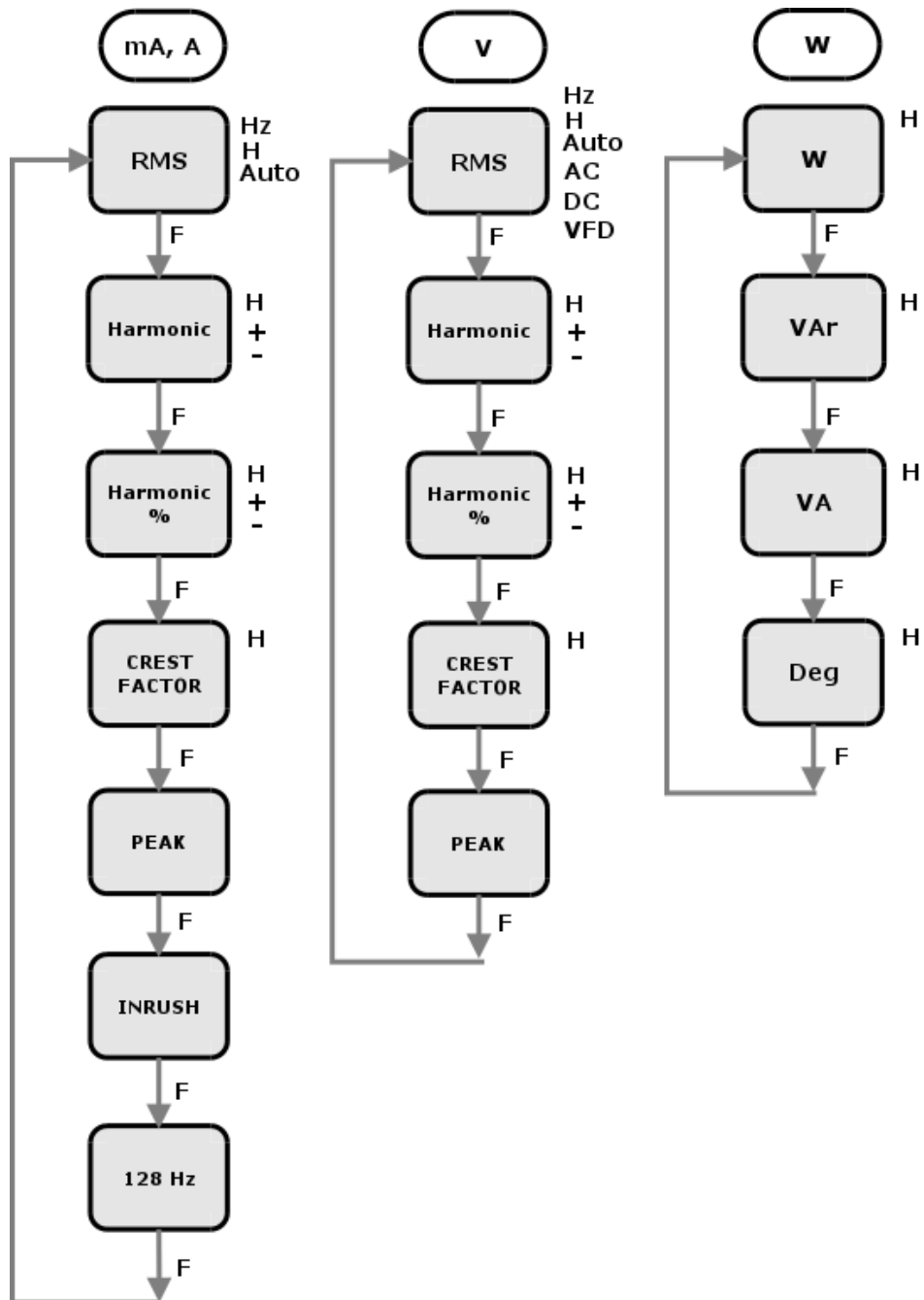


Figure 3.2: Flowcharts of sub function selection

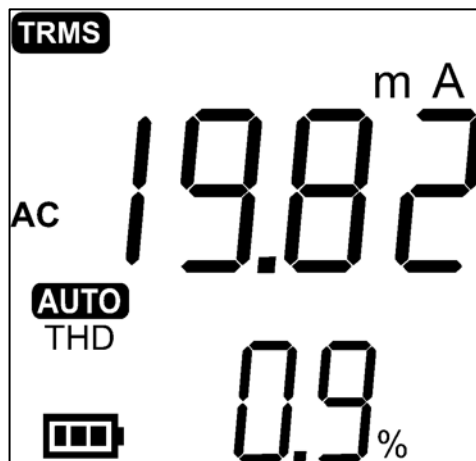
3.3 Test functions

Measuring mA, A and V

The following sections describe the functions available in the current and voltage measurement modes (positions of the rotary switch in mA, A and V). To select the desired function, the **F** key shall be pressed repeatedly until it is selected. For current measurements (mA, A), it is recommended to disconnect the test leads, except for the Inrush function where voltage can be measured (see “Warning” section).

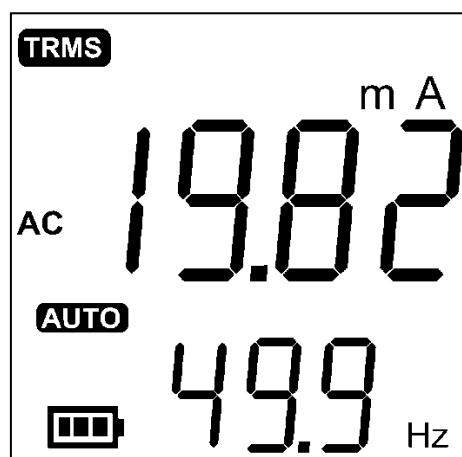
TRMS value measurement function

TRMS is the effective value of the current or the voltage. Secondary reading on the display is the THD (total harmonic distortion ratio) or the frequency of measured signal. THD is the ratio between the higher frequency components of the signal with the essential component (at 50 Hz or 60 Hz), expressed as percentage. A high THD value indicates high distortion of the measured signal whilst a 0%THD indicates a pure single-frequency sinusoid. Data hold in this mode is possible as well as the register of maximum and minimum values using the **H** key.






Frequency measurement

In this function, the frequency of the measured signal is displayed. Press **F** button for more than 2 s while in the TRMS measurement function to enter frequency measurement mode. To return to THD, press the same button again for more than 2 s.



Intelligent loss analysis (mA measurement only)

The clamp A-meter includes an algorithm that allows determining the cause for the current loss. This mode is enabled only when measuring current in the mA range and TRMS measurement is selected. In the TRMS measurement function, one or two icons will be shown on the screen informing of the possible reasons for the loss.

-  Indicates that the loss is possibly due to a defect in the equipment insulation.
-  Indicates that the loss may be partially due to defects in the insulation and partially to the accumulation of non-linear loads.
-  Indicates that a loss is possibly due to a high accumulation of non-linear loads.

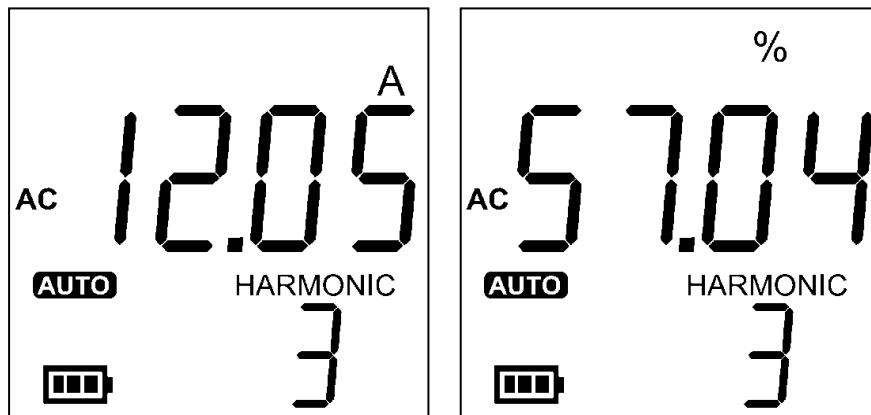
Harmonic analysis function and harmonic percent value

Harmonics (1 through to 19) can be measured as an absolute magnitude of the signal, or a percentage of the fundamental (the 1st harmonic). 1st harmonic is also called the fundamental frequency.

Absolute magnitude and percent value of the harmonics can be reached with F key while in voltage or current rotary switch positions.

Initially the harmonic 1 is displayed but this can be changed using the + and - keys. The display shows the percent of effective value, or an absolute harmonic value, together with the harmonic number (at the bottom of the screen).

For example, if there is a 50 Hz network frequency and the absolute value of the 3rd harmonic is measured, this is measuring the magnitude (current or voltage) of the 150 Hz component.



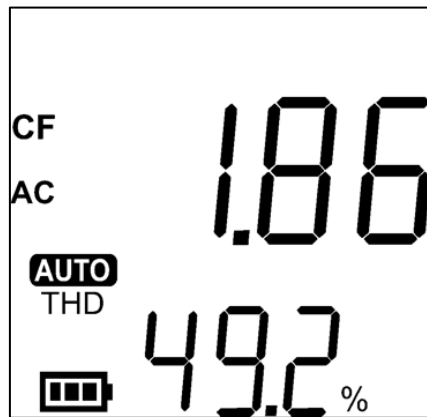
In this mode, data hold and registering of maximum and minimum values is possible by using the **H** key.

Crest factor function

Measures crest factor of the input signal. The crest factor is the ratio of the peak and the effective (or TRMS) value of a waveform. For a sinusoidal wave the crest value is 1.41. The greater the difference between the peak and efficient RMS value, the higher the crest factor is.

In this mode, data retention and registering of maximum and minimum values is possible by

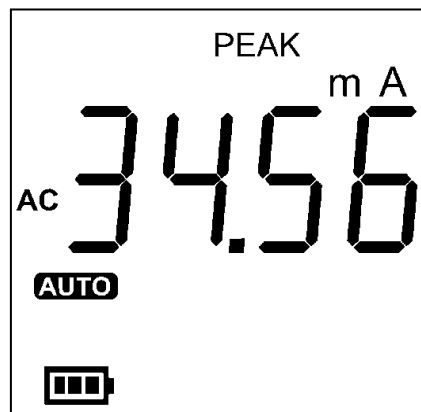
using the **H** key.



In this mode, data retention and registering of maximum and minimum values is possible by using the **H** key.

Peak hold function

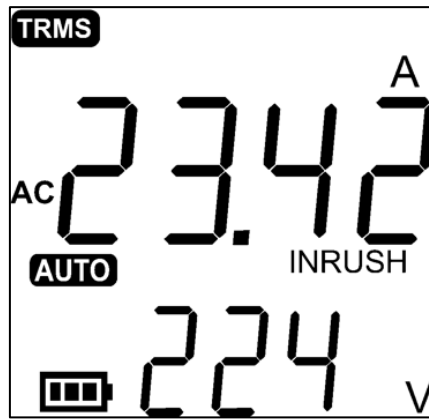
In this function, the peak value of the waveform is shown. The peak value is the highest measured value within one period of the waveform and is usually higher than the effective value (also known as the TRMS value), e.g. for a perfect sinusoidal signal the peak value is 1.41 times the effective value. Peak hold is executed with a faster sampling than other measurements at 25 μ s.



Inrush Current measurement (Current functions only)

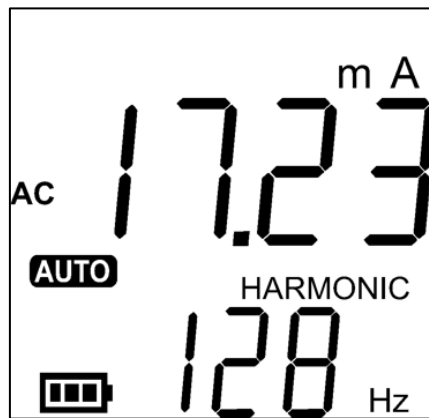
Inrush current is the maximum instantaneous current drawn by a circuit when first turned on, expressed as TRMS value. It is meant for use with motors and other loads that draw high initial current.

Additionally it is possible to connect the voltage probes and the instrument calculates the minimum RMS voltage of the initial signal.



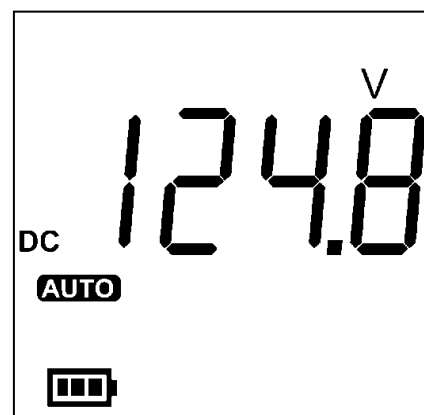
128 Hz Current measurement (Current functions only)

There is a notch filter at 128 Hz frequency. The instrument filters the rest of frequency spectrum out. This function is used in conjunction with other Metrel® Instruments or a signal generator for cable tracking.



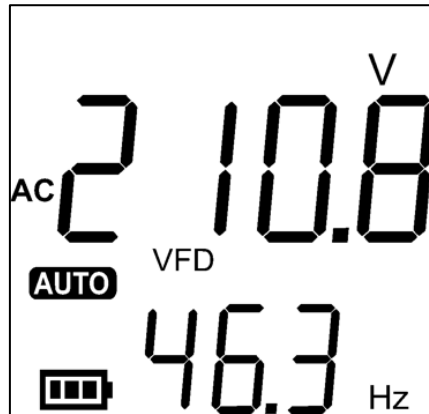
DC measurement (Voltage functions only)

In this function, the DC value of the waveform is shown. This mode is entered by pressing the AC/DC button in the TRMS measurement function screen. To change back to AC, press the same button again.



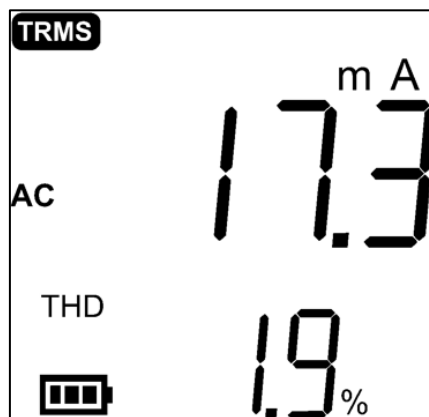
VFD measurement (Voltage functions only)

In this function the instrument calculates the equivalent base frequency and RMS value of voltage pulses generated by variable frequency drives. Press the AC/DC button in the TRMS measurement function screen to enter this mode.



Manual range selection

By pressing the **Auto** button, the range changes from auto-range to the different ranges available. This function can be used in V and A mode. When the auto-range is not active, the icon **AUTO** is not showed.

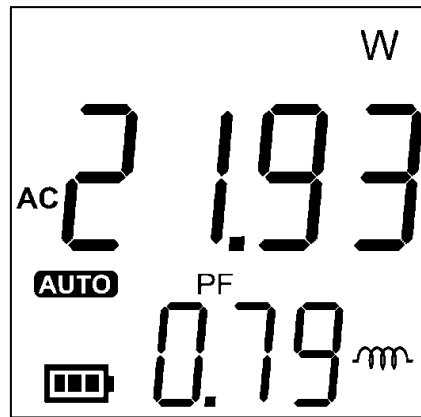


Measuring Power

In the following sections, the functions available in the power measuring mode (position W of the rotary switch) will be described. To select the desired function the **F** key must be pressed repeatedly until the required function is selected.

Active power measurement

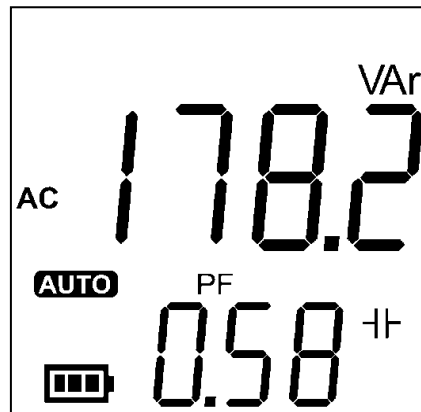
Measurement of the active power together with measurement of the power factor are shown on the screen. If the load is inductive, the symbol \sim will appear on the screen; if the load is capacitive, the symbol \dashv will appear on screen.



Position of the voltage terminals and the jaw is taken into account; the red terminal should be connected to the line terminal and the jaw should be connected so that the current flows towards the load in the direction indicated on the jaw. The instrument faces the source. In this mode, data hold and registering of maximum and minimum values is possible by using the **H** key.

Reactive Power Measurement

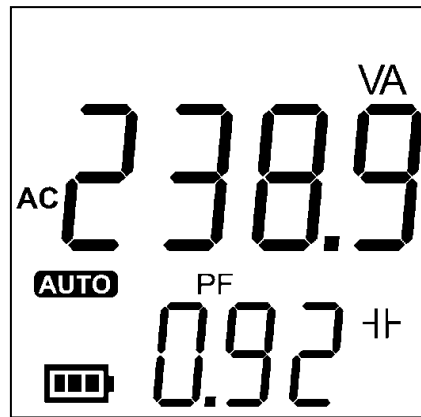
Measurement of the reactive power is shown together with the measurement of the power factor. If the load is inductive, the symbol m will appear on the screen and if the load is capacitive, the symbol \dagger will appear on screen.



Position of the voltage terminals and the jaw is taken into account; the red terminal should be connected to the line terminal and the jaw should be connected so that the current flows towards the load in the direction indicated on the jaw. In this mode, data hold and registering of maximum and minimum values is possible by using the **H** key.

Apparent Power Measurement

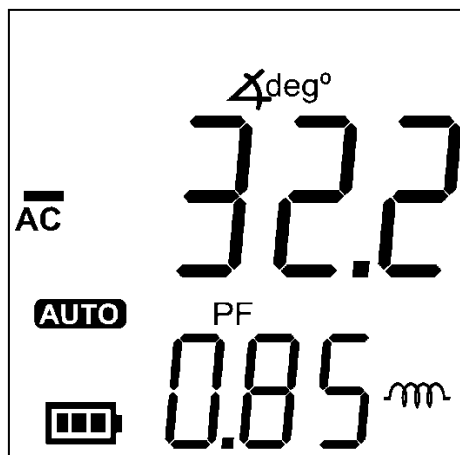
Measurement of the apparent power together with the measurement of the power factor are shown, if the load is inductive, the symbol m will appear on the screen and if the load is capacitive, the symbol \dagger will appear on screen.



In this mode data hold and registering of maximum and minimum values is possible by using the **H** key is possible.

Phase displacement measurement

Phase displacement measurement between the voltage and the current is shown in degrees. The position of the voltage terminals and the jaw should be taken into account; the red terminal should be connected to the line terminal and the jaw should be connected so that the current flows towards the load in the direction indicated on the jaw, with instrument facing the power source. If this is not the case the phase displacement angle shown will not be correct.



3.4 Data hold mode

To access the data hold mode, press the **H** key; press the key repeatedly to access the HOLD, MAX and MIN modes. The three modes are available in all the measuring functions except in the peak measurement.

HOLD Mode

In this mode, the value shown on the screen when the key was pressed is held. The **H** symbol will also appear on the screen.

MAX Mode

In this mode, the maximum value measured is shown since mode activation is displayed. The symbol **MAX** is on. Before using this function, the clamp-meter should be connected properly,

see chapter Description of Test Functions for details.


When recording the value, the difference between the peak value and the maximum value should be taken into account: the maximum value holds the highest measured value on the screen, whilst the peak value shows the highest absolute value of the waveform.

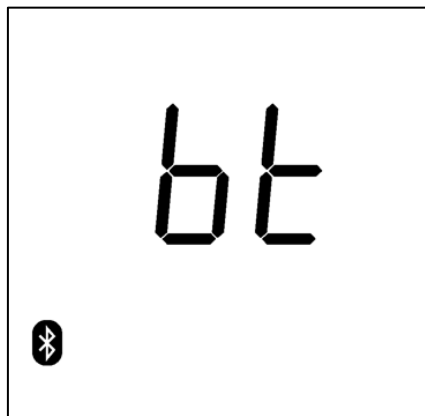
MIN Mode

In this mode, the minimum measured value is shown on the screen. The **MIN** symbol will be shown. Before using this function, the clamp should be connected properly, see chapter Description of Test Functions for details.

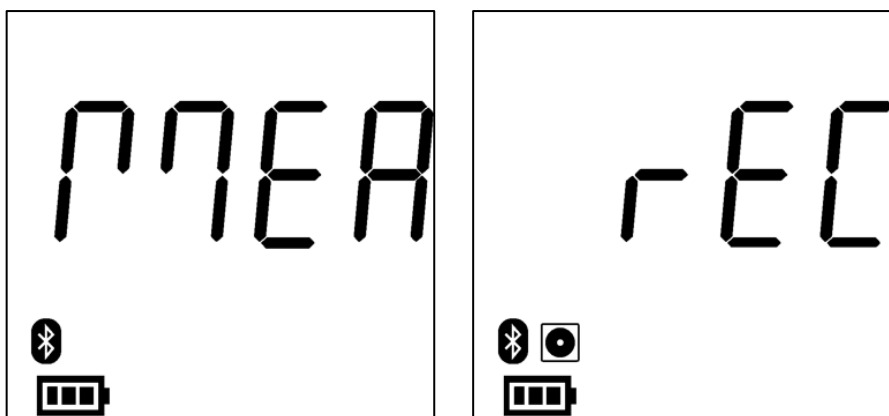
3.5 Bluetooth® Mode Functions

Activate the mode by setting the rotary switch to the  position. In this mode, the MD 9273 is controlled by Bluetooth® connected device, a Metrel® instrument or other application.

After switching to Bluetooth mode, the screen will show “bt Ini” and few seconds later “bt”. This means the MD 9273 is ready to be paired with control device. Follow the user manual of control device. When paired, the symbol  appears on the screen.



The paired device now controls the MD 9273. If a measuring function is set, message “MEA” appears on the screen. If a recording function is set, message “rEC” is presented.



Follow the user manual of the instrument to which the MD9273 is linked for details on supported test functions and their settings.

4 Technical Specifications

4.1 General specifications – Environment conditions

Measurement category clamp-meter	CAT III 600V
Measurement category test lead	CAT III 600V
Maximum current²	100 A
Pollution degree	2
Operation	Indoor
Altitude	< 2000 m
Operation temperature	0 °C – 40 °C (<80 % H.R., <10 °C without condensation)
Storage temperature	10 °C – 60 °C (<70 % H.R., extract batteries)
Temperature coefficient:	0.1 (of specified precision) / °C (<18 °C or >28 °C)
Functioning principle:	Sampling the signal at high speed
Data update on screen:	Twice a second
Screen:	3 3/4 + 3 digits LCD screen
Range selection:	Automatic and manual selection
Over-range indication:	-OL- is shown on the LCD screen, fast beep
Polarity indication:	“-“ is shown automatically
E.M.C.:	Emmission: Class B Immunity: Portable test and measurement equipment Meets EN 61326-1:2013, EN 61326-2-2:2013
Safety:	Meets EN 61010-1:2010, EN 61010-2-32:2012, EN 61010-2-033:2012, EN 61010-031:2015
Bluetooth®:	v3.0
Power supply:	3 V
Type of batteries:	2 x 1,5 V AA alkaline batteries
Consumption:	5 mA average, depending on function. 50 mA average in Bluetooth® mode
Duration of the batteries:	200 - 400 h (batteries 2000 mAh) 20 - 40 h (Bluetooth® mode)
Dimensions:	185 mm x 62 mm x 42 mm
Weight:	Approx. 210 g (without battery)

² This equipment cannot be exposed to currents above the limit

4.2 Measurement specifications

Current and voltage support automatic ranging within the same function.

TRMS current/voltage value

Function	Range	Resolution	Accuracy
mA, A	40 mA	0.01 mA	± 0.8 % of reading ± 3 digits
	400 mA	0.1 mA	± 0.8 % of reading ± 3 digits
	4 A	0.001 A	± 0.8 % of reading ± 3 digits
	40 A	0.01 A	± 1 % of reading ± 3 digits
	80 A	0.1 A	± 1.2 % of reading ± 3 digits
	100 A	0.1 A	± 5 % of reading
V	40 V	0.01 V	± 0.5 % of reading ± 4 digits
	400 V	0.1 V	± 0.5 % of reading ± 2 digits
	600 V	1 V	± 0.5 % of reading ± 2 digits
THD	0 ... 99.9 %	0.1 %	± 2 % of reading ± 3 digits
	100 ... 999 %	1 %	± 2 % of reading ± 3 digits

Note: the specifications are valid for waveforms with fundamental frequency between 45 Hz and 70 Hz and crest factor < 3.

DC voltage

V	40 V	0.01 V	± 0.5 % of reading ± 4 digits
	400 V	0.1 V	± 0.5 % of reading ± 2 digits
	600 V	1 V	± 0.5 % of reading ± 2 digits

Frequency

Hz	10 - 500 Hz	0.1 Hz	± 0.1 % ± 2 digits
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Note: The instrument is designed to measure power supply voltage and current signals in the range of 45 – 70 Hz and observes them as first harmonic. If the measured signal has frequency is greater than 70 Hz, the instrument will understand it as a higher harmonic.

Note: Frequency is measured at voltages higher than 15% of range or 0.3 V (whichever is higher). Manually change range to lower one if the instrument doesn't display the frequency while the signal is higher than 0.3 V.

Current Harmonics

N: harmonic component 2 ÷ 9th	
Measuring range	Accuracy
IhN < 10 % IRange	± 0.15 % × IRange ± 3 digits
10 % IRange < IhN < 100 % IRange	± 1.5 % × IhN ± 3 digits
N: harmonic component 10 ÷ 19th	
Measuring range	Accuracy
IhN < 10 % IRange	± 0.3 % × IRange ± 3 digits
10 % IRange < IhN < 100 % IRange	± 3 % × IhN ± 3 digits

IRange: Nominal clamp current (RMS)

IhN: measured current magnitude of Nth harmonic component

N: harmonic component

Note: current harmonics are measured at voltages higher than 10% of the range or 0.3 V, whichever is higher.

Note: if IRange is in the 100 A current range, the accuracy of the current harmonics is indicative.

Voltage Harmonics

N: harmonic component 2 ÷ 9th	
Measuring range:	Accuracy:
UhN < 3 % URange	± 0.1 % × URange ± 2 digits
3 % URange < UhN < 20 % URange	± 1 % × UhN ± 2 digits
N: harmonic component 10 ÷ 19th	
Measuring range:	Accuracy:
UhN < 3 % URange	± 0.2 % × URange ± 2 digits
3 % URange < UhN < 20 % URange	± 2 % × UhN ± 2 digits

URange: Voltage range (RMS)

UhN: measured voltage of Nth harmonic component

N: harmonic component

Crest Factor

Function	Range	Resolution	Accuracy
mA, A, V	1.00 ... 2.99	0.01	± 2 % of reading ± 2 digits
	3.00 ... 9.99	0.01	± 3 % of reading ± 5 digits

NOTE: minimum input signal amplitude is 2 V or 10 mA.

Peak Value

Function	Sampling time	Range	Resolution	Accuracy
mA, A	25 μ s	40 mA	0.01 mA	$\pm 5\%$ of reading ± 5 digits
		400 mA	0.1 mA	$\pm 5\%$ of reading ± 5 digits
		4 A	0.001 A	$\pm 5\%$ of reading ± 5 digits
		40 A	0.01 A	$\pm 5\%$ of reading ± 5 digits
		80 A	0.1 A	$\pm 5\%$ of reading ± 5 digits
		100 A	0.1 A	$\pm 5\%$ of reading ± 5 digits
V		40 V	0.01 V	$\pm 5\%$ of reading ± 5 digits
		400 V	0.1 V	$\pm 5\%$ of reading ± 5 digits
		600 V	1 V	$\pm 5\%$ of reading ± 5 digits

Inrush

Function	RMS cycle time calculation	Range	Resolution	Accuracy
mA, A	10ms (Half cycle)	40 mA	0.01 mA	$\pm 1.5\%$ of reading ± 3 digits
		400 mA	0.1 mA	$\pm 1.5\%$ of reading ± 3 digits
		4 A	0.001 A	$\pm 1.5\%$ of reading ± 3 digits
		40 A	0.01 A	$\pm 1.5\%$ of reading ± 3 digits
		80 A	0.1 A	$\pm 2\%$ of reading ± 3 digits
		100 A	0.1 A	$\pm 5\%$ of reading ± 3 digits
V		40 V	1 V	$\pm 1\%$ of reading ± 1 digits
		400 V	1 V	$\pm 1\%$ of reading ± 1 digits
		600 V	1 V	$\pm 1\%$ of reading ± 1 digits

VFD

Function	Range	Resolution	Accuracy
V	40 V	0.01 V	$\pm 2\%$ of reading ± 4 digits
	400 V	0.1 V	$\pm 2\%$ of reading ± 2 digits
	600 V	1 V	$\pm 2\%$ of reading ± 2 digits

Note: Specification is valid for PWM signals in the range of 1 kHz - 5 kHz and fundamental frequency in the range of 20 - 100 Hz.

Active power, reactive power and apparent power

Unit	Range	Resolution	Accuracy
W, VAr, VA	1.600	0.001	1 % ± 50 digits
	16.00	0.001	
	24.00	0.01	
	160.0	0.01	
	240.0	0.1	
	1600	1	
kW, kVAr, kVA	2.400	0.001	
	4.000	0.001	
	16.00	0.01	
	24.0	0.01	
	40.00	0.01	
	60.0	0.1	
PF	0.00 ... 1.00	0.01	± 5 digits
Phase °	-180.0 ... 180.0	0.1	± 30 digits

Note: One decimal place can be subtracted from the resolution following the rule:

- Value of S checked in counts (disregarding the decimal point).
- If it is above 2000 one decimal is subtracted from either P (where PF < 0.707) or Q (where PF > 0.707)
- If it is below the decimal places remain as in the table.

Note: Max display resolution is 4 digits. Specified resolution may vary if result of the S value is longer than 4 digits.

The P and Q value show the same number of decimal places as the S value.

5 Maintenance

This section provides basic maintenance information, including instructions for battery replacement. Do not try to repair or carry out maintenance tasks on your clamp-meter unless you are qualified for the same and have the corresponding information on maintenance, calibration and performance tests.

General maintenance


In order to avoid an electric shock or damage to the clamp, do not allow water to enter the body. Remove the test probes and all the input signals.

Clean the body periodically with a wet cloth and a non-aggressive detergent. Do not use abrasive or solvent products. Dust and humidity on the terminals can affect the readings.

To clean the terminals:

- Disconnect the clamp and remove the test leads.
- Clean the dust from the input terminals.
- Wet a clean cloth with a cleaning and greasing product.
- Clean both terminals. The greasing product insulates the terminals from contamination related to humidity.

Changing the batteries

In order to avoid incorrect measurements that can cause an electric shock or personal injury, change the batteries as soon as the  symbol starts blinking. Before changing the battery, disconnect all test leads and disconnect the clamp-meter from all power sources.

To change the battery:

- Move the rotary switch to the OFF position.
- Disconnect the test probes and/or all the connectors of the input.
- Use a screwdriver to remove the screw from the battery cover on the back of the instrument.
- Remove the used battery cells and replace them with new ones.
- Return the cover and screw it down.

Replacing test leads

Metrel suggests using either original test leads or standard 4mm banana test leads with plastic shielding around the contacts. The shield both ensures the user safety and adds stability to the terminal to prolong its life expectancy.

6 LIMITED WARRANTY

METREL warrants to the original product purchaser that each product it manufactures will be free from defects in material and workmanship under normal use and service within a period of one year from the date of purchase. METREL's warranty does not apply to accessories, fuses, fusible resistors, spark gaps, batteries or any product which, in METREL's opinion, has been misused, altered, neglected, or damaged by accident or abnormal conditions of operation or handling.

To obtain warranty service, contact your supplier or send the product, with proof of purchase and description of the fault, postage and insurance prepaid, to your local Metrel distributor. METREL assumes no risk for damage in transit. METREL will, at its option, repair or replace the defective product free of charge. However, if METREL determines that the failure was caused by misuse, unauthorised alteration, neglect, or damaged by accident or abnormal operation or handling, you will be billed for the repair. The cost of logistics shall be carried by the owner of the products.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE. METREL WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.



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Appendix A MD 9273 as an Adapter of Master Instrument

MD 9273 can be used as an adapter connected via Bluetooth® communication with Metrel Master Instrument in manner to expand it Power quality test ability. Supported test measurements and signal recordings are:

- P- Power Test
- U – Voltage test
- I – Current Test
- I_{max} – Inrush Test
- h_n – Voltage Harmonics
- h_n – Current Harmonics
- E – Events
- LOG – U, I, P, E Logger

Required Test is selected from Master Instrument. MD 9273 acquires test signals, processes measurements and sends results to the Master Instrument. For Specifications refer to MD 9273 Manual, Technical specifications section.

Master Instrument presents Test results on the screen. After test is finished, results can be saved to the Workspace memory for later use, as described in Master Instrument Manual.

A.1 Establishing Bluetooth® Communication

MD 9273 must be paired with Master Instrument, when used as an adapter. Pairing procedure is executed from Master Instrument.

Procedure:

1. **MD 9273:** switch it ON and select BT mode with Rotary Function switch.
2. **Master Instrument:** Open General Settings / Settings menu and navigate to the Adapters section menu, see *Figure A.1: Adapters setting menu*.

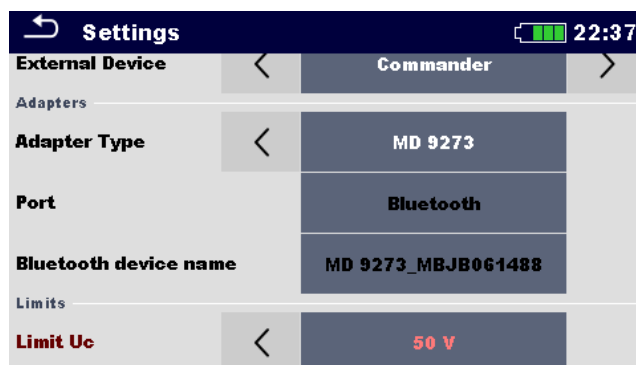



Figure A.1: Adapters setting menu

3. **Adapter type:** select MD9273 by using left / right arrows or tap on the field and select it from the list of adapters

4. **Port:** Bluetooth is automatically offered.
5. **Bluetooth device name:** select field and instrument start searching for Bluetooth devices; when finished, list of available devices is presented on the screen
6. **Select your MD 9273 from the list.** It is always presented in the format MD 9273_serial_number. Pairing procedure is now finished.

When MD 9273 adapter supported test is selected on Master Instrument, active BT communication is indicated with sign  on the right – top of the screen. If communication is not active, BT sign is crossed with red line and Error warning message is presented, see *Figure A.2* below.

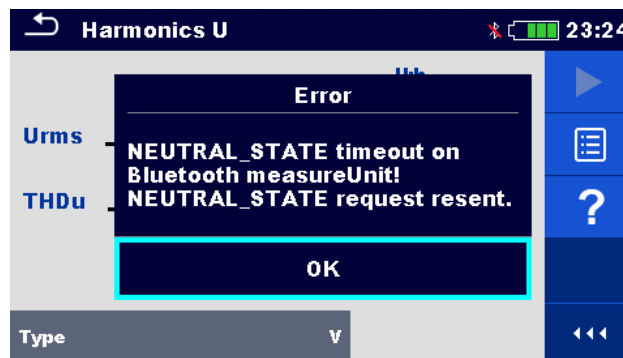


Figure A.2: Master Instrument Bluetooth communication error message

NOTE:

Pairing between same Metrel Master Instrument and same MD 9273 is necessary only when MD 9273 is first time used as a test adapter. If communication is not established, MD 9273 is probably switched OFF or Bluetooth link is out of range.

A.2 Managing Tests with MD 9273 Adapter

When used as an Adapter, MD 9273 supported tests are managed in the same manner as Master Instrument originate tests. They can be found under CLAMP group of Master instrument Single test Main menu, see figure *Figure A.3*.

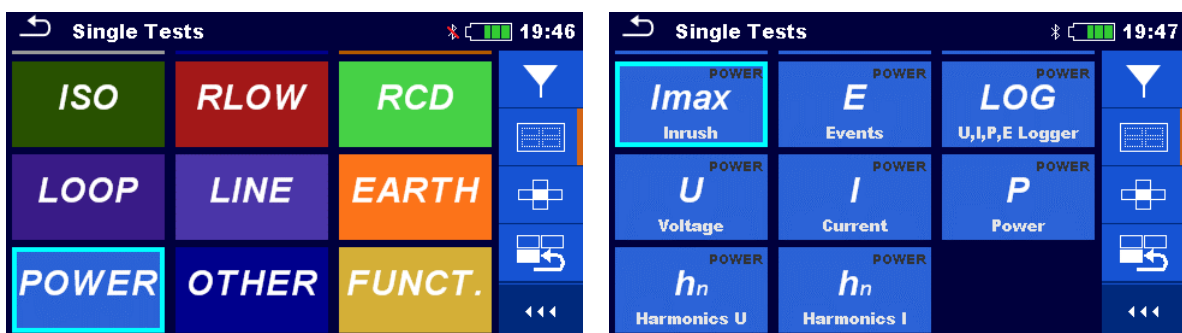



Figure A.3: Master instrument Test selection screens: Group selection (left) and Single Test selection on the right.

Refer to Master instrument Manual to learn how to:

- Select single test
- Single test screen organization
- Setting parameters and limits
- Commands to start the single test and save the results
- Editing graphs of recordings
- Use Master instrument Workspace manager and Memory organizer

NOTE:

Look for the Voltage monitor  at the bottom right of the Single test screen to distinguish between MD 9273 Adapter tests and Master instrument-originated tests. When the Master instrument tests are selected the voltage monitor is always present. When adapter tests are selected, it is omitted.

A.3 Single Tests with MD 9273 Adapter

This section describes the intended measurements and recordings supported by MD 9273 when used as a test adapter. The set of tests may differ for different Metrel Master instrument.

Appendix B P – Online power measurement

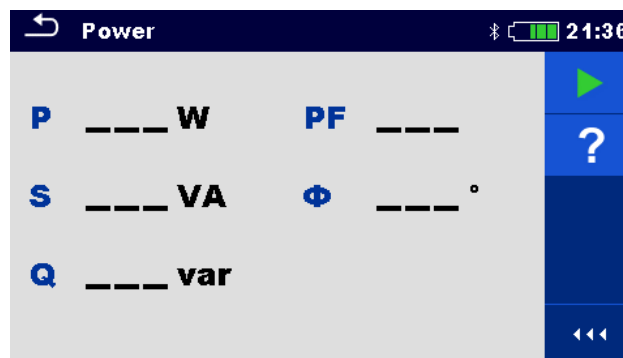


Figure B.4: Power test menu

Measurement parameters

There are no parameters to be set.

Connection diagram

Use **Power test** connection scheme from MD 9273 Manual.

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Power** function and wait for active Bluetooth® communication sign.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).



Figure B.5: Power test results

Measurement results / sub-results

P	Active power
S	Apparent power
Q	Reactive power (capacitive or inductive)
PF	Power factor (capacitive or inductive)
Φ	Phase displacement between voltage and current in degrees

NOTE:

Voltage test terminals connection and current flow toward load should be considered; the red voltage terminal should be connected to the Line terminal and the jaw should be correctly oriented to obtain positive sign of Power test result. If Power test result has negative sign, connection of the voltage terminal or jaw orientation are reversed. The result of phase displacement angle has opposite sign as well. Consequently, load character determination (capacitive or inductive) is switched.

Appendix C U – Online voltage measurement

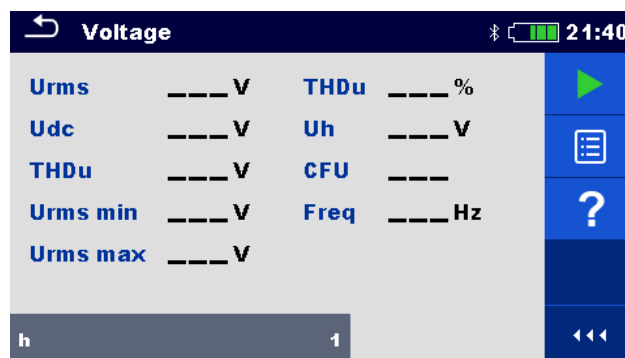


Figure C.6: Voltage test menu

Measurement parameters

h	Harmonic setup [1 to 19, 1 st is fundamental frequency]
----------	--

Connection diagram

Use **Voltage** test connection scheme from MD 9273 Manual.

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Voltage** function and wait for active Bluetooth® communication sign.
- Set test parameter.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

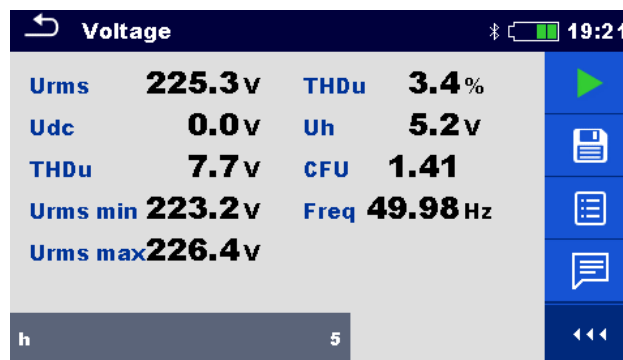


Figure C.7: Voltage test results

Measurement results / sub-results

Urms	Effective voltage value – last obtained result.
Urms min	Minimum effective voltage value during measurement time duration.
Urms max	Maximum effective voltage value during measurement time duration.
Udc	DC voltage value.
THDu [V]	Effective voltage value of all harmonics.
THDu [%]	Total harmonic distortion.
Uh	Effective voltage value of set harmonic (5 th on Figure C.7: Voltage test results).
CFU	Voltage Crest factor – peak voltage to effective voltage ratio.
Freq	Fundamental frequency.

Appendix D I – Online current measurement

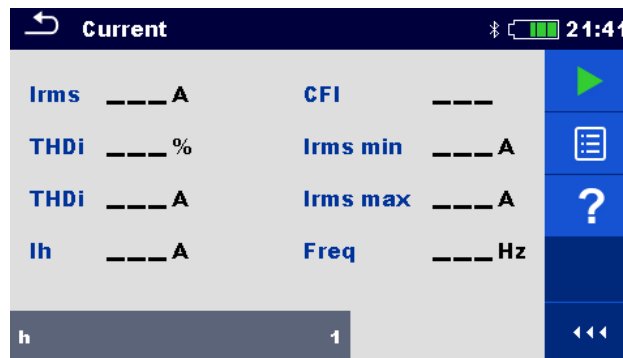


Figure D.8: Current test menu

Measurement parameters

h	Harmonic setup [1 to 19, 1 st is fundamental frequency]
----------	--

Connection diagram

Use **Current** test connection scheme from MD 9273 Manual.

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the **Current** function and wait for active Bluetooth® communication sign.
- Set test parameter.
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

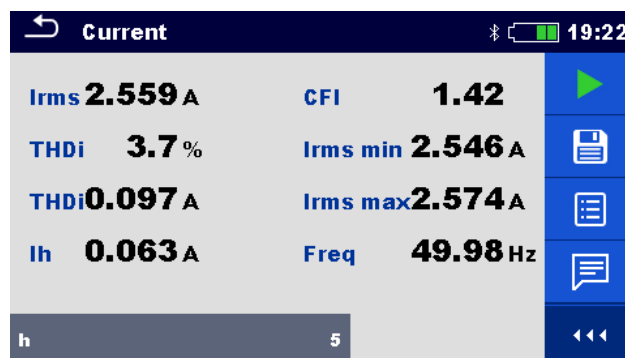


Figure D.9: Current test results


Measurement results / sub-results


Irms	Effective current value – last obtained result
Irms min	Minimum effective current value during measurement time duration
Irms max	Maximum effective current value during measurement time duration
THDi [A]	Effective current value of all harmonics

THDi [%]	Total harmonic distortion
I_h	Effective current value of set harmonic (5 th on Figure C.7: Voltage test results Figure D.9)
CFI	Current Crest factor – peak current to effective current ratio
Freq	Fundamental frequency

Appendix E I_{max} – Inrush Current Recording

Inrush current function records current and voltage transients that occur when load is turned on. Recorded values display on the screen of the master instrument in separate charts. MD 9273 voltage input should be connected to supply circuit so that voltage dip threshold trigger event is effective. MD 9273 calculates the minimum circuit effective voltage during recorded transient. Only one trigger event can be active at the same time, Inrush current or Voltage dip threshold; when one is set, the other is switched off automatically.

After Inrush recording is started, MD 9273 starts monitoring signals and waiting for trigger event to occur, which is symbolised with sign  on the bottom right of the screen. Displayed chart is divided in Pre-trigger area, presenting 1 second of total set chart duration time, and transient event area – rest of the chart duration time.

Trigger event occurs automatically when one of the recorder signals achieves set threshold level, or it can be initiated manually by tapping on the  icon within command menu on the right of the screen, see right figure of the Figure E.10.

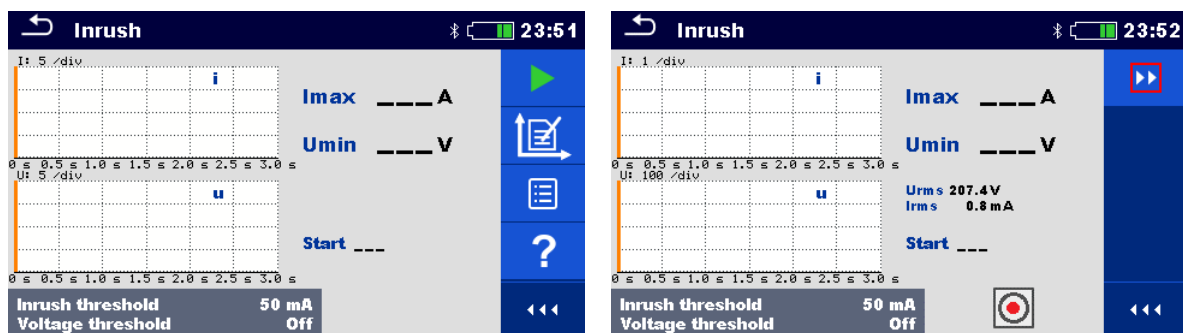


Figure E.10: Inrush current menu – setup on the left, waiting for trigger on the right

Test parameters

Inrush threshold	Inrush current threshold setting [Off, 5mA to 90A]
Voltage threshold	Voltage dip threshold setting [Off, 50V to 500v]
Duration	Recording duration [3s, 10s]

Connection diagram

Use Power test connection scheme from MD 9273 Manual.

Test procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the Inrush function and wait for active Bluetooth® communication sign.
- Set test parameters.
- Set charts Y value range within expected values (optional; could be set later).
- Start the test.
- Initiate set threshold event or manually trigger test recording.
- Save results (optional) after test is finished and results and recorded charts are presented on the screen.

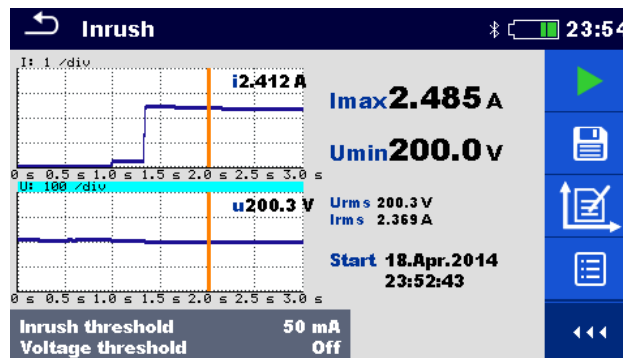


Figure E.11: Inrush test results

Test results / sub-results

I	Inrush current chart with value at red vertical line*.
U	Circuit voltage chart with value at red vertical line*.
I_{max}	Inrush current maximum value.
U_{min}	Circuit voltage dip minimum value.
U_{rms}	Circuit effective voltage – steady state.
I_{rms}	Circuit effective current – steady state.
Start	Inrush test start time from Master Instrument.

* tap on chart area or drag red vertical line to present chart value at chosen time

Appendix F h_n – Voltage harmonics test

Harmonics (1 through to 19) are measured and displayed in the chart as an absolute magnitude of the signal or as a percentage of the fundamental frequency amplitude (the 1st harmonic h_1). Absolute magnitude or percent value display is chosen by parameter setting.

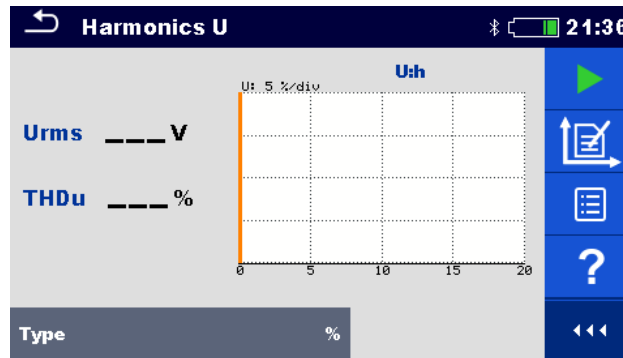


Figure F.12: Harmonics U test menu

Measurement parameters

Type	%	harmonics and distortion are displayed as relative value
	V	harmonics and distortion are displayed as absolute value

Connection diagram

Use **Voltage** test connection scheme from MD 9273 Manual.

Measurement procedure

- Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- Enter the Harmonics U function and wait for active Bluetooth® communication.
- Set Type parameter for display values of harmonics.
- Set charts Y value range within expected values (optional; could be set later).
- Start the continuous measurement.
- Stop the measurement.
- Save results (optional).

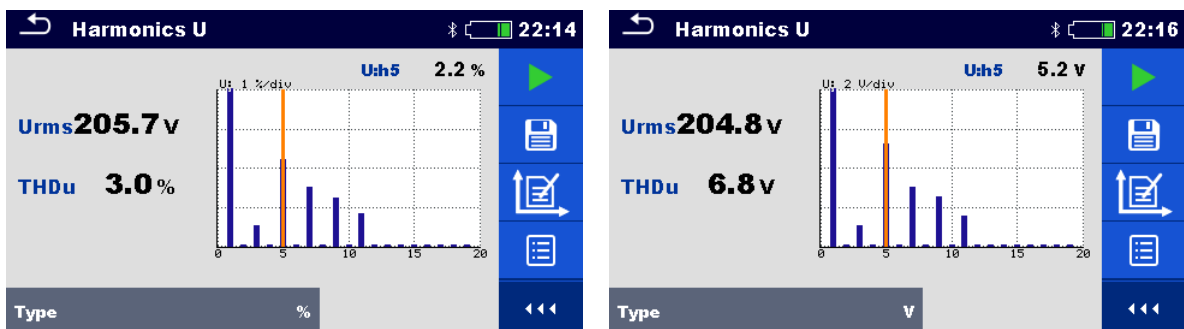


Figure F.13: Harmonics U test result

Measurement results / sub-results

U	Harmonics chart.
Urms	Effective voltage value.
THDu [%]	Total harmonic distortion.
THDu [V]	Absolute voltage of higher harmonics.
U:h5 [%]	Relative value of 5 th harmonic*.
U:h5 [V]	Absolute voltage of 5 th harmonic*.

*Tap on chart at chosen harmonic to present it value

Appendix G h_n – Current harmonics test

Harmonics (1 through to 19) are measured and displayed in the chart as an absolute magnitude of the signal or as a percentage of the signal value at the fundamental frequency (the 1st harmonic h₁). Absolute magnitude or percent value display is chosen by parameter setting.

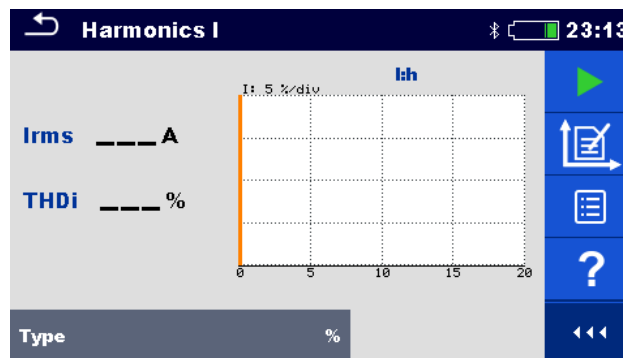


Figure G.14: Harmonics I test menu

Measurement parameters

Type	%	harmonics and distortion are displayed as relative value
	A	harmonics and distortion are displayed as absolute value

Connection diagram

Use **Current** test connection scheme from MD 9273 Manual.

Measurement procedure

- › Connect MD 9273 to the item to be tested and set Bluetooth® mode.
- › Enter the Harmonics I function and wait for active Bluetooth® communication.
- › Set Type parameter for display values of harmonics.
- › Set charts Y value range within expected values (optional; could be set later).
- › Start the continuous measurement.
- › Stop the measurement.

- › Save results (optional).

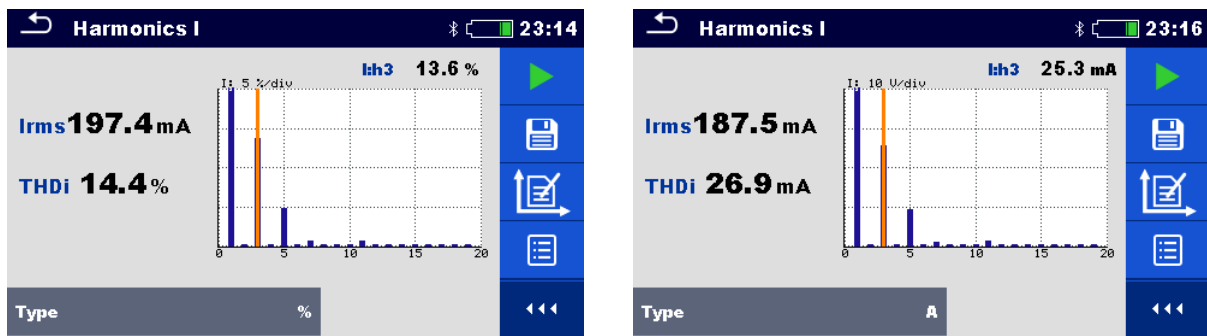


Figure G.15: Harmonics U test results

Measurement results / sub-results

I	Harmonics chart
Irms	Effective current value
THDi [%]	Total harmonic distortion
THDi [A]	Absolute current value of higher harmonics
I:h3 [%]	Relative value of 3 rd harmonic*
I:h3 [A]	Absolute current value of 3 rd harmonic*

*Tap on chart at chosen harmonic to present it value

Appendix H E – Events

Test is not supported yet.

Appendix I LOG – U, I, P, E Logger

Test is not supported yet.



Elma Instruments A/S
Ryttermarken 2
DK-3520 Farum
T: +45 7022 1000
F: +45 7022 1001
info@elma.dk
www.elma.dk

Elma Instruments AS
Garver Ytteborgsvei 83
N-0977 Oslo
T: +47 22 10 42 70
F: +47 22 21 62 00
firma@elma-instruments.no
www.elma-instruments.no

Elma Instruments AB
Pepparvägen 27
S-123 56 Farsta
T: +46 (0)8-447 57 70
F: +46 (0)8-447 57 79
info@elma-instruments.se
www.elma-instruments.se