



MDtest

User's Manual

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1 Introduction

1.1 Safety



WARNING

Read this User's Manual carefully and completely and follow all instructions contained therein. If not, the use of the instrument may be dangerous for the operator, devices under test or for the instrument!

If there is reason to believe that safe operation has become impossible, put the instrument out of operation and secure it against any unintended operation. Safe operation must be presumed to be no longer possible, if:



- The instrument does not operate properly any longer.
- The instrument, cables, connectors, plugs or accessories exhibits visible damages.
- The instrument was stored in unfavourable conditions for a long period.
- The instrument was exposed to extraordinary stress caused by transport.

WARNING



- Make sure that the instrument, measuring cables and all other accessories are in flawless condition, e.g. no damaged insulation, no broken cables or plugs etc.
- Make sure that the AC outlet is easily accessible. If some trouble or malfunction occurs, immediately disconnect the MDtest adaptor from the outlet.
- If the equipment is used in a manner not specified by the manufacturer, the device's protection may be compromised.
- The instrument may only be powered from a 230 V / 50 or 60 Hz grounded mains outlet, which is protected with a fuse or circuit breaker with a maximum rating of 16 A.
- In order to check the proper PE connection to a mains outlet, MDtest generates a continuous current of ca. 1.5 mA / 50 or 60 Hz to the PE conductor. This test current can activate the insulation monitoring device in IT systems.
- Only a trained, skilled person, who is familiar with hazardous voltage operations, can handle the MDtest. Unexpected hazardous voltages can occur on devices under test (dangerously charged capacitors, etc.).

The MDtest is designed to perform electrical safety testing based on:

- IEC 62353:2014
- IEC 60601-1 (only some tests)

1.4 Terms and definitions

Accessible conductive part

The part of the ME equipment (other than the applied part), which is accessible to the patient, to the operator in contact with the patient or can come in contact with the patient.

Applied part

The part of the ME equipment that (in normal use) necessarily comes into physical contact with the patient for ME equipment or an ME system to perform its function.

Mains part

The part of electrical equipment forming a circuit that is intended to be connected to the supply mains.

Another terms and definitions – see IEC 62353:2014

ID number (ID)

Unique ID number for the DUT.



Hazardous voltage.



Warning concerning a point of danger! Read User's Manual and observe all precautions!



Hint, notice.

2 Description of the instrument

2.1 General description

The MDtest instrument is designed to verify the safety of electrical appliances and medical devices in general. All AC measurements are measured by the method TRMS (true rms), and for some measurements the absolute value of the DC component can be displayed. Measured circuits meet the requirements of EN 60601 and EN 62353 (requirements for measuring circuits), including the required input characteristics.

The MDtest performs the following tests:

- Earth bond test >1 A AC
- Insulation resistance test 500 V DC and 250 V DC
- Alternative (substitute) equipment and applied part leakage current
- Direct equipment and applied part leakage current
- Differential leakage current
- Ground (Earth) leakage current
- Chassis (Enclosure) leakage current
- Lead to Ground (Patient) leakage current
- Lead isolation (Mains on applied parts leakage current)
- PE current during operation and differential leakage current
- Apparent power, mains voltage and current consumption

With additional equipment can be measured:

- measurement of PE current during operation and differential leakage current of three-phase portable appliance by means of optional adapters
- measurement of apparent power and current consumption by means of current clamp

The MDtest has furthermore additional features, which improve the safety of both the operator and the DUT. These include:

- check for dangerous contact voltage on the PE of power outlet (before the start of the measurement)
- check if the PE of the power outlet is grounded (before the start of the measurement)
- automatic check for leakage current amplitude of the device under test
- check of the appliance's current with automatic switch off the Test Socket **1**:
 - 0 ÷ 12 A max. 25 min
 - 12 ÷ 16 A max. 60 sec
- manual self-test

Features and highlights:

- test results can be saved under an ID number which is unequivocally assigned to the respective DUT (barcode, RFID chip)
- the test structures created at the PC software can be loaded into the MDtest
- measurement data saved to the test instrument can be imported to PC software via the USB port and reports can be generated
- user-defined test sequences created at the PC software
- user-defined report templates created at the PC software

2.2 Terminals

1. Test Socket for connection of tested appliance's power supply cord
2. **PE** – terminal for connecting the exposed conductive part of the tested appliance (the terminal is connected to the PE terminal of Test Socket **1**)
3. **ITOUCH 2k Ω** – touch leakage current test terminal
4. **RISO / IALT** – insulation resistance / alternative leakage current test terminal
5. **PAT** – terminal for connecting the patient parts of tested appliance
6. **RPE** – earth bond test terminal
7. **PEMAINS** – terminal connected with PE of mains
8. USB - socket type A for connection USB 2.0 Full Speed HID (Human Interface Device), e.g. barcode scanner
9. USB – socket type B, PC connection
10. EXT input - current clamp / three-phase adapter / other adapters connector
11. Power supply cord



WARNING

- Do not connect any external voltage to any terminal or connector. The only exception is the power supply cord **11** which is intended for powering the MDtest from the 230 V / 50 or 60 Hz mains outlet.
- Max. load on Test Socket **1** is 16 A (limited in time).
- Use original accessories only.
- Do not connect any external voltage between RPE terminal and the PE in Test Socket **1** or PE terminal.

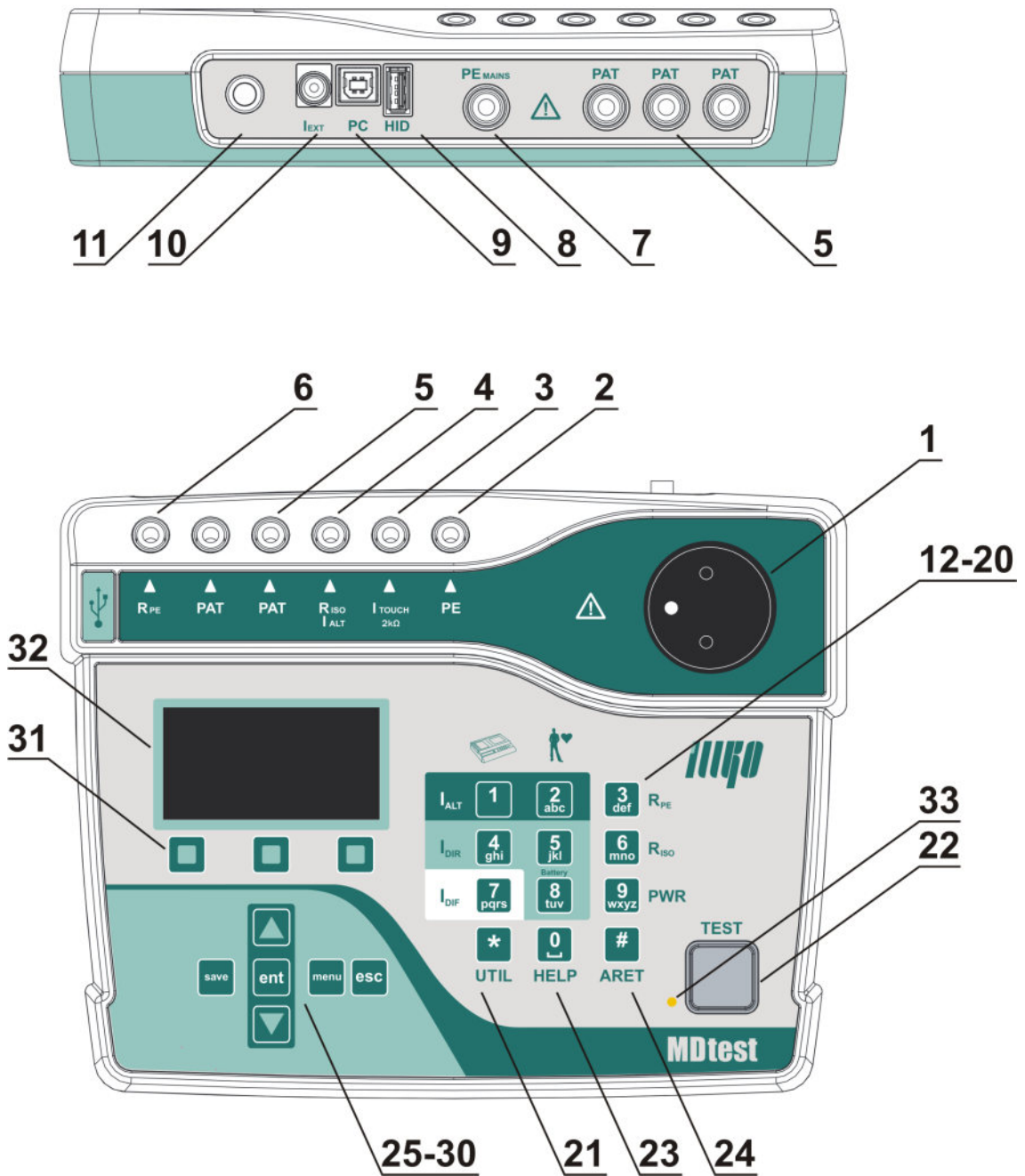


Figure 1: Front panel and rear panel

2.3 Keyboard

12. [**1 IALT**] – Alternative leakage current of the device
13. [**2 IALT**] – Alternative leakage current of the patient parts
14. [**3 RPE**] – Earth bond test
15. [**4 IDIR**] – Direct leakage current of the accessible part
16. [**5 IDIR**] – Direct leakage current of the patient part
17. [**6 RISO**] – Insulation resistance, selection of test voltage 500 V / 250 V DC
18. [**7 IDIF**] – Differential leakage current of the accessible part
19. [**8 IDIR Battery**] – Leakage current of the patient part, battery powered device
20. [**9 Power**] – Apparent power consumption, current, mains voltage
21. [*** UTIL**] – Leakage current according to EN 60601-1:
 - Leakage current of instrument part
 - Touch leakage current of instrument part
 - Leakage current of the patient part
 - Leakage current of the patient part using the MAP method (mains on applied parts)
22. [**TEST**] – Starts measurement

2.4 Additional functions

23. [**0 HELP**] – display the circuit diagram for selected measurement
24. [**# ARET**] – lock the TEST key
25. [**▲**] – scroll up
26. [**▼**] – scroll down, hold displayed data
27. [**save**] – save measured values
28. [**menu**] – main menu
29. [**ent**] – ENTER, find DUT according to ID, other functions depending on context
30. [**esc**] – ESCAPE, other functions depending on context
31. Context menu buttons - actual function is displayed above the button

2.5 Display of information

32. Graphic OLED display
33. LED indicator for measuring status

2.6 Graphic OLED display

- a) Measured function
- b) Real time clock / Measuring is in progress
- c) Selected method and ID of DUT
- d) Measured value
- e) Actual function of context button (31)
- f) Warning, notice, additional information

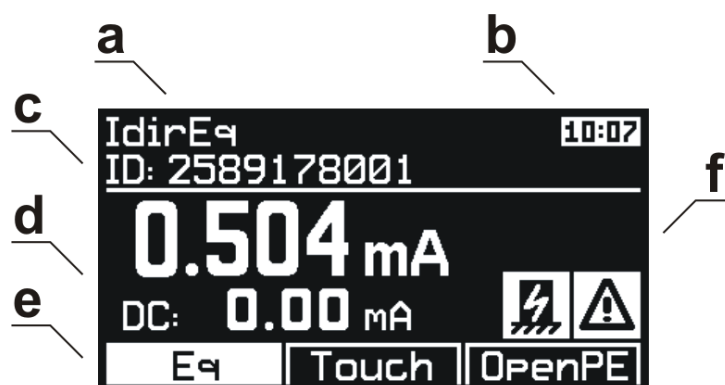


Figure 2: Graphic OLED display

2.7 Selection of the items in Menu or List





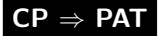
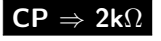



















The item is selected using buttons:

[▲] and [▼]

Faster scroll in the lists:

[Page-] and [Page+]

2.8 Users interface symbols

	lock the TEST key
	automatic lock the TEST key
	displayed value is held
	L-N reversal in Test Socket 1
	plug the test lead into the PAT terminal
	plug the test lead into the ITOUCH 2kΩ terminal
	unplug / do not plug patient parts
	test sequence is active
	test lead resistance compensation is finished
	the value of compensation is higher than measured value
	press button [esc]
	press button [TEST]
	the selection is active, self-test passed
	the selection is not active, self-test failed
	measuring is in progress
	warning – Test Socket 1 energizing
	plug external accessories
	inner temperature is increasing when measuring PE resistance
	notice - DUT must be isolated from ground
	test voltage 500 V DC
	test voltage 250 V DC
	menu Properties of DUT
	menu Test sequences
	menu Empty file of DUT
	menu Setup

2.9 Abbreviations

L	phase conductor
N	neutral conductor
PE	protect earth conductor
ALT	alternative (substitute) method
DIF	differential method
DIR	direct method
60601Earth	protect conductor current – direct method (EN 60601-1)
60601Touch	touch current – direct method (EN 60601-1)
60601Pat	patient leakage current – direct method (EN 60601-1)
60601MAP	patient leakage current Mains on applied part – direct method (EN 60601-1)
Eq	equipment
R	L-N reversal
Ext	external
Touch	touch
Pat	patient
B	battery
M	mains part
CP	conductive part
AP	applied part
MD	measuring device
FE	functional earth
Mains	mains voltage supply
DUT	device under test
DUT PE	device under test protective earth
Open PE	open protective earth
Open N	open neutral
socket	connection: Test Socket 1
RPE	connection: terminal RPE (Note: also applies to the other terminals)

2.10 Included in the set

The set includes all accessories necessary for testing 230 V / 50 or 60 Hz appliances equipped with a movable power supply cord.

The set includes:

- The measuring instrument MDtest
- **P 2011** - Test lead, black, 2 m
- **P 3011** - Test tip black
- USB cable A-B
- CD (User's Manual + SW for PC)
- User's Manual
- Calibration certificate
- Warranty card

2.11 Optional accessories

Carrying bag:

- **P 6140** - Bag for instrument and some accessories

Measuring cables and adapters:

- **P 2012** - Test lead, blue, 2 m
- **P 2020** - Test lead, black, 5 m
- **P 2030** - Test lead - connects up to 10 patient parts to MDtest
- **P 3012** - Test tip, blue
- **P 3031** - Test tip (2 mm), black
- **P 4011** - Crocodile clip, black
- **P 4012** - Crocodile clip, blue
- **P 8030** - Adapter for testing extension power supply cords

Special accessories:

- **P 8010** - Current clamp transformer
- **P 8015** - Three-phase adapter, 16 A socket, 5 contacts
- **P 8016** - Three-phase adapter, 16 A socket, 4 contacts
- **P 8017** - Three-phase adapter, 32 A socket, 5 contacts
- **P 8018** - Three-phase adapter, 32 A socket, 4 contacts
- **P 9010** - Wireless barcode scanner (CCD) BT/USB 2.0 Full Speed

3 Putting into operation

3.1 Connecting to mains outlet



If the mains outlet, mains cable, instrument's case or accessories are damaged, do not connect the MDtest to the mains outlet!

If Idir and Idif is being measured, use the grounded mains outlet only to supply the instrument!

The MDtest can only be powered from 230 V / 50 or 60 Hz, which is protected with a fuse or circuit breaker with a maximum rating of 16 A. The instrument is automatically switched on after plugging into the mains outlet. Disconnect any DUT while connecting/disconnecting the MDtest to/from the mains outlet!



The MDtest automatically tests the protective PE (ground) pin of the mains outlet. If the PE connection is inadequate, then the message **(PE error)** is displayed.

In order to check the proper PE connection to a mains outlet, the MDtest generates a continuous current of ca. 1.5 mA / 50 or 60 Hz to the PE conductor. This test current can activate the insulation monitoring device in IT systems.

If the MDtest is connected to an IT earthing system, it is possible to measure – e.g. Rpe, Riso, Ialt and IdirPatB.

If dangerous contact voltage arises on the PE, then the **(PE error)** indicator lights up when the operator presses the key [TEST]. If operator presses the [TEST] key after this, the measurement will not start.



WARNING

If the test result for the ground pin of the mains outlet is unsatisfactory (in TT or TN systems), the outlet must be repaired before you plug in the MDtest to the outlet again!

3.2 Self-test

It can sometimes be difficult to identify if the measuring instrument does not work properly, especially when measuring current leakage. The MDtest therefore has built in the possibility to promptly test the basic functionality. The functionality of the following functions can be tested:

- Insulation resistance
- Measurement of alternative (substitute) leakage current
- Measurement of PE current during operation
- Measurement of differential leakage current



WARNING

- Disconnect DUT before the MDtest self-test!
- This test does not substitute for calibration!
- The MDtest has to be connected to TT or TN mains.

The test result is displayed on the display using the symbols pass / fail. Test proceeds as follows:

- Disconnect the DUT.
- Press the [**menu**] key and release it.
- Use the [**▼**] key to select (**Setup**), press the [**ent**] key for confirmation.
- Use the [**▼**] key to select (**Self-test**), press the [**ent**] key for confirmation.
- Press the [**TEST**] button. The test will then start; after it is finished, the results are displayed: ✓ (self-test passed) or ✗ (self-test failed).
- The correct values are:
 - RisoM-PE: $2.000 \pm 0.050 \text{ M}\Omega$
 - IaltEq: $0.100 \pm 0.010 \text{ mA}$
 - IdirEq: $0.100 \pm 0.010 \text{ mA}$
 - IdifEq: $0.100 \pm 0.010 \text{ mA}$

Contact service if the test results differ from the ones described above.

3.3 Help screens

The help screens are available in all functions. The Help screens contain schematic diagrams for illustrating how to properly connect the instrument for electric installation, applied standards and the number of a picture according to the standard. After selecting the measurement you want to perform, press the [**0 HELP**] (once or repetitively) key in order to see the associated Help screens. Press the [**0 HELP**] or [**esc**] to leave the Help.

4 Measurements

4.1 Selection of the function

The measured function can be selected automatically in sequence mode (see chapter 5.6) or manually (see Figure 3).

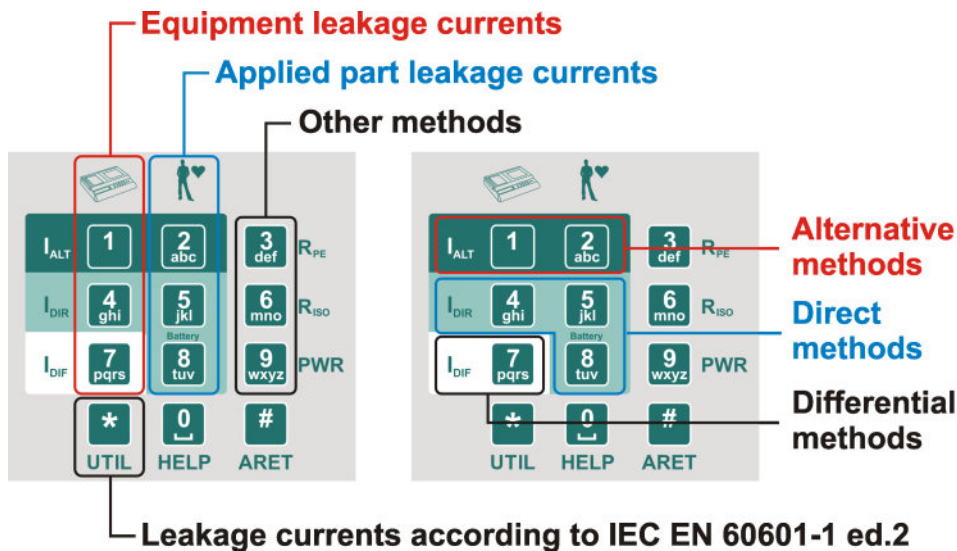


Figure 3: Keyboard

4.2 Measurement mode control

The beginning, process and ending of measurements are controlled by the [TEST] key. If the [esc] key was pressed during the measurement, then it will be cancelled (the measured value is not saved).

4.2.1 Measurement mode

The measurement can start in four different measurement modes:

- *One measuring cycle* – after the [TEST] key is pressed and released, one measuring cycle starts and is completed after a few seconds. The result of the measurement is displayed.
- *Continuous measurement* – press the [TEST] key; measurement is in progress and current measured values are displayed until the [TEST] key is released. The result of the measurement is displayed.
- *Locking the measurement* - press the [# ARET] key and then press the [TEST] key. Then release both keys. The measurement is in progress and the current measured values are displayed until the [TEST] key is again pressed and released. Reverse steps are possible too: press the [TEST] key and then press the the [# ARET] key.

- *Automatically locking the measurement* – this function can be set in the menu Setup. Measuring is similar to Locking the measurements but the [# **ARET**] key is not used.

Measuring in process is indicated by the symbol .

4.2.2 HOLD function

When measurement is in progress, the current measured values are displayed. By pressing and releasing the [▼] key the last measured value is displayed even if the measurement has either ended or is in progress. This measured value is stored in temporary memory.

The HOLD function is indicated when the symbol **HOLD** on indicator changes to unremitting light. The HOLD function can be cancelled (when measurement is still in progress) by pressing and releasing the [▼] key.

4.2.3 Measurement of apparent power consumption

During some measurements, the apparent consumption is displayed in the upper display.

4.3 Earth bond - Rpe

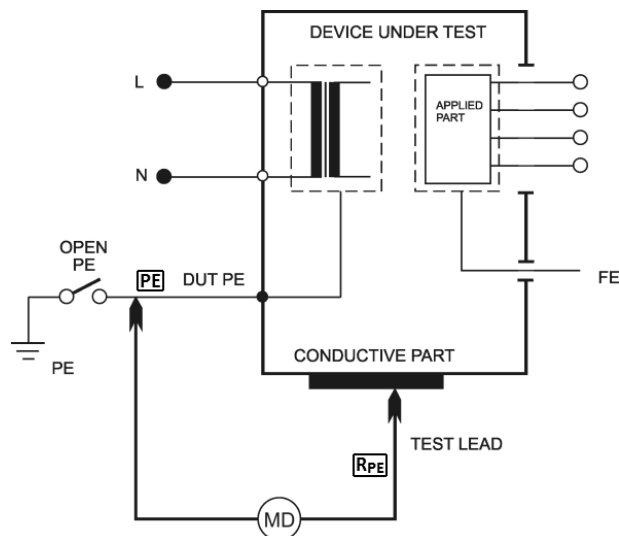


Figure 4: Rpe measurement

WARNING




- Do not connect any external voltage between the RPE terminal and the PE in Test Socket 1 or PE terminal.
- If you are going to test equipment which can be charged to voltage >25 V (e.g. filter capacitors), discharge it before the test!

If external voltage is present on the device under test, the message **(Interference voltage at the input)** is displayed. This status is a dangerous fault condition; disconnect the DUT from the MDtest immediately to avoid damage!



Resistance measurement is also possible if the MDtest is connected to the IT mains.

We recommend performing the measurements for a max. of 30 secs. because of power dissipation inside the instrument (only for value <math><10.00 \Omega</math>). If the temperature inside exceeds the allowed limit, the

symbol  is displayed and the acoustic signal sounds.

4.3.1 Test lead resistance compensation



Compensation means that the test lead resistance is measured and then automatically memorized and subtracted from all Rpe measurements. The real earth bond resistance is thus displayed. The compensation constant remains in the instrument's memory even if the instrument is switched off. Therefore, the lead compensation is valid until a new compensation is carried out.

Procedure:

- Press the [**3 RPE**] key and release it.
- Plug the test lead with the test tip into the **RPE** terminal.
- Plug the test tip of the test lead either into the **PE** terminal or press it against the ground pin of the Test Socket **1**. If you use two test leads (which are connected to the **PE** terminal and the **RPE** terminal), then make a short-circuit of their test tips.
- Press the [**TEST**] key and release it.
- Press the [**Cal**] key and release it. The measured value is saved.

The compensation is effective for test lead resistance $<2.00 \Omega$. If the test lead resistance is $>10.00 \Omega$ and the compensation procedure has been carried out, compensation is cancelled and all the following displayed results are the sum of the earth bond + test lead resistance. The **CAL** symbol is not displayed.

If compensation is active (it means that test lead resistance $<2.00 \Omega$ was memorized), then the **CAL** symbol is displayed during Rpe measurements.

If the measured value is less than the saved compensation value during measurement (after subtraction, the memorized resistance will result in a negative number), the display shows the absolute value and the **CAL** symbol appears inversely. The cause may be replacing test leads for shorter ones with less resistance. In this case, it is necessary to re-compensate the test leads resistance.

4.3.2 Protective earth resistance

Procedure:

- Press the [**3 RPE**] key and release it.
- Plug the test lead with the test tip into the **RPE** terminal.
- Connect the tested appliance:
 - One-phase appliance with a movable power supply cord – plug in its mains plug to Test Socket **1**.
 - Three-phase appliance with a movable power supply cord – connect the PE pin of its plug to the instrument's **PE** terminal by means of the optional test lead + crocodile clip.
 - Hard-wired appliance – **firstly disconnect the appliance from the mains!** Connect its point of PE connection to the instrument's PE terminal by means of the optional test lead + crocodile clip.

- Press the test tip against the exposed conductive part of the tested appliance.
- Press the [TEST] key. If the [CAL] indicator lights up during measurement, it means that the test lead resistance is compensated.
- After finishing the measurement, the last measured value is displayed.



The lowest measured value can be displayed - press the [3 RPE] key during the measuring. The current and the lowest value are displayed now. When the measurement is finished, only the lowest value is displayed. To deactivate the function, press the [3 RPE] key again.



WARNING

If only $>10.00 \Omega$ is displayed it means that the measured earth bond resistance is higher than the maximal value which can be measured by MDtest. The maximal value is **the sum resistance of the test leads and the resistance of the earth bond!**

4.4 Insulation resistance - Riso

The three insulation resistance tests take measurements on (500 V and 250 V):

- Mains – Protective earth [M-PE]
- Applied part - Protective earth [AP-PE]
- Mains – Applied part [M-AP]

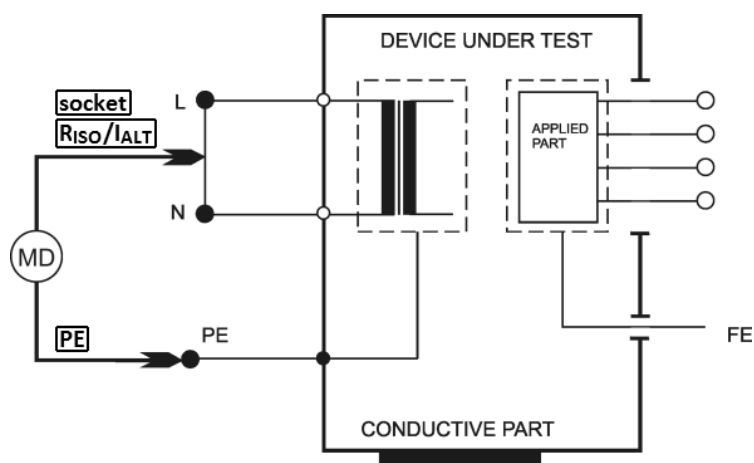


Figure 5: RisoM-PE measurement

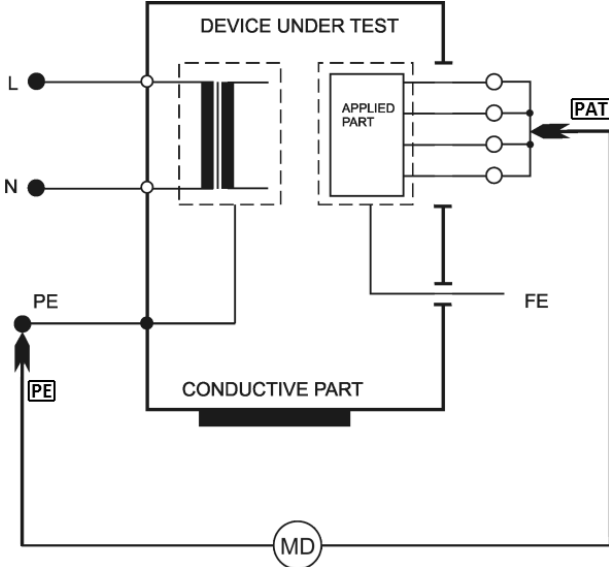


Figure 6: RisoAP-PE measurement

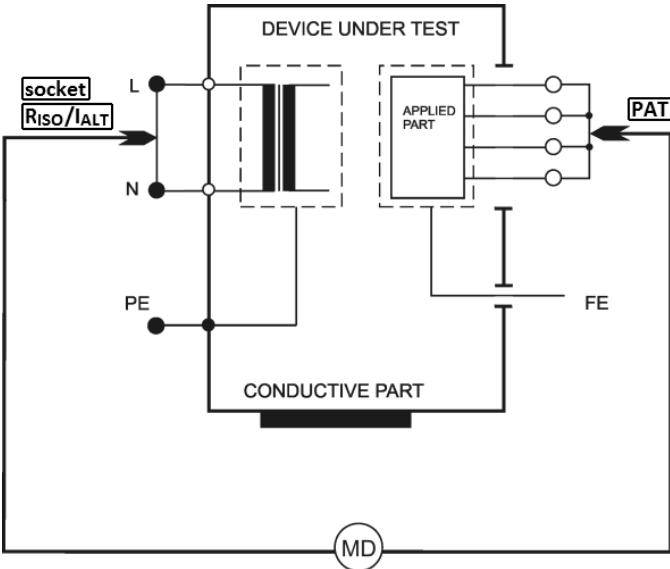


Figure 7: RisoM-AP measurement



- Do not touch the exposed conductive parts of the tested appliance while measurement is in progress – **RISK OF ELECTRIC SHOCK!**
- Do not disconnect the test leads while measurement is in progress or immediately after finishing the measurement. The capacitive component of the tested appliance can be charged to a voltage of up to 550 V; after the [TEST] key is released, this voltage is automatically discharged.
- Make sure the tested appliance is de-energized – its mains voltage must be disconnected before the start of the measurement!



- Before measuring resistance, the MDtest device checks if the DUT is de-energized. If so, then an acoustic signal sounds and the display shows a warning message (**Interference voltage at the input**).
- Resistance measurement is also possible if the MDtest is connected to the IT mains.

Procedure:

- Press the [6 RISO] key and release it. Press the button again to toggle between 500 V and 250 V.
- Press one of the function keys to select the type of measuring you require.
- Connect the appliance for testing:
 - For a one-phase appliance with a movable power supply cord – plug in its mains plug to Test Socket 1.
 - For a three-phase appliance with movable power supply cord – connect the PE pin of its plug to the instrument's **PE** terminal by means of the optional test lead + crocodile clip. Then connect the remaining current-carrying conductors by means of the test lead + test tip to the instrument's **RISO / IALT** terminal.
 - For a hard-wired appliance – **first disconnect the appliance from the mains!** Connect the point of the PE connection to the instrument's **PE** terminal by means of the optional test lead + crocodile clip. Then connect the remaining current-carrying conductors by means of the test lead + test tip to the instrument's **RISO / IALT** terminal.
- If an applied part is measured, plug it into the **PAT** terminal.
- Switch on the tested appliance's mains switch.
- Press the [TEST] key. It is recommended that you hold the [TEST] key down for 5-10 seconds (or even longer if the displayed result is not stabilized); the influence of the tested appliance's internal capacitance can be eliminated by this method.
- After finishing the measurement the last measured value is displayed.

4.5 Enclosure leakage current according to EN 62353

4.5.1 Alternative method - IaltEq

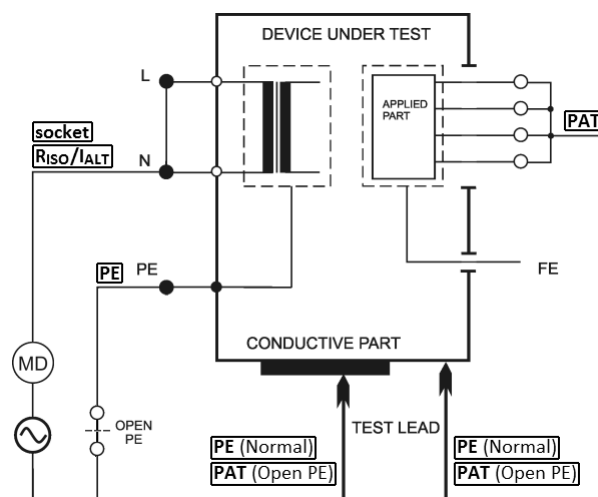


Figure 8: IaltEq measurement

Outlet conditions:

- Normal
- Open PE



Do not touch exposed conductive parts of the tested appliance while measurement is in progress – **RISK OF ELECTRIC SHOCK!**



The test voltage is max. 230 V and the short circuit current is approximately 1.5 mA.
Leakage current measurement is also possible if the MDtest is connected to the IT mains.

Procedure:

- Press the [**1 IALT**] key and release it.
- If the measurement with open PE can be performed, press the [**OpenPE**] key.
- For a one-phase appliance with movable power supply cord, plug in its mains plug to Test Socket 1 and plug the applied part into the **PAT** terminal. If necessary (e.g. protective class II appliances), plug the test lead into the **PE** terminal (if Open PE is selected plug into the **PAT** terminal).
- Switch on tested appliance's mains switch.
- Press the [**TEST**] key.
- Press the test tip against the exposed conductive part of the tested appliance.
- The last measured value is displayed after finishing the measurement.
- Switch off the tested appliance's mains switch.

4.5.2 PE current during operation - IdirEq

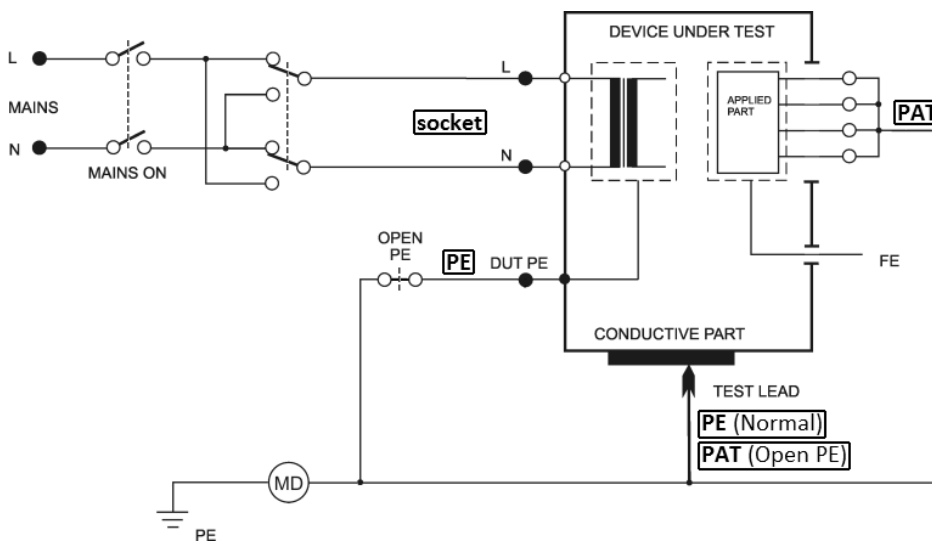


Figure 9: IdirEq measurement

Outlet conditions:

- Normal Polarity
- Reversed Polarity
- Normal Polarity, Open PE
- Reversed Polarity, Open PE



If the test voltage is present in Test Socket 1, then the tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings referred to by the DUT!

Do not touch the exposed conductive parts of the tested object after the mains switch is switched on!



The MDtest is equipped with an electronic check for excessive leakage current during measurement. If the leakage current exceeds the limit value of approximately 10 mA, then the mains voltage is disconnected from the Test Socket 1. This status is indicated by displaying (**Current >10.00 mA**) and the acoustic signal sounds.

The absolute value of the DC component can be measured and displayed (see chapter 6.5.2).

**WARNING**

- The earth bond resistance (chapter 4.3) must be first tested; it is recommended that you also test the insulation resistance if it is possible too (chapter 4.4). Then you can carry out the leakage current measurement!
- The DUT must be isolated from the ground (from the earth potential) during measurement!
- Test Socket **1** of the MDtest must not be used for continuous power supply of the appliance!

Procedure:

- Press the [**4 IDIR**] key and release it.
- If the measurement with open PE can be performed, press the [**OpenPE**] key.
- Press the [**Eq**] or [**OpenPE**] keys repetitively in order to measure with L-N reversal. Symbol L-N reversed is displayed
- Connect the tested appliance: plug in its mains plug into Test Socket **1** and plug the applied part into the **PAT** terminal. If necessary (e.g. protective class II appliances), plug the test lead into the **PE** terminal (if Open PE is selected plug into the **PAT** terminal).
- Press the [**TEST**] key.
- Switch on the tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- The HOLD function can be used (press the [**▼**] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.5.3 Differential leakage current - I_{difEq}

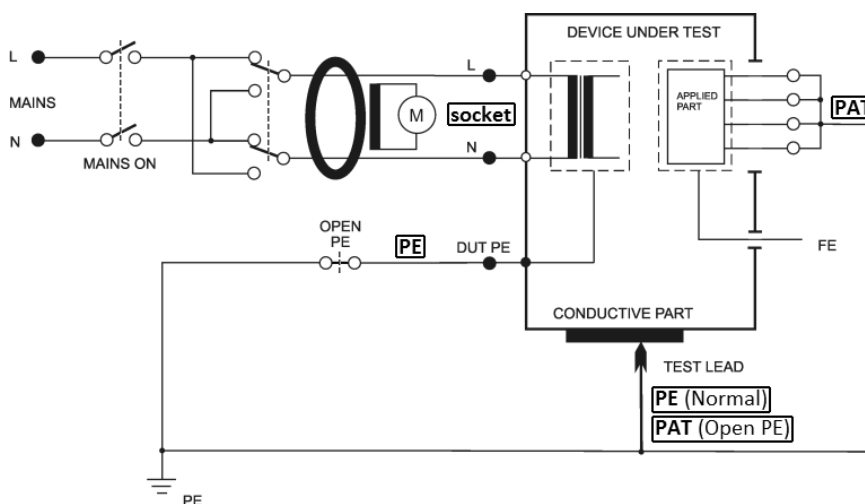


Figure 10: I_{difEq} measurement

Outlet conditions:

- Normal Polarity
- Reversed Polarity
- Normal Polarity, Open PE
- Reversed Polarity, Open PE



If the test voltage is present in Test Socket 1, then the tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings referred to by the DUT!

Do not touch the exposed conductive parts of the tested object after the mains switch is switched on!



The MDtest is equipped with an electronic check for excessive leakage current during measurement. If the leakage current exceeds the limit value of approximately 10 mA, then the mains voltage is disconnected from the Test Socket 1. This status is indicated by displaying **(Current >10.00 mA)** and the acoustic signal sounds.

WARNING



- The earth bond resistance (chapter 4.3) must be first tested; it is also recommended that you also test the insulation resistance if it is possible (chapter 4.4). Then you can carry out the leakage current measurement!
- Test Socket 1 of the MDtest must not be used for continuous power supply of the appliance!

Procedure:

- Press the [**7 IDIF**] key and release it.
- If the measurement with open PE can be performed, press the [**OpenPE**] key.
- Press the [**Eq**] or [**OpenPE**] keys repetitively in order to measure with L-N reversal. Symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket **1** and plug the applied part into the **PAT** terminal. If necessary (e.g. protective class II appliances), plug the test lead into the **PE** terminal (if Open PE is selected plug into the **PAT** terminal).
- Press the [**TEST**] key.
- Switch on the tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- The HOLD function can be used (press the [**▼**] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.6 Leakage current from the Application parts according to EN 62353

4.6.1 Alternative method - IaltPat

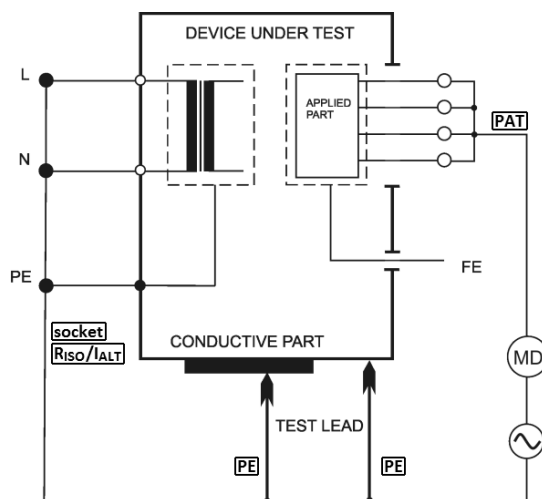


Figure 11: IaltPat measurement



Do not touch the exposed conductive parts of the tested appliance while measurement is in progress – **RISK OF ELECTRIC SHOCK!**



The test voltage is max. 230 V and the short circuit current is approximately 1.5 mA.

Leakage current measurement is also possible if the MDtest is connected to the IT mains.

Procedure:

- Press the [**2 IALT**] key and release it.
- Connect the tested appliance: plug in its mains plug into the Test Socket **1** and plug the applied part into the **PAT** terminal. If necessary (e.g. protective class II appliances), plug the test lead into the **PE** terminal.
- Switch on tested appliance's mains switch.
- Press the [**TEST**] key.
- Press the test tip against the exposed conductive part of the tested appliance.
- The last measured value is displayed after finishing off the measurement.
- Switch off the tested appliance's mains switch.



If the measured value is <0.100 mA, then the resolution can be increased. For higher resolution press the [**4/5 D**] key.

This setting is not saved.

4.6.2 Direct method - IdirPat

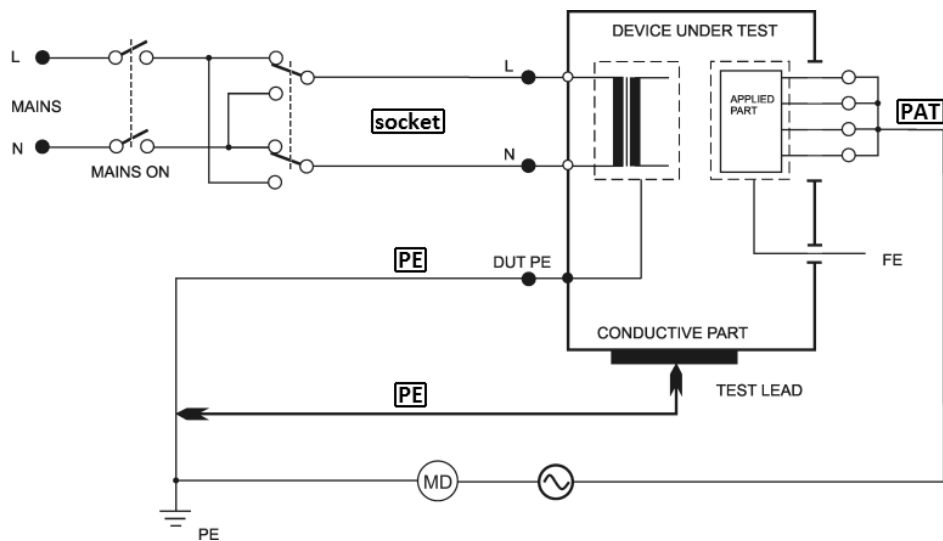


Figure 12: IdirPat measurement



If the test voltage is present in Test Socket **1**, then the tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings referred to by the DUT!

Do not touch the exposed conductive parts of the tested object after the mains switch is switched on!



The MDtest is equipped with an electronic check for excessive leakage current during measurement. If the leakage current exceeds the limit value of approximately 10 mA, then the mains voltage is disconnected from the Test Socket **1**. This status is indicated by displaying **(Current >10.00 mA)** and the acoustic signal sounds.

WARNING



- The earth bond resistance (chapter 4.3) must be first tested; it is recommended that you also test the insulation resistance if it is possible too (chapter 4.4). Then you can carry out the leakage current measurement!
- Test Socket **1** of the MDtest must not be used for continuous power supply of the appliance!

Procedure:

- Press the [**5 IDIR**] key and release it.
- Press the [**Rever**] key repetitively in order to measure with L-N reversal. The symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket **1** and plug the applied part into the **PAT** terminal. If necessary (e.g. protective class II appliances), plug the test lead into the **PE** terminal.
- Press the [**TEST**] key.
- Switch on the tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- The HOLD function can be used (press the [**▼**] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.6.3 Direct method, DUT with an internal electrical power source - IdirPatB

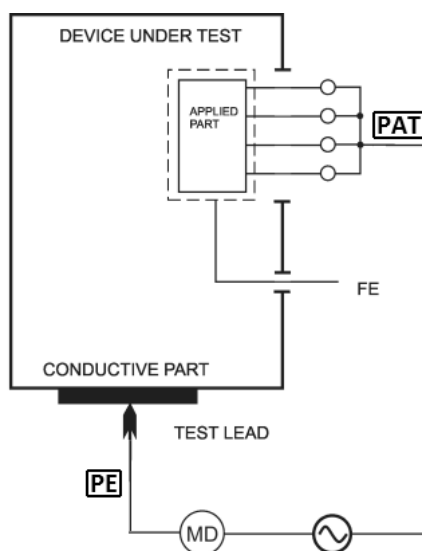


Figure 13: IdirPatB measurement



Do not touch the exposed conductive parts of the tested appliance while measurement is in progress – **RISK OF ELECTRIC SHOCK!**



The test voltage is max. 230 V and the short circuit current is approximately 1.5 mA.

Leakage current measurement is also possible if the MDtest is connected to the IT mains.

Procedure:

- Press the [**8 IDIR BATTERY**] key and release it.
- Plug the applied part into the **PAT** terminal.
- Plug the test lead into the **PE** terminal.
- Switch on tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- Press the [**TEST**] key.
- The last measured value is displayed after finishing the measurement.
- Switch off the tested appliance's mains switch.

4.7 Leakage currents according to IEC EN 60601-1



WARNING

Leakage currents (according to EN 60601-1) are measured by the same measurement methods as leakage current, which is specified in chapter 4.5.2. Therefore, all safety warnings and operating instructions apply for these measurements as to those measured leakage currents listed in chapter 4.5.2.



- Some measurements are possible to perform with the DC component measurement (see chapter 6.5.2).
- To perform the SFC (Single Fault Condition) – the Neutral or PE conductor is interrupted. During the measurement a warning beep is emitted.

4.7.1 Earth leakage current (direct method) - I60601Earth

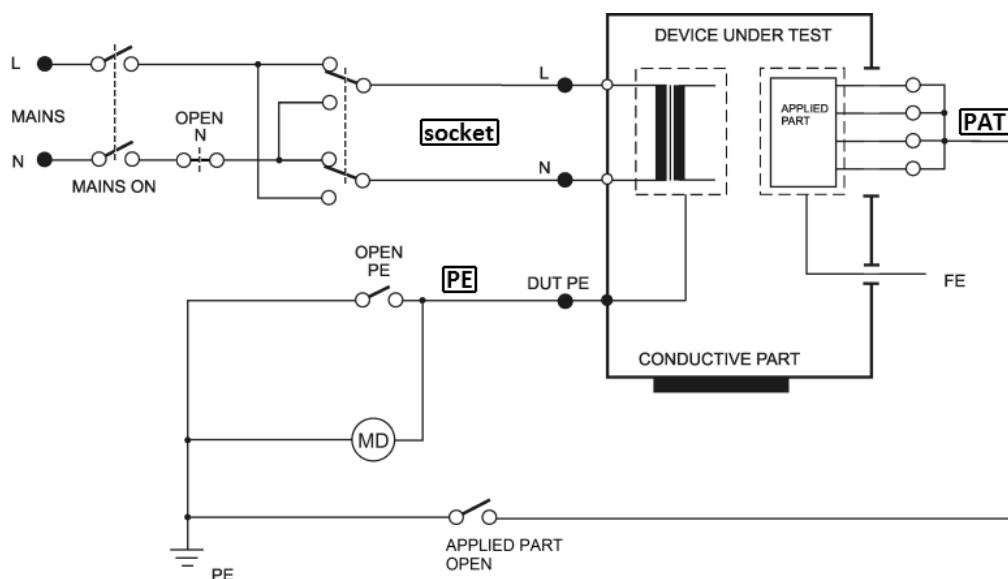


Figure 14: I60601Earth measurement

Outlet conditions:

- Normal Polarity
- Reversed Polarity
- Normal Polarity, Open Neutral
- Reversed Polarity, Open Neutral

Procedure:

- Press the [* UTIL] key and release it. Then press the [1] key and release it.
- If the measurement with open N can be performed press the [OpenN] key.
- Press the [Default] or [OpenN] keys repetitively in order to measure with L-N reversal. The symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket 1.
- Press the [TEST] key.
- Switch on the tested appliance's mains switch.
- The HOLD function can be used (press the [▼] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.7.2 Enclosure (chassis) leakage current (direct method) - I60601Touch

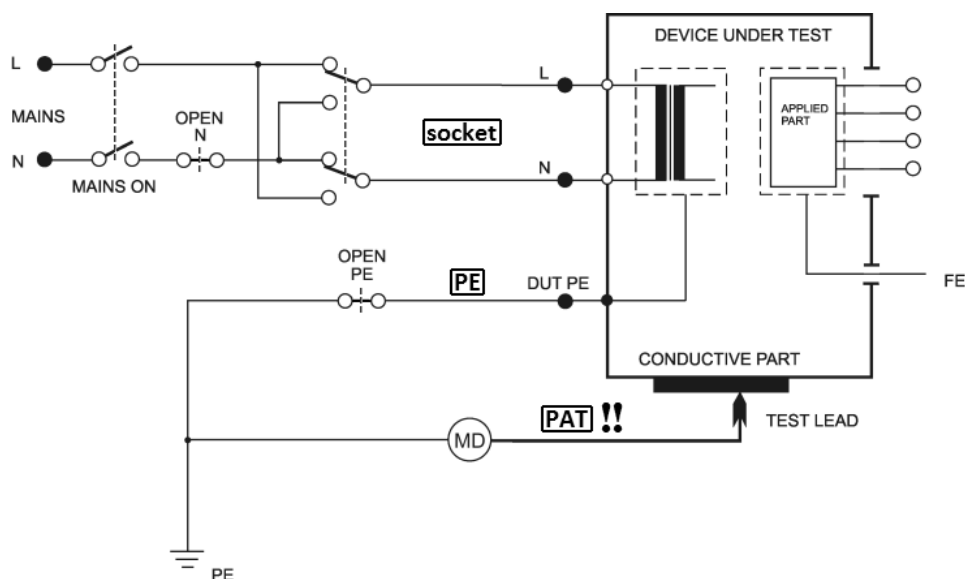


Figure 15: I60601Touch measurement

Outlet conditions:

- | | |
|---------------------------------|-----------------------------------|
| - Normal Polarity | - Reversed Polarity |
| - Normal Polarity, Open Neutral | - Reversed Polarity, Open Neutral |
| - Normal Polarity, Open PE | - Reversed Polarity, Open PE |

Procedure:

- Press the [* UTIL] key and release it. Then press the [2] key and release it.
- If the measurement with open N can be performed, press the [OpenN] key.
- If the measurement with open PE can be performed, press the [OpenPE] key.
- Press the [Default], [OpenN] or [OpenPE] keys repetitively in order to measure with L-N reversal. Symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket 1. Plug the test lead into the PAT terminal. **Do not plug the applications parts!**
- Press the [TEST] key.
- Switch on the tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- The HOLD function can be used (press the [▼] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.7.3 Lead to ground (application part) leakage current (direct method) - I60601Pat

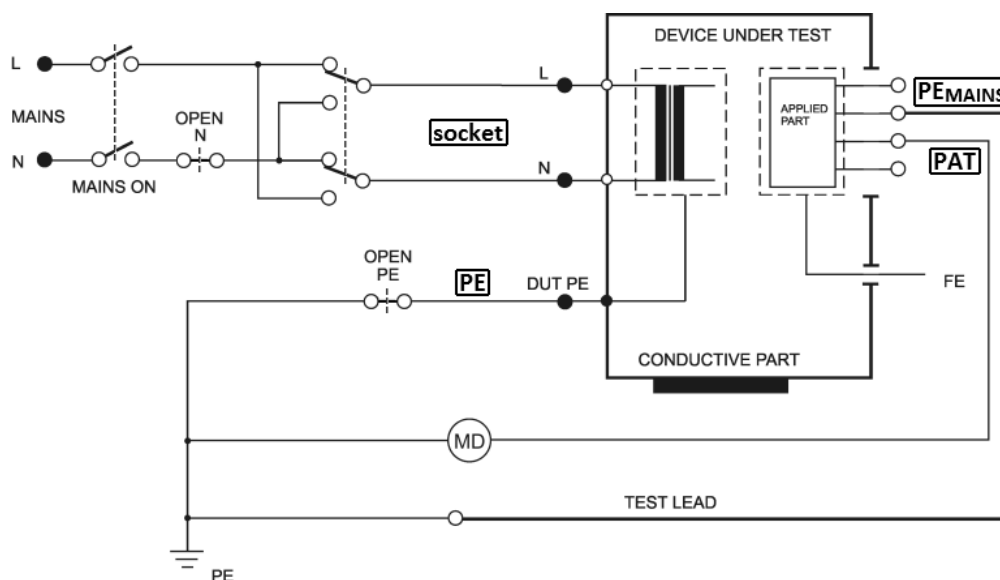


Figure 16: I60601Pat measurement

Outlet conditions:

- Normal Polarity
- Normal Polarity, Open Neutral
- Normal Polarity, Open PE
- Reversed Polarity
- Reversed Polarity, Open Neutral
- Reversed Polarity, Open PE

Procedure:

- Press the [* UTIL] key and release it. Then press the [3] key and release it.
- If the measurement with open N can be performed, press the [OpenN] key.
- If the measurement with open PE can be performed, press the [OpenPE] key.
- Press the [Default], [OpenN] or [OpenPE] keys repetitively in order to measure with L-N reversal. Symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket 1. Plug the applications parts into the PAT or PEMAINS terminals.
- Press the [TEST] key.
- Switch on the tested appliance's mains switch.
- The HOLD function can be used (press the [▼] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.7.4 Lead isolation – Mains on Applied Parts leakage current (direct method) - I60601MAP

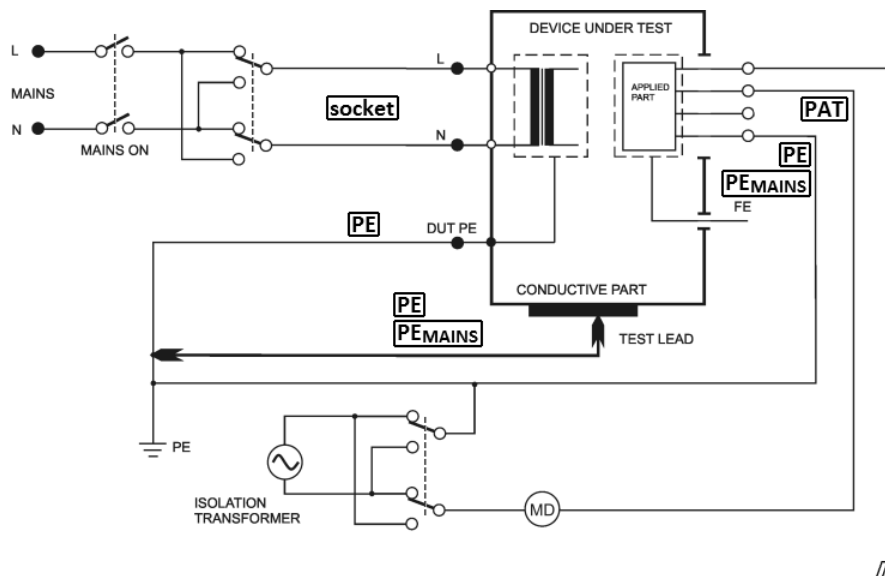


Figure 17: I60601MAP measurement

Outlet conditions:

- Normal Polarity, Normal Polarity Isolation transformer
- Normal Polarity, Reversed Polarity Isolation transformer
- Reversed Polarity, Normal Polarity Isolation transformer
- Reversed Polarity, Reversed Polarity Isolation transformer

Procedure:

- Press the [* UTIL] key and release it. Then press the [4] key and release it.
- Select the polarity of the isolated AC test voltage:
[MAP1] => normal, [MAP2] => reversed.
- Connect the tested appliance: plug in its mains plug into Test Socket 1. Plug the applications parts into the PAT terminal. If necessary (e.g. protective class II appliances), plug the test lead into the PE or PEMAINS terminals.
- Press the [TEST] key.
- Switch on the tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- The HOLD function can be used (press the [▼] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.8 Other leakage currents

4.8.1 Alternative method - I_{altEq}

The measuring method is similar to Alternative method - I_{altEq} (chapter 4.5.1), but the applications parts are not connected. The test lead connect to the **ITOUCH 2k Ω** terminal.

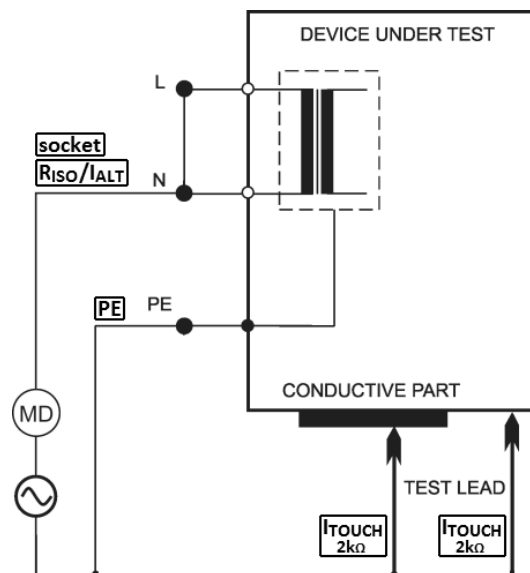


Figure 18: I_{altEq} measurement

4.8.2 PE current during operation – I_{dirEq} / differential leakage current - I_{difEq}

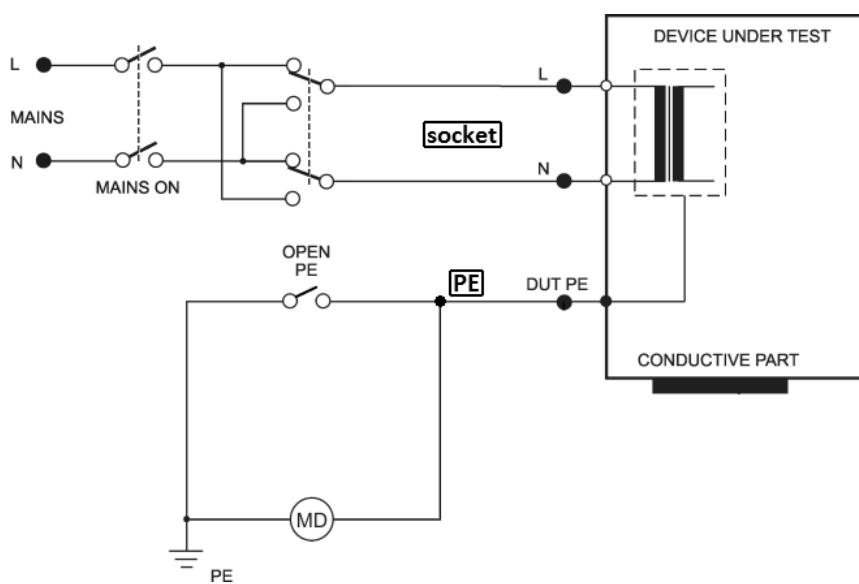


Figure 19: I_{dirEq} measurement

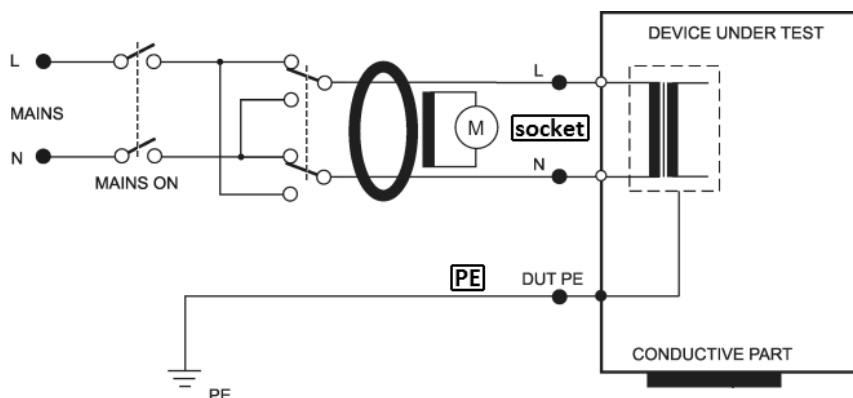


Figure 20: IdifEq measurement

**WARNING**

These leakage currents are measured by the same measurement methods as leakage currents, which are specified in chapters 4.5.2 or 4.5.3. Therefore, all safety warnings and operating instructions apply for these measurements as to those measured leakage currents listed in chapters 4.5.2 or 4.5.3.


Procedure:

- Press the [4 IDIR] key (direct method) or the [7 IDIF] key (differential method).
- Press the [Eq] key repetitively in order to measure with L-N reversal. The symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket 1.
- Press the [TEST] key.
- Switch on the tested appliance's mains switch.
- The HOLD function can be used (press the [▼] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

Three-phase and hard-wired appliance:

Optional accessories are intended for leakage current measurement of both three-phase and hard-wired appliances.

Procedure:

- Press the [4 IDIR] or [7 IDIF] key repetitively in order to select the external method. The symbol  is displayed.
- Connect the optional three-phase adapter to the terminal 10.
- Switch on the tested appliance's mains switch.
- Press the [TEST] key.
- The last measured value is displayed after finishing the measurement.
- Switch off the tested appliance's mains switch.

4.8.3 Enclosure leakage current (direct method or differential method) - IdirTouch / IdifTouch

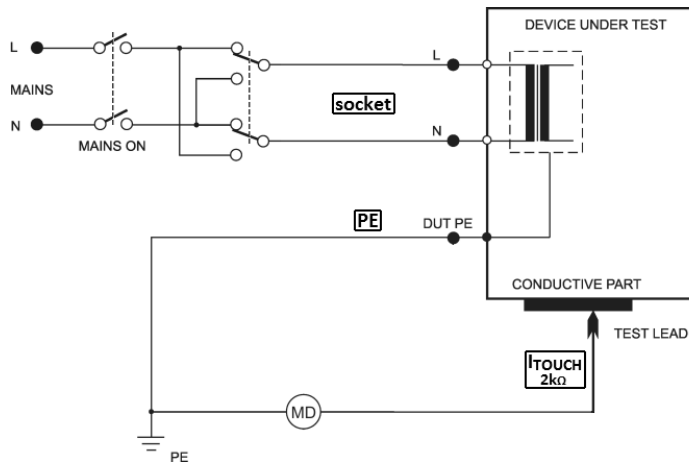


Figure 21: IdirTouch measurement

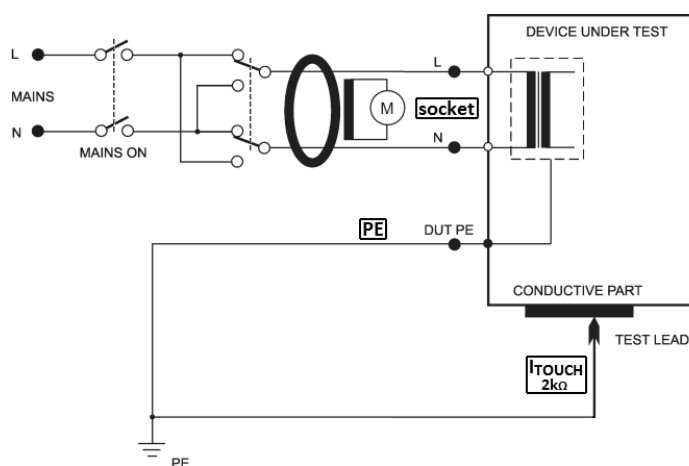


Figure 22: IdifTouch measurement



WARNING

Enclosure leakage currents are measured by the same measurement methods as leakage currents which are specified in chapters 4.5.2 or 4.5.3. Therefore, all safety warnings and operating instructions apply for these measurements as to those measured leakage currents listed in chapters 4.5.2 or 4.5.3.



IdirTouch measurement: Only the component of the current that leakages from the ungrounded parts is measured (see Figure 21).

IdifTouch measurement: Both components of the leakage current (PE lead and ungrounded parts) are measured (see Figure 22).

Procedure:

- Press the [**4 IDIR**] key (direct method) or the [**7 IDIF**] key (differential method) and release it. Then press the [**Touch**] key and release it.
- Press the [**Touch**] key repetitively in order to measure with L-N reversal. The symbol L-N reversed is displayed.
- Connect the tested appliance: plug in its mains plug into Test Socket **1**.
- Plug the test lead into the **ITOUCH 2k Ω** terminal.
- Press the [**TEST**] key.
- Switch on the tested appliance's mains switch.
- Press the test tip against the exposed conductive part of the tested appliance.
- The HOLD function can be used (press the [**▼**] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

4.9 Apparent power, mains voltage and current consumption - Power

4.9.1 Power, mains voltage and current consumption in test socket



If test voltage is present in Test Socket **1** – it is indicated by the (TEST) indicator, then the tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings referred to by the DUT!

Do not touch the exposed conductive parts of the tested object after the mains switch is switched on – **RISK OF ELECTRIC SHOCK!**



WARNING

Test Socket **1** of the MDtest must not be used for continuous power supply of appliance!

Procedure:

- Press the [**9 Power**] key and release it.
- Connect the tested appliance: plug in its mains plug into Test Socket **1**.
- Press the [**TEST**] key.
- Switch on the tested appliance's mains switch.
- The HOLD function can be used (press the [**▼**] key).
- Switch off the tested appliance's mains switch.
- Finish the measurement (see chapter 4.2.1).

If the measured value of power is higher than the highest measurable value the symbol >>>> appears.


4.9.2 Measuring of power and current consumption by means of current clamp



WARNING

It is important to observe these principles for proper measurement: Both the MDtest and the tested appliance must be powered from identical phase.

Procedure:

- Press the [**9 Power**] key repeatedly in order to select the external method.
The symbol  is displayed.
- Connect the optional current clamp to the terminal **10**.
- Switch on the tested appliance's mains switch.
- Enclose with current clamp's jaws live conductor L of the measured appliance.
- Press the [**TEST**] key.
- The last measured values are displayed after finishing the measurement.
- Switch off the tested appliance's mains switch.

If the measured value of power is higher than the highest measurable value the symbol >>>> appears.

5 Database operations

5.1 Storing measurement data

A set of data can be stored for each appliance. Data can be created and transferred to the MDtest from a PC and other data is created during the measurement. Each set of data (file) has its unique identification number (ID) assigned.

The structure of the file:

Item	Transfer from PC	Description	Created
ID	yes	1-20 ASCII code charts	barcode scanner, ID editor
test sequence	yes	sequence of test steps	transfer from PC, assign of the test sequence
measurement data	no		measurement and store of the value
final evaluation	no		initial evaluation (passed) is possible to change manually
date of measurement	no	editable on a PC only	saving the measured value

5.2 The structure of the data memory

Measured values and other possible data are stored as a file in a temporary memory where the ID is assigned and finally the file is transferred to the main memory.

Conversely you can load a set of measurements of a particular appliance from the main memory to the temporary memory and then edit it.



Measuring up to **4 000 DUTs** can be stored in the main memory.

To perform the whole procedure:

- Read the device ID number (use the barcode scanner) or enter the ID from the keyboard.
- Perform all required measurements.
- Check the visual inspection, functional test and measured values (**PASSED** is preset by default).
- Press the [**save**] key, the data will be transferred from the temporary memory to main memory.



The data stored in the temporary memory can be displayed after selecting the appropriate quantity. If a memory cell in the temporary memory is empty, the symbol — — — — is displayed.

5.3 Entering characters

In this mode the text, setting, etc. can be entered and edited. When the keys are pressed repetitively, the alphanumeric symbols are entered:

[0]	0 <i>space</i>
[1]	1 + - . , _
[2]	2 <i>A B C a b c</i>
[3]	3 <i>D E F d e f</i>
[4]	4 <i>G H I g h i</i>
[5]	5 <i>J K L j k l</i>
[6]	6 <i>M N O m n o</i>
[7]	7 <i>P Q R S p q r s</i>
[8]	8 <i>T U V t u v</i>
[9]	9 <i>W X Y Z w x y z</i>
[*]	* : ; = ! ? @ \$ % &
[#]	# () < > { } [] / \

Context button:

[< <]	move the cursor left
move the cursor right	
[< Del]	backspace

Entry mode can be abandoned:

[ent]	confirm entry and returns back
[esc]	discard modifications and returns back

5.4 Identification number of device under test (ID)

The ID number is an individual number, which is assigned to only one DUT. An appliance ID of up to 20 alphanumeric characters can be entered.

The appliance ID can be entered with:

- keypad of MDtest
- barcode scanner
- external USB keyboard (necessary to confirm it by pressing the ENTER key)



The ID number should be entered before the start of the measurement. If the ID number already exists in the main memory (e.g. was transferred from a PC), then the data is loaded into temporary memory. If the user forgot to enter the ID number before the start of the measurement, it is possible to enter it before saving the data file into the main memory of the appliance. However, if the appliance with this ID exists already, the data will be rewritten completely!

Barcode scanner, external keyboard

Any device which has an USB 2.0 Full Speed HID (Human Interface Device) can be used with MDtest.

- Plug the barcode scanner or keyboard into the USB connector **8**.
- A confirmation beep confirms the barcode has been received. If an external keyboard is used, press the ENTER key to confirm the ID and the ID number will be displayed.
- The ID number is read only when measurement is not in progress and/or no menu / warning is displayed.



The ID number can be inserted via barcode scanner or keyboard in the ID editor mode too.

5.5 Working with test results

5.5.1 Viewing a list of tested DUTs

Use the [▲] or [▼] keys to display a list of tested DUTs, which are stored in the main memory. The data stored for each appliance can be viewed or edited. To modify/edit stored data, it is necessary to transfer the data to temporary memory and after modification send the data back to the main memory.

The list of appliances contains the following information:

- ID number
- measured values - if the device has been loaded onto the temporary memory and then stored in the main memory the symbol **(V)** – **value** is displayed
- test sequence – if a test sequence is made for the device, the symbol **(S)** – **sequence** is displayed



The symbol **(V)** next the ID of DUT is displayed even if no measurement has been performed. The symbol only informs the user about a data transfer from temporary memory to the main memory.

5.5.2 Searching for stored DUTs

The device allows the user to search for a DUT according to their ID numbers:

- Insert the ID number via the barcode scanner, external USB keyboard or (internal) keypad.
- MDtest starts searching.
- If the ID number is found, then it is confirmed by a long beep, the data file is transferred to the temporary memory and the ID number is displayed.
- If the ID number is not found, the message will be displayed and triple beep sounds.

For manual searching press the **[ent]** key and insert the ID number via the MDtest keypad and then press the **[ent]** key again.

DUT can be also selected directly from the list (database). Press the **[▲]** or **[▼]** keys to open the database. Then select the DUT via **[▲]** or **[▼]** keys and press the **[Load]** key.

5.5.3 Creating a new DUT file

Creating a new DUT file is performed as follows:

- Create a new ID number (see chapter 5.5.2).
- Confirm that it is a new device.
- Make a note of the device (type, serial number etc.) for archiving on a PC.
- Perform all measurements (if required).
- Evaluate the results of the visual inspection, functional test and measurement (default value is "PASSED") – see chapter 6.2.
- Press the **[save]** key to save the new record in the main memory.



The data file is created in temporary memory (see chapter 5.2) and then is transferred to the main memory. Therefore, it is flagged that a measurement was performed – the symbol **(V)** is displayed even if no values were measured.

5.5.4 Deleting a DUT from the main memory

A stored DUT can be deleted from the main memory one by one or by selecting DUTs. Deleting a DUT is performed as follows:

- Press the **[▲]** or **[▼]** keys to open the database.
- Use the **[▲]** or **[▼]** keys to highlight the ID number which should be deleted.
- Press the **[menu]** key.
- Press the **[Delete]** key and confirm **[Yes]**.

When removing more records at once follow in a similar way - use the **[Mark]** key.

**WARNING**

Deleting records will not free up more space in the main memory. The memory is released only when the complete memory is erased (manually in the menu or before loading new data from the PC).

5.5.5 Modification of the ID number

Modification of ID number is performed as follows:

- Press the **[▲]** or **[▼]** keys to open the database.
- Use the **[▲]** or **[▼]** keys to highlight the ID number which should be modified.
- Press the **[menu]** key.
- Press the **[Rename]** key and insert a new ID – see chapter 5.3.
- Press to the **[ent]** key to confirm or press **[esc]** to leave.



During the modification, the ID is checking if the new ID contains up to 20 characters (a longer text is automatically reduced).

Furthermore, it is checked whether an appliance with the same ID is already present in the database. If this situation occurs, the new appliances' ID will not be saved and a message will be displayed (**ID is already in database**).

5.5.6 Viewing measured values and evaluation

The record on the stored values of the appliance can be viewed as follows:

- Press the **[▲]** or **[▼]** keys to open the database.
- Use the **[▲]** or **[▼]** keys to highlight the ID number which should be viewed.
- Press the **[ent]** key to open the file with the measured values and evaluation.
- Use the **[▲]** or **[▼]** keys to display the results.



If the data file has not transferred from the temporary memory to the main memory (the symbol **V** is not displayed), you cannot view the measured values and their evaluation. Therefore, when you press the **[ent]** key, you will hear a warning beep.

5.5.7 Modification of measured values and evaluation

Measured values cannot be edited, but it is possible to repeat the measurement. Measured values and the evaluation status of appliances stored in the database can be changed so that the data set, which is loaded into the temporary memory, performs a new measurement of the variables whose values you want to change. You can also change the evaluation status (see chapter 6.2). A changed data file is saved again to the main memory. The change is made in the following manner:

- Press the [▲] or [▼] keys to open the database.
- Use the [▲] or [▼] keys to highlight the ID number which should be modified.
- Press the [Load] key to transfer the set of data from the main memory to the temporary memory.
- Perform the new measurement or change the evaluation (see chapter 6.2).
- Press the [save] key to store the modified data set back to the main memory.

5.6 Test sequences

5.6.1 Description of the test sequence

The test sequence is the fastest and easiest way to test appliances. During the test, preprogrammed measurements run automatically in a sequential order. The complete test results can be stored together with the associated appliance ID.

The automatic measurement procedure consists of individual steps which are necessary to do step by step and each step has to be confirmed. The automatic procedure is created in the PC software. The steps of measurement are selected from the selection and become part of the definition of the appliance. The process can include all variables that the measuring device MDtest allows. Furthermore, you can define their order.

After activation, the test sequence with the symbol **SEQ** is displayed in the upper right corner of the display. The automatic process can be interrupted at any time and continue with the manual measurement mode.

The automatic procedure always consists of the following steps:

- Confirm whether the user wishes to start the measurement procedure
- The result of the visual inspections (**required**)
- Selected measuring methods (optional item)
- ...
- The result of the functional test (**required**)
- The measurement result (**required**)
- The question of whether the values are to be stored in the main memory

5.6.2 Creating a test sequence

The test sequence can only be created using the PC software. Here measurements can be defined, including their sequence. The procedure also automatically assigns the result of the visual inspection, functional test and measurement operation.



Some measurements cannot be measured separately (e.g. IEq, Uline and S, etc.). If these variables are independently selected, measurement is performed at the same time.

5.6.3 Assigning a test sequence to appliance

In order to use the automatic procedure, it is necessary to activate it. The automatic measurement procedure can be activated in the following ways:

- An automatic process is transferred from the PC individually for a particular appliance, at the same time as the file's data. The test sequence is automatically activated before starting the measurement.
- If the file does not contain the loaded data for an test sequence, the appliance can assign any of the procedures stored on the MDtest (see chapter 6.3).

5.6.4 Using the test sequence

If the tested appliances are assigned to the automatic measurement procedure, it is possible to start a test of the appliance using the following procedure:

- Confirm the **Sequence wizard** measurements using the [**TEST**] key. If you press the [**esc**] key, the automatic procedure will be shut down and the measurement can be done without using the test sequence.
- Follow the instruction shown on the display or select the result of the evaluation.
- If you want to repeat a step, press the [**Repeat**] key. If the step was performed successfully and you wish to proceed, press [**TEST**].
- If you want to interrupt the automatic process and switch to the manual mode, press the [**End**] key. The steps which have been performed up to now will be retained.
- During the test sequence procedure, it is not possible to store the measured values with the [**save**] key. The results are stored after confirmation that the procedure is completed.



For some measurements the middle context button can be displayed. For example: IaltPat - change resolution 4/5 digits.

6 Instrument main menu

6.1 Main menu structure

- **DUT properties**
 - Measured values
 - Visual inspection result
 - Functional test result
 - Measurement result
- **Test sequences**
- **Empty file**
- **Setup**
 - System info
 - Measure DC values
 - Self-test
 - Date – next calibration
 - Erase database
 - Measurement locking
 - Save last method
 - Date and Time
 - Keys beep
 - Volume
 - Language

The operating the menu is as follows:

- Press the [**menu**] key to open the Main menu.
- Use the [**▲**] or [**▼**] keys to select the desired function, confirm the selection by pressing the [**enter**] key.
- Use the [**esc**] keys to return.

6.2 Menu - DUT properties

6.2.1 Menu - Measured values

This menu can be used to display measured values with an evaluation status. All data are transferred from the temporary memory.

6.2.2 Menu - Visual inspection result

In this menu it is possible to set the result of visual inspection: Failed / Passed / N/A (not performed).

6.2.3 Menu - Functional test result

In this menu it is possible to set the result of functional test result: Failed / Passed / N/A (not performed).

6.2.4 Menu - Measurement result

In this menu it is possible to set the result of measurement operation: Failed / Passed / N/A (not performed).



The default setting for the visual inspection, functional test and measuring results is **PASSED**.

6.3 Menu - Test sequences

In this menu you can view a list of available measurement test sequences which can be assigned to the currently selected appliance.

Assigning the test sequences from the list of the currently selected appliance is done as follows:

- Press the [**menu**] key.
- Select the **Test sequences** item and press the [**ent**] key for confirmation.
- Select required test sequence.
- Press the [**ent**] key to check each individual step in the test sequence.
- Press the [**Load**] key to assign the test sequence to DUT.



The list of test sequences cannot be modified in MDtest – it is transferred from the PC software.

6.4 Menu - Empty file

In this menu the temporary memory is erased, i.e.:

- the ID number is empty
- all measured values are deleted
- the results of the visual inspection, functional test and measurement operation are set to PASSED
- the test sequence is deactivated

6.5 Menu - Setup

6.5.1 Menu - System info

These items can be displayed Serial number, Firmware version, Production date and The number of records.

6.5.2 Menu - Measure DC values

This will activate the measurement and display the absolute value of the DC component in the selected leakage currents:

- IdirEq(R)
- I60601Earth(R) + SFC, variant Open N
- I60601Touch(R) + SFC, variant Open N or Open PE
- I60601Pat(R) + SFC, variant Open N or Open PE



If measurement of a DC component is enabled, that measurement cycle will take longer.
The value is transmitted to the PC software.

6.5.3 Menu - Self-test

This option can be performed to verify the functionality of the MDtest. Disconnect equipment under test before the self-test. The self-test does not replace calibration. The procedure is described in chapter 3.2.

6.5.4 Menu - Date of next calibration

In this menu, you can set the next calibration date. The measuring device starts to display a warning message 45 days before the expiration date, e.g., **Date of the next calibration: 01.01.2020**. This information is displayed only once a day. If the calibration has expired, there is the message, e.g., **Calibration expired on 01.01.2020**. Enter into the menu, the date of the next calibration is performed by pressing the [ent] key. The date is inserted using the keyboard device. Confirm the selection by pressing the [ent] key or press the [esc] key to return without saving the changes.



The ?? characters are automatically skipped in the editor.

6.5.5 Menu - Erase database

Use this option to erase the entire main memory device, i.e., database appliances. The essential instrument settings and a list of test sequences remain preserved. Erasing the memory must be confirmed by pressing the [Yes] key.



How long it takes to erasing entries depends on the memory usage. It can take up to 2 minutes when all memory locations are occupied.

6.5.6 Menu - Measurement locking

This option allows you to automatically lock every measurement. When enabled, each time measurement is displayed the symbol **AUT.ARET**. The switch activation is done by pressing the [ent] key.

6.5.7 Menu - Save last method

This option allows you to save last measuring method. When enabled, last method is selected immediately after connection the MDtest to the mains. The switch activation is done by pressing the [ent] key.

6.5.8 Menu - Date and Time

The date and time can be set in this menu. The date is attached to each stored test result and then transferred to the PC software. Press the [ent] key to enter this submenu. Insert the date and time via the MDtest keypad and confirm by the [ent] key or press the [esc] key to return without saving the changes.



The ' ' characters are automatically skipped in the editor.
When you transfer data from the PC to the MDtest, the internal clock is automatically synchronized with the PC's time.

6.5.9 Menu - Keys beep

In this menu, an audible indication of pressing a key can be enabled / disabled. The change is done by pressing the [ent] key.

6.5.10 Menu - Volume

In this menu, the volume is set of the audible indication. Press the [ent] key to change the level.

6.5.11 Menu - Language

The instrument language can be set in this menu. Press the [ent] key to change the language.

7 Additional information

7.1 Communication – data transfer

Data transfer between the MDtest and the PC is completely controlled by the PC software and it cannot be controlled directly from the measuring device. To transfer data, prepare the MDtest as follows:

- Connect the MDtest to a PC using a USB cable plugged into connector **9** (drivers must be installed on the PC for the proper use of USB communication).
- If the MDtest is in the mode of working with databases, shut it down and set the device to measuring mode.
- Before transferring data from a PC to the MDtest, memory will be erased. How long it takes to erasing entries depends on the memory usage. It can take up to 2 minutes when all memory locations are occupied. **Attention: data unsaved to the PC will be lost forever!**
- Do not operate with the instrument during data transfer.
- An informative window is displayed during data transfer.

7.2 Messages on the display

7.2.1 Warning messages

PE error

A fault occurred in the PE circuit. The cause may be:

- the PE conductor circuit is not sufficiently grounded (high impedance fault loop or IT system)
- voltage on the protective wire

All device functions are blocked. If it is the IT system, the user must confirm this condition (see Figure 23). The resistance of the PE conductor, substitute leakage current and insulation resistance can be only measured in IT systems. In other cases, we cannot continue measuring (see Figure 24).



The test of the PE circuit is performed only once, immediately after connection to the mains.



Figure 23: Warning message: PE error (IT systems)



Figure 24: Warning message: PE error

Interference voltage at the input

The device has blocked the measuring. The cause may be:

- *Interference voltage on the DUT*
The measuring instrument tests (before start of Riso and Rpe measurements) if interference voltage is not present on the DUT.
If the warning message (Figure 25) appears, then check the disconnection of the DUT from the mains. Another reason could be that the measuring leads are too long. Please, use the original leads only.
- *Interference voltage in the mains*
If during measurement a greater interference in the mains occurs, the MDtest disables the measuring and the warning message (Figure 25) appears.
In this case, repeat the measurement later.

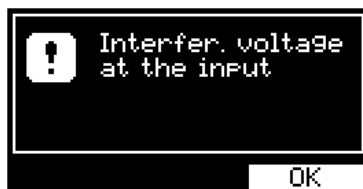


Figure 25: Warning message: Interference voltage at the input

Current >10.00 mA

If the leakage current of the appliance exceeds approximately 10.00 mA, power supply is disconnected from the Test Socket **1**, then an acoustic signal sounds and the display shows the warning message (Figure 26).



Figure 26: Warning message: Current >10.00 mA

Measuring - time limit

If the time of measuring exceeds the allowed limit (according to the appliance's current - see chapter 2.1), power supply is disconnected from the Test Socket 1, then an acoustic signal sounds and the display shows the warning message (Figure 27).

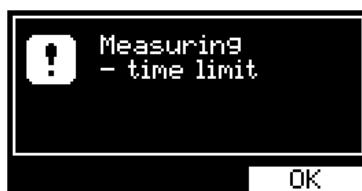


Figure 27: Warning message: Measuring - time limit

Cannot be measured (calibration error / damaged data)

The device automatically checks the adjustment constants and other data. If the data is damaged then the measurement cannot be performed. An acoustic signal sounds and the display shows the warning message (Figure 28 or Figure 29). In both cases, the device must be sent for repair to the manufacturer.

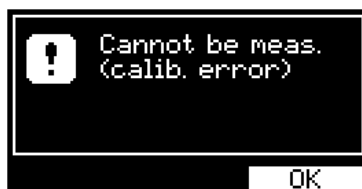


Figure 28: Warning message: Cannot be measured (calibration error)

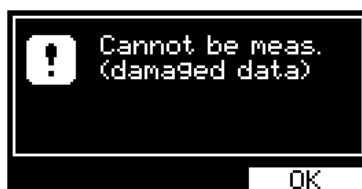


Figure 29: Warning message: Cannot be measured (damaged data)

Empty database

When you try to view a list of appliances with an empty memory, then an acoustic signal sounds and the display shows the warning message (Figure 30).



Figure 30: Warning message: Empty database

Memory usage

If the memory usage increase to 90%, then an acoustic signal sounds and the display shows the warning message (Figure 31). If the memory is full (100%), then it is necessary to erase the memory (see chapter 6.5.5) to continue to work with the device (store new appliances).



Figure 31: Warning message: Memory usage

Measurement was cancelled

If the [esc] key was pressed during the measurement, then it will be cancelled. An acoustic signal sounds and the display shows the warning message (Figure 32). The measured value is not saved.

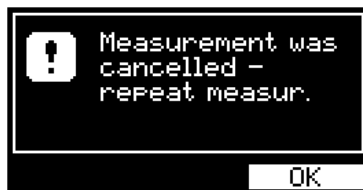


Figure 32: Warning message: Measurement was cancelled

ID is already in database

When you enter an ID which is already in the database, then an acoustic signal sounds and the display shows the warning message (Figure 33).



Figure 33: Warning message: ID is already in database

Test leads: Rpe >2.0 Ω

The maximum value of the test leads' resistance is 2.0 Ω. When you try to compensate for a higher value, an acoustic signal sounds and the display shows the warning message (Figure 34).

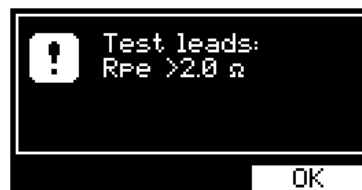


Figure 34: Warning message: Test leads: Rpe >2.0 Ω

Warning concerning of a point of danger

Read the User's Manual and observe all precautions! Symbol (Figure 35) highlights the fact that it is necessary to follow the safety instructions in the manual. A RISK OF INJURY OR DEVICE DAMAGE!



Figure 35: Warning concerning of a point of danger

Warning concerning a DUT isolated placing

Symbol (Figure 36) highlights the fact that all conductive parts must be isolated from accidental grounding.



Figure 36: Warning concerning a DUT isolated placing

Warning concerning heating the internal circuit when Rpe is measured

When low Rpe values are measured, it may overheat the internal circuit of the MDtest. We recommend performing the measurements for a max. of 30 secs. (only for value $<10.00 \Omega$). If the temperature inside exceeds the allowed limit, the symbol (Figure 37) is displayed and the acoustic signal sounds.



Figure 37: Warning concerning heating the internal circuit when Rpe is measured

7.2.2 Operational information

Measuring in progress

An animated symbol indicates that the measurement is running (Figure 38). It is displayed only during measurement and a LED indicator **33** simultaneously flashes.



Figure 38: Measuring in progress

Locking the measurement

The locking can be cancelled by pressing the [TEST] key or any key except for [▼] and [esc].



Figure 39: Locking the measurement

Automatically locking the measurement

The locking can be cancelled by pressing the [TEST] key or any key except for [▼] and [esc]. This setting can be enabled / disabled in Setup menu, see chapter 6.5.6.



Figure 40: Automatically locking the measurement

HOLD function

By pressing and releasing the [▼] key, the last measured value is displayed even if the measurement has either ended or is in progress. The HOLD function can be cancelled (measurement is still in progress) by pressing and releasing the [▼] key.



Figure 41: HOLD function

Test sequence

After activation, the test sequence symbol is displayed (Figure 42).



Figure 42: Test sequence

Measured value is out of range

If the value is higher / lower than max. / min. range, the maximal / minimal value is displayed with the symbol > "higher than" (Figure 43) or < "lower than" (Figure 44).



Figure 43: Measured value is out of range (max)



Figure 44: Measured value is out of range (min)

7.2.3 Setting information

Test leads compensation

The test leads' resistance is measured and then automatically memorized and subtracted from Rpe measurement (see chapter 4.3.1).



Figure 45: Test leads compensation

Incorrect compensation for the test leads

If the measured value is less than the saved compensation value during measurement (after subtraction, the memorized resistance will result in a negative number), the display shows the absolute value and the symbol **CAL** on the display appears inversely (Figure 46). In this case, it is necessary to perform the compensation again (see chapter 4.3.1).



Figure 46: Incorrect compensation for the test leads

External input activation

After activation of the external input **10**, a symbol is displayed (Figure 47). The Test Socket **1** is not active.



Figure 47: External input activation

7.2.4 Database information

The appliance has associated data about a performed measurement

When data transfer from the temporary memory to the main memory is performed, then the symbol is displayed. The symbol is displayed even if no measurement has been performed.



Figure 48: The appliance has associated data about a performed measurement

The appliance has associated data about a test sequence

The procedure is activated automatically after loading the appliance data from the temporary memory to the main memory (see chapter 5.6).

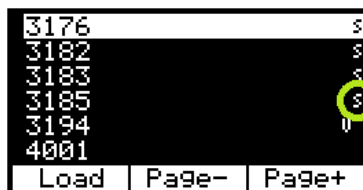


Figure 49: The appliance has associated data about a test sequence

7.3 Reset of the instrument

It is advised to execute an instrument RESET in the event of a malfunction. Disconnect the MDtest from mains, wait 30 s and plug it in again. If problems occur with the database system of MDtest, please reset the device and erase the memory (see chapter 6.5.5).

Attention! All data stored in the main memory will be lost.

If malfunction persists, contact your local distributor.

7.4 Utilization of other external adapters

7.4.1 Adapter for testing extension power supply cords (P 8030)

The adapter is designed to measure the continuity of the protective circuit extension cords. It facilitates the work and significantly improves the contact of their PE pins. Connect the banana plug adapter into the **RPE** terminal, plug the adapter into Test Socket **1** on the front panel MDtest and perform the test lead resistance compensation of the adapter (see chapter 4.3.1).

Then connect the plug of the measured extension cord into Test Socket **1**, lock the measurement (see chapter 4.3) and plug the adapter into the socket of the tested extension cord. The resistance of the PE circuit is now measured.

7.4.2 Three-phase adapter (P 8015-8018)

The three-phase adapter must be used for measuring three-phase appliances with a movable power supply cord. It is necessary to plug in tested appliance by means of the three-phase adapter and to select the required measuring method by means of the three phase adapter's function switch before measurement.

The three-phase adapters are produced in different versions:

P 8015 - Three-phase adapter, 16 A socket, 5 contacts

P 8016 - Three-phase adapter, 16 A socket, 4 contacts

P 8017 - Three-phase adapter, 32 A socket, 5 contacts

P 8018 - Three-phase adapter, 32 A socket, 4 contacts

7.5 Maintenance

Regularly check the technical safety and integrity of the insulation on the power supply cord, plastic case and all accessories. The plastic case should not be polluted with substances which can noticeably degrade the case's insulation quality.

Use soft cloth, slightly moistened with lukewarm soap water to clean the plastic case. Do not spill cleaning liquid over the instrument! Do not use cleaning liquids based on petrol, hydrocarbons, etc.

Wait until the instrument becomes totally dry before using it!



WARNING

Do not expose the instrument to temperatures over 70 °C. If this temperature is exceeded, the plastic case can be damaged!

7.6 Recurrent tests and testing after repair

The MDtest is powered with a mains voltage of 230 V / 50 or 60 Hz and therefore all recurrent tests and testing after repair should be done in accordance with local regulations.

Insulation resistance between LN and PE in the MDtest must not be measured because of varistors in EMC filter.

The protective conductor must produce a test current approx. 1.5 mA. If leakage current is measured (instead of insulation resistance measurement), the value must remain below:

- 3.5 mA if the Direct or Differential leakage current measurement has been chosen
- 7 mA if the Equivalent leakage current has been chosen

7.7 Calibration and service

Measuring instruments should be regularly calibrated. **We recommend an interval of calibration 2 year.**

Furthermore, we recommend carrying out calibration after each repair.

Please contact us to fix an appointment for the inspection and calibration of your test instruments, for the address see below:

ILLKO, s.r.o.

Masarykova 2226/18a

678 01 Blansko

Czech Republic

tel./fax: (+420) 516 417 355

e-mail: illko@illko.cz

<http://www.illko.cz>



WARNING

Unauthorized persons are not allowed to open the MDtest. There are no replaceable components inside the instrument.

Please remember to include your address, email contact, phone number and **description of any faults** with the package.

7.8 Ecology



Transportation packing

Transport packaging is made of corrugated cardboard; it is recyclable.



Instrument

This symbol signifies that the product should not be thrown away into municipal waste at its end-of-life.

Please dispose of this product according to the relevant statutory requirements.

8 Technical specification

8.1 General data

Protective class	II (double insulation)
Over voltage class	CAT II/300V
Pollution degree	2
Degree of protection	device: IP 40, test socket: IP 20

Reference condition:

Line voltage	230 V \pm 1 % / 50 Hz \pm 1 %
Ambient temperature	(23 \pm 2) °C
Humidity	45 \div 55 % @ 23 °C
Position	arbitrary

Operating condition:

Line voltage	230 V \pm 10 % / 50 Hz \pm 1 % or 60 Hz \pm 1 %
Ambient temperature	0 \div 40 °C
Humidity	75 % @ 23 °C (condensation not allowed)
Elevation	max. 2 000 m
Supply current	max. 16 A (it depends on tested appliance, time limit)
Quiescent current	< 25 mA
Dimensions (w x d x h)	250 x 195 x 50 mm
Mass (without accessories)	1.7 kg
Storage temperature / storage humidity	-10 \div 50 °C / max. 70 %
Case resistance to temperature	70 °C
PE test	before the start of the measurement
PC connection	USB cable

8.2 Functions

Notes: R - reading, D - digit

8.2.1 Earth bond

Entire measuring range

0.000 \div 10.00 Ω

Measuring sub range 0.000 \div 0.999 Ω

Resolution	0.001 Ω
Reference error ($L_S < 200 \mu\text{H}$)	\pm (2 % of R + 6 D)
Operating error ($L_S < 200 \mu\text{H}$)	\pm (3 % of R + 8 D)

Measuring sub range 1.00 \div 10.00 Ω

Resolution	0.01 Ω
Reference error ($L_S < 200 \mu\text{H}$)	\pm (2 % of R + 5 D)
Operating error ($L_S < 200 \mu\text{H}$)	\pm (3 % of R + 7 D)
Operating range of use (according EN 61557-4)	0.030 \div 10.00 Ω
Open-circuit voltage	5 \div 12 V AC
Test current ($R \leq 1 \Omega$, depends on the variant).....	<input type="checkbox"/> ≥ 1.0 A AC
	<input type="checkbox"/> ≥ 0.2 A DC
Test lead compensation	yes (up to 2 Ω)

8.2.2 Insulation resistance

Entire measuring range	0.100 ÷ 100.0 MΩ
Measuring sub range 0.100 ÷ 3.999 MΩ	
Resolution	0.001 MΩ
Reference error	± (2 % of R + 8 D)
Operating error	± (3 % of R + 8 D)
Measuring sub range 4.00 ÷ 19.99 MΩ	
Resolution	0.01 MΩ
Reference error	± (2 % of R + 8 D)
Operating error	± (3 % of R + 8 D)
Measuring sub range 20.0 ÷ 100.0 MΩ	
Resolution	0.1 MΩ
Reference error	± (4 % of R + 15 D)
Operating error	± (5 % of R + 15 D)
Operating range of use (according EN 61557-2)	0.100 ÷ 100.0 MΩ
Nominal output voltage Un	500 / 250 V DC
Open-circuit voltage	(-0 %, +50 %) Un
Nominal test current	≥ 1 mA DC
Short-circuit current	< 10 mA DC
Self-test	2.000 ± 0.050 MΩ

8.2.3 Alternative leakage current

Entire measuring range	0.000 ÷ 20.00 mA
Measuring sub range 0.0000 ÷ 0.0999 mA¹	
Resolution	0.0001 mA
Reference error	± (2 % of R + 9 D)
Operating error	± (3 % of R + 9 D)
Measuring sub range 0.000 ÷ 3.999 mA	
Resolution	0.001 mA
Reference error	± (1 % of R + 8 D)
Operating error	± (2 % of R + 8 D)
Measuring sub range 4.00 ÷ 20.00 mA	
Resolution	0.01 mA
Reference error	± (1 % of R + 5 D)
Operating error	± (2 % of R + 5 D)
Operating range of use	0.028 ÷ 20.00 mA
Nominal open-circuit test voltage ... line voltage ± 15 %, line frequency ± 0.5 Hz	
Short-circuit current	< 3.5 mA
Internal resistance of test voltage source	> 80 kΩ
Self-test	0.100 ± 0.010 mA

¹When measuring patient leakage current and higher resolution (5 digits) is set.

8.2.4 Direct leakage current (TRMS AC+DC value)

Entire measuring range 0.000 ÷ 10.00 mA

Measuring sub range 0.000 ÷ 1.499 mA

Resolution 0.001 mA

Reference error ± (1 % of R + 3 D)

Operating error ± (1.5 % of R + 4 D)

Measuring sub range 1.50 ÷ 10.00 mA

Resolution 0.01 mA

Reference error ± (1 % of R + 5 D)

Operating error ± (2 % of R + 7 D)

Operating range of use 0.030 ÷ 10.00 mA

Test voltage line voltage

Frequency characteristic of internal test circuitry according IEC 62353:2014

Self-test 0.100 ± 0.010 mA

8.2.5 Direct leakage current (DC component)

Entire measuring range 0.00 ÷ 10.00 mA**

Resolution 0.01 mA

Reference error ± (2 % of R + 5 D)

Operating error ± (3 % of R + 8 D)

Operating range of use 0.30 ÷ 10.00 mA**

Test voltage line voltage

Frequency characteristic of internal test circuitry according IEC 62353:2014

(** the display shows the absolute value)

8.2.6 Differential leakage current

Entire measuring range 0.000 ÷ 10.00 mA

Measuring sub range 0.000 ÷ 0.999 mA

Resolution 0.001 mA

Reference error ± (2 % of R + 5 D + *X)

Operating error ± (3 % of R + 8 D + *X)

Measuring sub range 1.00 ÷ 10.00 mA

Resolution 0.01 mA

Reference error ± (2 % of R + 5 D + *Y)

Operating error ± (3 % of R + 5 D + *Y)

Operating range of use 0.036 ÷ 10.00 mA

Test voltage line voltage

Frequency characteristic of internal test circuitry according IEC 62353:2014

Self-test 0.100 ± 0.010 mA

*X = S (0.01 IΔ + 0.006) [D]

*Y = S (0.001 IΔ + 0.0006) [D]

S Apparent power of tested appliance [VA]

IΔ ... Displayed value of leakage current [mA]

8.2.7 Leakage current by means of three-phase adapter

Entire measuring range	0.00 ÷ 20.00 mA
Resolution	0.01 mA
Reference error	$\pm (3 \% \text{ of R} + 10 \text{ D})^2$
Operating error	$\pm (4 \% \text{ of R} + 15 \text{ D})^2$
Operating range of use	0.58 ÷ 20.00 mA

8.2.8 Apparent power

Entire measuring range	10 ÷ 3680 VA
Resolution	1 VA
Reference error	$\pm (3 \% \text{ of R} + 2 \text{ D})$
Operating error	$\pm (5 \% \text{ of R} + 5 \text{ D})$

8.2.9 Mains voltage UL-N

Entire measuring range	207.0 ÷ 253.0 V
Resolution	0.1 V
Reference error	$\pm (1 \% \text{ of R} + 2 \text{ D})$
Operating error	$\pm (2 \% \text{ of R} + 2 \text{ D})$

8.2.10 Current consumption

Entire measuring range	0.0 ÷ 16.0 A
Resolution	0.1 A
Reference error	$\pm (2 \% \text{ of R} + 1 \text{ D})$
Operating error	$\pm (3 \% \text{ of R} + 2 \text{ D})$

8.2.11 Current consumption by means of current clamp

Entire measuring range	0.0 ÷ 100.0 A
Resolution	0.1 A
Reference error	$\pm (3 \% \text{ of R} + 4 \text{ D})^2$
Operating error	$\pm (4 \% \text{ of R} + 4 \text{ D})^2$

8.2.12 Apparent power by means of current clamp

Entire measuring range	10 ÷ 9999 VA
Resolution	1 VA
Reference error	$\pm (5 \% \text{ of R} + 5 \text{ D})^2$
Operating error	$\pm (8 \% \text{ of R} + 5 \text{ D})^2$

²Current clamp or three-phase adapter error has to be considered additionally.



ILLKO, s.r.o., Masarykova 2226, 678 01 Blansko, Czech Republic



DECLARATION OF CONFORMITY

Apparatus Identification: MDtest (IL2550)
Apparatus Classification: Test and Measurement Equipment

Statement of Conformity:

Based on sample product test result using appropriate standards, and in accordance with the following EC directives ILLKO, s.r.o. hereby declares the MDtest (IL2550) to be in conformity with:

EC Directive LVD 2006/95/EC
EC Directive EMC 2004/108/EC

Sample Product Testing for EMC:

Tested by: INSTITUTE FOR TESTING AND CERTIFICATION, a.s.
Testing Laboratory No. 1004.3
Division 4 - MESIT QM
Sokolovská 573
Uherské Hradiště
Czech Republic

Standard used

ČSN EN 55011 ed.3:2010 +A1:2011
ČSN EN 61326-1 ed.2:2013
ČSN EN 61000-4-2 ed.2:2009
ČSN EN 61000-4-3 ed.3:2006+A1:2008 +A2:2011
ČSN EN 61000-4-4 ed.2:2005+A1:2010
ČSN EN 61000-4-5 ed.2:2007
ČSN EN 61000-4-6 ed.3:2009
ČSN EN 61000-4-11 ed.2:2005

As Czech implementation of

EN 55011:2009 +A1:2010
EN 61326-1:2013
EN 61000-4-2:2009
EN 61000-4-3:2006+A1:2007+A2:2010
EN 61000-4-4:2004+A1:2010
EN 61000-4-5:2006
EN 61000-4-6:2009
EN 61000-4-11:2004

Report ID: EMC: Test Report No. 41410274AE1, issued June 11, 2015 – Test Report about Electromagnetic Test on the Measuring Instrument MDtest (IL2550)

Sample Product Testing for safety:

Tested by: INSTITUTE FOR TESTING AND CERTIFICATION, a.s.
Testing Laboratory No. 1004.3
Division 4 - MESIT QM
Sokolovská 573
Uherské Hradiště
Czech Republic

Standard used

ČSN EN 61010-1 ed.2 :2011 6, A13: 2009, A14: 2010, Opr.4: 2010, A15: 2012
ČSN EN 61010-2-030:2011

As Czech implementation of

EN 61010:2010
EN 61010-2-030:2010

Report ID: LVD: Test Report No. 414102746AL1, issued June 30, 2015 – Test Report about Electric Safety Test on the Measuring Instrument MDtest (IL2550)

Issue Date: 2015-07-12

Ivo Lipovský
Product Manager



This manual is current when is delivered together with the device, but may not correspond to the older or newer version of firmware.

The firmware can be upgraded during calibration, repair, or by appointment. When the firmware was upgraded, please check our website www.illko.cz for modified User's manual.

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