DeltaPAT

MI 3309 BT

Instruction manual

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METREL®

Distributor:

Manufacturer:

Metrel d.d.
Ljubljanska cesta 77
SI-1354 Horjul

E-mail: metrel@metrel.si
http://www.metrel.si

CE Mark on your equipment certifies that this equipment meets the requirements of the EU (European Union) regulations concerning safety and electromagnetic compatibility

Table of contents

1. General description

The multifunctional portable appliance tester DeltaPAT is intended to perform measurements for testing the electrical safety of portable electrical equipment.
The following tests can be performed:

- visual inspection;
- earth continuity resistance;
- insulation resistance;
- insulation resistance of isolated accessible conductive parts;
- substitute leakage current;
- substitute leakage current of isolated accessible conductive parts;
- IEC cord polarity test;
- differential leakage current test;
- touch leakage test;
- RCD and PRCD tests, also PRCD-K and PRCD-S;
- power test;
- TRMS voltage;
- clamp current;
- functional test.

Some instrument's highlights:

- Power supply from both mains power and batteries;
- graphic LCD with resolution of 128 x 64 dots, with backlight;
- large data flash memory for storing test results and parameters (approx. 1500 tests can be stored);
- two communication ports (USB and RS232C) for communication with PC, barcode scanner, printer and RFID reader/writer;
- Bluetooth communication with PC, printers, and Android devices
- additional connectors for fixed appliances testing;
- built-in real time clock;
- fully compatible with new METREL PATLink PRO PC software package;

Powerful functions for fast and efficient periodic testing are included:

- pre-programmed test sequences;
- fast testing with the help of barcodes and RFID tags;
- custom test sequences can be uploaded from PC.

The graphic display with backlight offers easy reading of results, indications, measurement parameters and messages. Two LED Pass/Fail indicators are placed at the sides of the LCD.
The unit is very intuitive to use and has help menus describing how to perform each test. The operator therefore does not need any special training (except reading this instruction manual) to operate the instrument.

1.1. Warnings

In order to reach a high level of operator safety while carrying out various measurements using the instrument, as well as to keep the test equipment undamaged, it is necessary to consider the following general warnings:

- ⚠ **Warning on the instrument means »Read the Instruction manual with special care to safety operation«. The symbol requires an action!**
- **Read this instruction manual carefully, otherwise use of the instrument may be dangerous for the operator, for the instrument or for the equipment under test!**
- **If the test equipment is used in manner not specified in this instruction manual the protection provided by the equipment may be impaired!**
- **Do not use the instrument and accessories if any damage is noticed!**
- **Do not touch any test leads/terminals while the appliance is connected to the MI 3309 BT DeltaPAT.**
- **Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!**
- **Use only correctly earthed mains outlets to supply the instrument!**
- **The mains supply voltage has to be higher than 80 V a.c. otherwise the internal power supply could be damaged.**
- **Use only standard or optional test accessories, supplied by your distributor!**
- **Instrument servicing and adjustment have to be carried out by competent authorized personnel!**
- **Hazardous voltages can exist inside the instrument. Disconnect all test leads, remove the power supply cable and switch off the instrument before opening the battery or fuse compartment.**
- **Instrument contains rechargeable NiCd or NiMh battery cells. The cells should only be replaced with the same type as defined on the battery placement label or in this manual. Do not use alkaline battery cells.**
- **If a test code with an earth continuity test current higher than 200 mA is selected (manually, with barcode scanner or with RFID reader/writer) the DeltaPAT instrument will automatically perform the Earth continuity test with a 200 mA test current. Other test parameters remain unchanged. The operator must be competent to decide if performing the test with a 200 mA current is acceptable!**
- **If a test code with an Active polarity test is selected the DeltaPAT instrument will automatically perform Normal polarity test. The operator must be competent to decide if performing the Normal polarity test is acceptable!**

1.2. Battery and charging

The instrument uses six AA size rechargeable NiCd or NiMH battery cells. Alkaline battery cells are not allowed.
Battery condition is always displayed in the upper right corner of the display.
If the battery power becomes too weak, the instrument indicates this as shown in ***Figure 1.1***. This indication appears for a few seconds and then the instrument turns itself off.

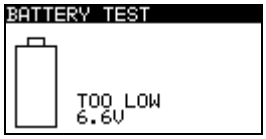


Figure 1.1: *Discharged battery indication*

The battery is charged whenever the instrument is connected to mains voltage. The instrument automatically recognizes the connection to the mains voltage and begins charging. Internal circuit controls charging and assures maximum battery lifetime.

Symbols:

	Indication of battery charging

Figure 1.2: *Charging indication on display*

- ⚠ **When connected to an installation, the instruments battery compartment can contain hazardous voltage inside! Before opening the battery compartment cover, disconnect all accessories connected to the instrument and switch off the instrument.**
- Ensure that the battery cells are inserted correctly otherwise the instrument will not operate and the batteries could be discharged.
- If the instrument is not to be used for a long period of time, remove all batteries from the battery compartment.
- Rechargeable NiCd or NiMH batteries type HR 6 (size AA) can be used. Metrel recommends only using rechargeable batteries with a capacity of 2100mAh or higher.

1.3. New battery cells or cells unused for a longer period

Unpredictable chemical processes can occur during the charging of new battery cells or cells that have been left unused for a longer period (more than 3 months). NiMH and NiCd cells can be subjected to these chemical effects (sometimes called the memory effect). As a result the instrument operation time can be significantly reduced during the initial charging/discharging cycles of the batteries.

In this situation, Metrel recommend the following procedure to improve the battery lifetime:

Procedure	**Notes**
‣ Completely charge the battery.	At least 14h with the in-built charger.
‣ Completely discharge the battery.	This can be performed by using the instrument normally until the instrument is fully discharged.
‣ Repeat the charge / discharge cycle at least 2-4 times.	Four cycles are recommended in order to restore the batteries to their normal capacity.

Note:

- The charger in the instrument is a pack cell charger. This means that the battery cells are connected in series during the charging. The battery cells have to be equivalent (same charge condition, same type and age).
- One different battery cell can cause an improper charging and incorrect discharging during normal usage of the entire battery pack (it results in heating of the battery pack, significantly decreased operation time, reversed polarity of defective cell,…).
- If no improvement is achieved after several charge / discharge cycles, then each battery cell should be checked (by comparing battery voltages, testing them in a cell charger, etc). It is very likely that only some of the battery cells are deteriorated.
- The effects described above should not be confused with the normal decrease of battery capacity over time. Battery also loses some capacity when it is repeatedly charged / discharged. Actual decreasing of capacity, versus number of charging cycles, depends on battery type. This information is provided in the technical specification from battery manufacturer.

1.4. Standards applied

The DeltaPAT is manufactured and tested in accordance with the following regulations:

Electromagnetic compatibility (EMC)	
EN 61326	Electrical equipment for measurement, control and laboratory use – EMC requirements Class B (Hand-held equipment used in controlled EM environments)
Safety (LVD)	
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
EN 61010-2-030	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits
EN 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test
EN 61010-2-032	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement
Functionality	
EN 61557	Electrical safety in low voltage distribution systems up to 1000 V_{AC} and 1500 V_{AC} – Equipment for testing, measuring or monitoring of protective measures Part 2 Insulation resistance Part 4 Resistance of earth connection and equipotential bonding
VDE 0404-1	Testing and measuring equipment for checking the electric safety of electric devices - Part 1: General requirements
VDE 0404-2	Testing and measuring equipment for checking the electric safety of electric devices - Part 2: Testing equipment for tests after repair, change or in the case of repeat tests
Other reference standards for testing portable appliances	
VDE 0701-702	Inspection after repair, modification of electrical appliances – Periodic inspection on electrical appliances General requirements for electrical safety
NEN 3140	Guidelines for safe working practices The IEE Code of Practice for In-service Inspection and Testing of Electrical Equipment 3rd edition

Note about EN and IEC standards:

- Text of this manual contains references to European standards. All standards of EN 6XXXX (e.g. EN 61010) series are equivalent to IEC standards with the same number (e.g. IEC 61010) and differ only in amended parts required by European harmonization procedure.

2. Instrument description

2.1. Front panel

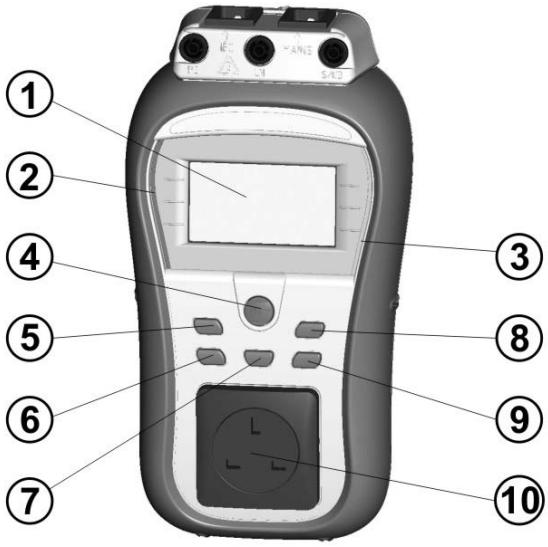


Figure 2.1: *Front panel*

Legend:

1	LCD	128 x 64 dots matrix display with backlight.
2	FAIL	Red indicator — Indicates PASS / FAIL of result.
3	PASS	Green indicator
4	TEST	Starts testing / confirms selected option.
5	UP	Selects parameter / changes value of selected parameter.
6	DOWN	
7	MEM	Store / recall / clear tests in memory of instrument.
8	TAB	Selects the parameters / item / option in selected function.
9	ON / OFF	Switches the instrument power on or off. To switch the instrument Off the key must be pressed for 2 seconds. The instrument automatically turns off in 15 minutes after the last key was pressed.
	ESC	Returns to previous level.
10		Test socket.

2.2. Connector panel

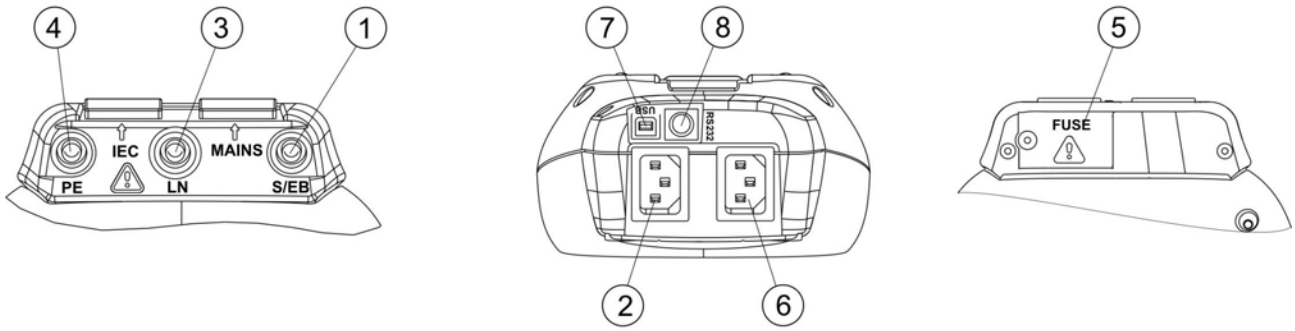


Figure 2.2: *Connector panel*

Legend:

1	S/EB	Probe and Earth continuity terminal
2	IEC	IEC test terminal
3	LN	LN terminal (for connection of fixed installed appliances)
4	PE	PE terminal (for connection of fixed installed appliances)
5	FUSE compartment	Fuses: 2 x T16 A / 250 V; breaking capacity: 1500 A (for protection against overload and short circuit)
6	MAINS	Mains supply connector and test terminal. (Used for charging, Voltage and (P)RCD tests also)
7	USB connector	Communication with PC USB (1.1) port.
8	PS/2 connector	Communication with barcode scanner. Communication with printer. Communication with RFID reader/writer. Communication with PC RS232 port. Initialization of Bluetooth Dongle.

Warning:

- **Maximum allowed voltage on MAINS terminal is 300 V (CAT II)!**

2.3. Back side

Figure 2.3: *Back side*

Legend:

1	Inserts for side belt
2	Battery compartment cover
3	Fixing screw for battery compartment cover
4	Back side information label
5	Holder for inclined position of the instrument

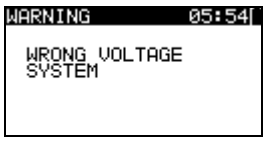
Figure 2.4: *Battery compartment*

Legend:

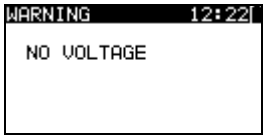
1	Battery cells	Type HR 6 (size AA), rechargeable NiMH / NiCd
2	Serial number label	

2.4. Meaning of symbols and messages on the instrument display

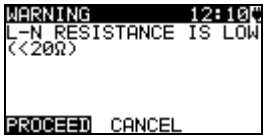
Before performing a measurement, the instrument performs a series of pre-tests to ensure safety and to prevent any damage. These safety pre-tests are checking for any external voltage and load condition on test terminals. If a pre-test fails, an appropriate warning message will be displayed. Warnings and protective measures are described in this chapter.



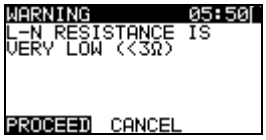
WARNING!
Improper supply voltage warning. Possible causes:
- no earth connection or other wiring problem on supply socket,
- instrument is connected to 110 V or IT earthing supply system.



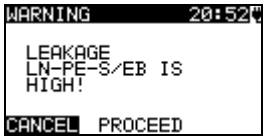
WARNING!
No voltage was detected on the mains input. Check mains connection.



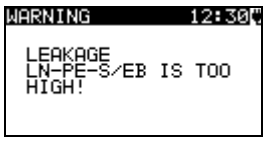
WARNING!
A low resistance of the appliance' supply input was measured in the pre-test. This means that most likely a high current will flow after applying power to the tested appliance. If the high current is only of short duration (caused by a short inrush current) the test can be performed, otherwise not.
Select **PROCEED** or **CANCEL**.



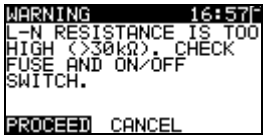
WARNING!
A very low resistance of the appliance' supply input was measured in the pre-test. It is likely that fuses will blow after applying power to the tested appliance. If the too high current is only of short duration (caused by an inrush current) the test can be performed otherwise it must be stopped.
Select **PROCEED** or **CANCEL**. **It is recommended to additionally check the appliance before proceeding with the test!**



WARNING!
A high leakage current (higher than 3.5 mA) will flow if power would be connected to the tested appliance.
Select **PROCEED** or **CANCEL. Proceed with testing only if all safety measures have been taken.**



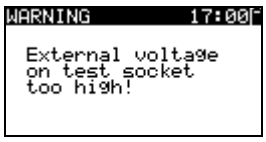
WARNING!
A dangerous leakage current (higher than 20 mA) will flow if power would be connected to the tested appliance. The instrument blocks the test.



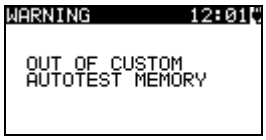
WARNING!
A high resistance between L and N was measured in the fuse pre-test. This indication means that the device under test has very low power consumption or it is:

- not connected;
- switched off;
- contains a fuse that has blown.

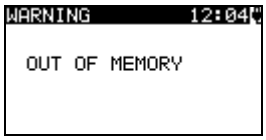
Select **PROCEED** or **CANCEL**.



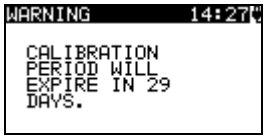
WARNING!
Voltage on test socket or IEC test terminal is higher than approximately 20 V (AC or DC)!
Disconnect the device under test from the instrument immediately and determine why an external voltage was detected!



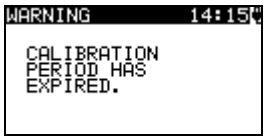
WARNING!
The custom autotest memory has reached the limit of 50 sequences.



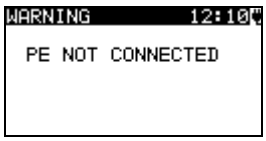
WARNING!
The internal memory is full!



WARNING!
The calibration period will expire in less than 1 month. The instrument counts down the days.



WARNING!
The calibration period has expired. Recalibrate the instrument!



PE between test socket and IEC test terminal is not connected!

The instrument detects a serious failure. Switch OFF the instrument. Disconnect all cables and leads. Switch ON the instrument again.
Return the instrument to the repair center if the message is displayed again.

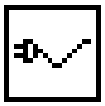
WARNING!
A high voltage will be present on the output of the instrument!

WARNING!
A high insulation test voltage is present on the output of the instrument.

Measurement is in progress.

Test result can be saved.

Connect the test lead to the S/EB test terminal.



Flex the mains cable of appliance during the test.

Test lead resistance in Earth Continuity measurement is compensated.

Check that the device under test is switched on (to ensure that the complete circuit is tested).

Connect the cord to be tested to the IEC test terminal.

The results of the Substitute leakage current / Substitute leakage - P tests are calculated on base of a 110 V power supply.

Indicate which connection in the test socket is over the limit. (blank contact - under limit, filled contact - over limit)

RCD must be switched on.

Change position of mains cord before RCD test.

Test passed.

Test failed.

Measurement was aborted due to improper conditions during the test.

2.4.1. Battery indication

The indication shows the charge condition of battery and connection of external charger.

Battery capacity indication.

Low battery.
Battery is too weak to guarantee correct result.
Replace or recharge the battery cells.

Instrument is connected to the mains (and is charging)

3. Technical specifications

3.1. Earth continuity

Range	Resolution	Accuracy
0.00 Ω ÷ 19.99 Ω	0.01 Ω	±(5 % of reading + 3 digits)
20.0 Ω ÷ 199.9 Ω	0.1 Ω	Indication only
200 Ω ÷ 1999 Ω	1 Ω	

Powered by..... battery or mains
Test currents..... 200 mA into 2.00 Ω
Open circuit voltage ..... <9 V AC
Test lead compensation..... up to 5 Ω
Pass levels..... 0.10 Ω, 0.20 Ω, 0.30 Ω, 0.40 Ω, 0.50 Ω, 0.60 Ω, 0.70 Ω, 0.80 Ω, 0.90 Ω, 1.00 Ω, 1.50 Ω, 2.00 Ω
Test duration..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s
Test method..... 2-wire measurement
Test terminals ..... PE (Test socket) ↔ S/EB (probe)
PE (IEC Cord) ↔ PE (Test socket)
PE (terminal) ↔ S/EB (probe) (for fixed installed appliances)

3.2. Insulation resistance, Insulation – P resistance

Range	Resolution	Accuracy
0.00 MΩ ÷ 19.99 MΩ	0.01 MΩ	±(5 % of reading + 3 digits)
20.0 MΩ ÷ 49.9 MΩ	0.1 MΩ	
50.0 MΩ ÷ 199.9 MΩ	0.1 MΩ	Indication only

Powered by..... battery or mains
Nominal voltages ..... 250 V DC, 500 V DC (- 0 %, + 10 %)
Measuring current..... min. 1 mA at 250 kΩ (250 V), 500 kΩ (500 V)
Short circuit current..... max. 2.0 mA
Pass levels..... 0.01 MΩ, 0.10 MΩ, 0.25 MΩ, 0.30 MΩ, 0.50 MΩ, 1 MΩ, 2 MΩ, 4 MΩ, 7 MΩ, 10 MΩ, --- MΩ
Test duration..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s

Test terminals (Insulation)..... LN (Test socket) ↔ PE (Test socket)
LN (terminal) ↔ PE (terminal) (for fixed installed appliances)
LN (Test socket) ↔ S/EB (probe)
LN (terminal) ↔ S/EB (probe) (for fixed installed appliances)

Test terminals (Insulation-P)..... LN (Test socket) ↔ S/EB (probe)
LN (terminal) ↔ S/EB (probe) (for fixed installed appliances)

3.3. Substitute leakage current

Range	Resolution	Accuracy
0.00 mA ÷ 9.99 mA	0.01 mA	±(5 % of reading + 3 digits)
10.0 mA ÷ 20.0 mA	0.1 mA	

Powered by..... battery or mains
Open circuit voltage ..... <50 V AC at rated mains voltage
Short circuit current..... <40 mA
Pass levels:
Substitute leakage ..... 0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2,25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10.0 mA, 15.0 mA, ---- mA
Test duration..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s
Displayed current..... calculated to appliance nominal mains supply voltage (110 V or 230 V)

Test terminals (Sub. leakage)... LN (Test socket) ↔ PE (Test socket)
LN (terminal) ↔ PE (terminal) (for fixed installed appliances)
LN (Test socket) ↔ S/EB (probe)
LN (terminal) ↔ S/EB (probe) (for fixed installed appliances)

3.4. Substitute leakage – P current

Range	Resolution	Accuracy
0.00 mA ÷ 4.99 mA	0.01 mA	±(5 % of reading + 3 digits)

Powered by..... battery or mains
Open circuit voltage ..... <50 V AC at rated mains voltage
Short circuit current..... <40 mA
Pass levels:
Substitute leakage - P..... 0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2,00 mA, --- mA
Test duration..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s
Displayed current..... calculated to appliance nominal mains supply voltage (110 V or 230 V)

Test terminals (Sub. leakage-P) LN (Test socket) ↔ S/EB (probe)
LN (terminal) ↔ S/EB (probe) (for fixed installed appliances)

3.5. Polarity test

Powered by..... battery or mains
Test voltage ..... <50 V AC
Detects..... PASS, L OPEN, N OPEN, PE OPEN, L-N CROSS, L-N SHORT, L-PE SHORT, N-PE SHORT, MULTIPLE FAULT.

Test terminals ..... Test socket ↔ IEC test terminal

3.6. Differential leakage current

Range	Resolution	Accuracy
0.00 mA ÷ 19.99 mA	0.01 mA	±(5 % of reading + 5 digits)

Apparent power ..... Indication only
Influence of load current…….≤ 0.01mA / A

Powered by..... mains
Pass levels:..... 0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10.00 mA, 15.00 mA, ---- mA
Test duration:..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s, --- s
Frequency response: ..... complies with EN61010-1 Figure A1

Test terminals ..... Test socket

* Measurement is limited to 120 s if (I_{load} > 10 A).

3.7. Touch leakage current

Range	Resolution	Accuracy
0.00 mA ÷ 7.00 mA	0.01 mA	±(10 % of reading + 5 digits)

Apparent power .....Indication only

Powered by.....mains
Pass levels:.....0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA 2.25 mA, 2.50 mA, 3.50 mA, --- mA
Test duration:.....2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s, --- s
Frequency response .....complies with EN61010-1 Figure A1

Test terminals .....Test socket – EB/S test probe

* Measurement is limited to 120 s if (I_{load} > 10 A).

3.8. PRCD and RCD testing

3.8.1. General RCD Trip-out time

Complete measurement range corresponds to EN 61557-6 requirements.
Maximum measuring times set according to selected reference for RCD testing.

Range	Resolution	Accuracy
0 ms ÷ 1999 ms (½×$I_{\Delta N}$)	0.1 ms	±3 ms
0 ms ÷ 300 ms ($I_{\Delta N}$)	0.1 ms	
0 ms ÷ 40 ms (5×$I_{\Delta N}$)	0.1 ms	±1 ms

Powered by..... mains
Test current..... ½×$I_{\Delta N}$, $I_{\Delta N}$, 5×$I_{\Delta N}$ ($I_{\Delta N}$ = 10 mA, 15 mA, 30 mA)
Start angle ..... 0°, 180°, both
Test modes..... single, autotest

Test terminals MAINS terminal

Specified accuracy is valid for complete operating range.

3.8.2. Portable RCD trip-out time

Range	Resolution	Accuracy
0 ms ÷ 1999 ms(½×$I_{\Delta N}$)	0.1 ms	±3 ms
0 ms ÷ 300 ms ($I_{\Delta N}$)	0.1 ms	
0 ms ÷ 40 ms (5×$I_{\Delta N}$)	0.1 ms	±1 ms

Powered by..... mains
Test current..... ½×$I_{\Delta N}$, $I_{\Delta N}$, 5×$I_{\Delta N}$ ($I_{\Delta N}$ = 10 mA, 15 mA, 30 mA)
Start angle ..... 0°, 180°, both
Test modes..... single, autotest

Test terminals Test socket – IEC test terminal

Specified accuracy is valid for complete operating range.

3.9. Power

Apparent power

Range	Resolution	Accuracy
0.00 kVA ÷ 4.00 kVA	0.01 kVA	±(5 % of reading + 3 digits)

Current

Range	Resolution	Accuracy
0.00 A ÷ 16.00 A	0.01 A	±(5 % of reading + 3 digits)

Powered by..... mains
Test duration:..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s, --- s
Test terminals ..... MAINS terminal

* Measurement is limited to 120 s if (I_{load} > 10 A).

3.10. TRMS Voltage

Range	Resolution	Accuracy
80 ÷ 300 V	1 V	±(2 % of reading + 2 digits)

Result type..... True r.m.s.
Nominal frequency range..... 0 Hz, 50 Hz ÷ 60 Hz
Frequency accuracy ..... Indication only

Test terminals ..... MAINS terminal

3.11. Clamp current

True RMS current using 1000:1 current clamp (A 1283)

Range	Resolution	Accuracy*
0.00 mA ÷ 9.99 mA	0.01 mA	±(5 % of reading + 10 digits)
10.0 mA ÷ 99.9 mA	0.1 mA	±(5 % of reading + 5 digits)
100 mA ÷ 999 mA	1 mA	±(5 % of reading + 5 digits)
1.00 A ÷ 9.99 A	0.01 A	±(5 % of reading + 5 digits)
10.0 A ÷ 16.0 A	0.1 A	±(5 % of reading + 5 digits)

***It does not consider accuracy of current transformer.

Pass levels:..... 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10.00 mA, 15.00 mA, ---- mA
Test duration [s]:..... 2, 3, 5, 10, 30, 60, 120, none
Test terminals ..... Clamp inputs ↔ PE (terminal), LN (terminal)

Temperature coefficient outside reference temperature limits is 1 % of measured value per °C

3.12. General data

Power supply voltage..... 9 V_{DC} (6×1.2 V NiMH or NiCd battery, type HR 6) (size AA)
Operation..... typical 8 h
Battery charging current..... 250 mA (internally regulated)

Overvoltage category..... CAT II / 300 V

Protection classification ..... double insulation
Pollution degree..... 2
Protection degree case..... IP 40
Protection degree test connectors .... IP 20

Display..... 128 x 64 dots matrix display with backlight

Dimensions (w × h × d) ..... 14 cm × 8 cm × 26 cm
Weight ..... 1.14 kg, without battery cells

Reference conditions:
Reference temperature range..... 10 °C ÷ 30 °C
Reference humidity range..... 40 %RH ÷ 70 %RH

Operation conditions:
Working temperature range ..... 0 °C ÷ 40 °C
Maximum relative humidity ..... 95 %RH (0 °C ÷ 40 °C), non-condensing

Storage conditions:
Temperature range ..... -10 °C ÷ +70 °C
Maximum relative humidity ..... 90 %RH (-10 °C ÷ +40 °C)
80 %RH (40 °C ÷ 60 °C)

The error in operating conditions could be at most the error for reference conditions (specified in the manual for each function) +1 % of measured value + 1 digit, unless otherwise specified in the manual for particular function.

Memory.....1500 memory locations

Communication transfer speed:
RS232 interface..... 9600 bps, 1 start bit, 8 data bits, 1 stop bit
RS232 connector ..... PS/2 connector, female
USB interface..... 115200 bps
USB connector..... type B
Bluetooth interface..... 115200 bps

Protection pre-tests:
- External voltage between LN and PE (DC and AC).
- Excessive leakage between S/EB and PE (DC and AC).
- L-N resistance is low or very low.

Connectivity (fuse) pre-test:
- Appliance is not switched on or there is too high resistance between L and N.

Maximum resistance for connectivity pre-test.....30 kΩ

4. Main menu and test modes

4.1. Instrument Main menu

From the Main menu of the instrument there are five instrument operation modes, Help menu and Setup menu can be selected:

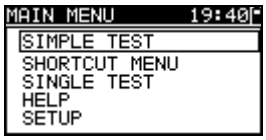


Figure 4.1: *Instrument Main menu*

Keys:

▲ / ▼ **TAB**	Select one of the following menu items: <**SIMPLE TEST**> simple pre-programmed sequences, can be redefined by the user, see *chapter 6.1 Simple test.* <**SHORTCUT MENU**> code based pre-programmed test sequences, suitable for working with barcodes, QR codes and RFID tags, see chapter *6.2 Shortcut test sequences*; <**SINGLE TEST**> individual tests, see *chapter 5 Single test*; <**HELP**> help screens; <**SETUP**> menu for setup of the instrument, see *chapter 4.6 Setup menu*;
TEST	Confirms selection.

4.2. Simple test menu

By default this menu contains a list of simple test sequences. Up to 50 custom autotest sequences can be pre-programmed in this testing mode. Customized test sequences can also be downloaded to and/or uploaded from the PC SW PATLink PRO.

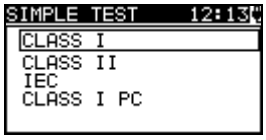


Figure 4.2: *Simple test menu*

See chapter *6.1 Simple test* for detailed description about this test mode.

Note:

- Limits of the CLASS I, CLASS II, IEC, CLASS I PC tests are shown in *Appendix B*

4.3. Shortcut menu

In this menu are all the most popular pre-defined autotest sequences that can be selected and performed *(shown in Appendix C)*. When an autotest sequence has been completed, the measurement results ***can*** be stored into instrument internal memory.

Figure 4.3*:* Autotest shortcut menu example

See chapter *6.3 Carrying out (Simple, Shortcut) test sequences*.

4.4. Single test menu

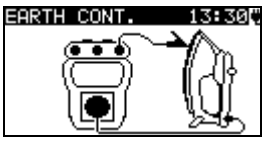
In single test menu individual tests can be performed.

Figure 4.4: *Single test menu*

See chapter *5 Single test* for more information.

4.5. Help menu

Help menu contains schematic diagrams to illustrate how to correctly connect a device under test to the PAT testing instrument.



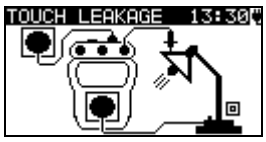


Figure 4.5: *Example of help screens*

Keys:

▲/▼	Selects next / previous help screen.
TEST, ESC	Returns to ***Main menu*****.**

4.6. Setup menu

In the Setup menu different parameters and settings of the instrument can be viewed or set.

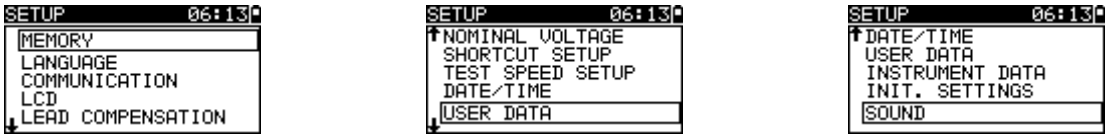


Figure 4.6: *Setup menu*

Keys:

⮝ / ⮟	Select the setting to adjust or view: <**MEMORY**> to recall, print or clear stored results, print labels and write RDIF tags; <**LANGUAGE**> instrument language; <**COMMUNICATION**> Communication and printer settings; <**LCD**> LCD contrast and backlight settings; <**LEAD COMPENSATION**> Compensates test lead in Earth continuity function; <**NOMINAL VOLTAGE**> used for calculation in Substitute leakage function; <**SHORTCUT SETUP**> to select the advance or basic shortcut codes; <**TEST SPEED SETUP**> to select the speed of the test; <**DATE/TIME**> date and time; <**USER DATA**> user data settings (initials); <**INSTRUMENT DATA**> basic instrument information; <**INIT. SETTINGS**> factory settings, <**SOUND**> sound control.
TEST	Confirms selection.
ESC	Returns to the ***Main menu***.

4.6.1. Memory

In the Memory menu stored results can be recalled, printed or deleted. Labels can be printed and RFID tags can be written in this menu.

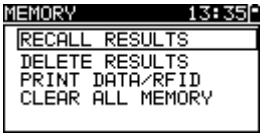


Figure 4.7: *Memory menu*

See chapter *7 Working with autotest results* for more information.

4.6.2. Language selection

The instrument language can be set in this menu.

Figure 4.8: *Language menu*

Keys:

⮝ / ⮟	Selects the language.
TEST	Confirms selection and returns to ***Setup menu*****.**
ESC	Returns to ***Setup menu*** without changes.

4.6.3. Communication

In this menu communication ports can be configured and the printer can be set.

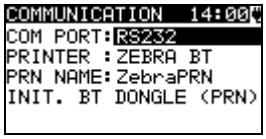


Figure 4.9: *Communication menu*

Options:

COM PORT	USB: communication with PC RS232: communication with external devices (printer, scanner, RFID reader/ writer, PC)
PRINTER	Selects the printer (can be a RS232 or Bluetooth printer)
PRN NAME	Enters menu for searching for Bluetooth printer.
INIT. BT DONGLE (PRN)	Initializes Bluetooth dongle for the printer.

Keys:

⮝ / ⮟	Selects item to be changed.
TEST	Selects option and confirms**.**
ESC	Returns to ***Setup menu***. Displayed settings are saved.

Note:

- For operation with some external devices the communication port is reconfigured automatically while communication with the device is active. For example, if a RS232 printer is connected to the output of the instrument it will work regardless how the COM PORT is set.

4.6.3.1. Searching for the Bluetooth printer and pairing with instrument

In the *Searching menu* a Bluetooth printer can be found, selected and paired with the instrument.

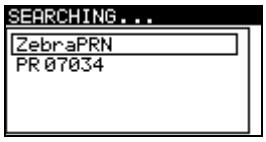


Figure 4.10: *Selection of Bluetooth printer*

Keys:

▲ / ▼	Selects the printer from the list of found Bluetooth devices.
TEST	Confirm selection of a printer (eg. ZebraPRN)**.**
ESC	Returns to ***Communication menu*** *without selection of a printer*.

Notes:

- This operation must be performed when working with the printer for the first time or if the printer was changed.
- Bluetooth printers can also be operated from some Metrel Android applications. In this case the Bluetooth printer must be selected and paired with the instrument and the Android device. For more information refer to chapter 8.3 Bluetooth communication and Metrel Android application manual.

4.6.3.2. Initialization of the Bluetooth dongle

Initialization procedure (Bluetooth dongle for the printer):

1. Connect printer's Bluetooth dongle A 1436 to the instrument's PS/2 port.
2. Press RESET key on the Bluetooth dongle A 1436 for **at least 10 seconds.**
3. Select INIT. BT DONGLE (PRN) in Communication menu and press TEST.
4. Wait for confirmation message and beep. Following message is displayed if dongle was initialized properly:

   EXTERNAL BT DONGLE SEARCHING OK!

5. Connect successfully initialized Bluetooth dongle A 1436 to the printer using RS-232 to PS2 interface cable.

Notes:

- The Bluetooth dongle A 1436 should always be initialized before first use with the printer.
- For more information about communication via Bluetooth refer to chapter *8. Communication* and A 1436 manual.

4.6.4. LCD contrast and backlight

In this menu the contrast and backlight mode of the LCD can be set.

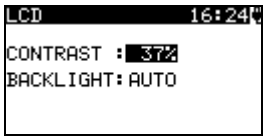


Figure 4.11: *LCD contrast menu*

Backlight modes:

AUTO	The high backlight level is active for 30 seconds after last pressing of any key. Then the backlight level returns to low level until a key is pressed again.
OFF	Backlight level is low.
ON	Backlight level is high.

Keys:

TAB	Toggles between setup of contrast and backlight
/	Sets contrast value or backlight mode
TEST	Confirms selection and returns to ***Setup menu***.
ESC	Returns to ***Setup menu*** without changes.

Note:

- If you press the down () key while starting up the instrument you will automatically jump to the LCD contrast menu.
- While the instrument is connected to mains voltage the backlight is automatically switched to the HIGH level.

4.6.5. Test lead compensation

In this menu the Test lead used for Earth continuity function can be compensated.

Figure 4.12*: Lead Compensation screen*

Keys:

TEST	Compensates test lead resistance.
ESC	Returns to ***Setup menu***.

Compensation of test lead resistance procedure:

1. Connect test lead(s) to the instrument between:
   a) PE terminal and S/EB terminal (see *Figure 4.12*), or
   b) Test socket PE terminal and S/EB terminal.
2. Press **TEST** key to perform resistance measurement and compensation of lead(s) resistance**.**

Notes:

- CAL Symbol is displayed if the compensation was carried out successfully.
- The highest value for lead compensation is 5 Ω. If the resistance is higher the compensation value is set back to default value.

4.6.6. Nominal voltage selection

The DeltaPAT instrument supports testing of 110 V and 230 V portable appliances. For 110 V appliances the substitute leakage current results should be scaled to 110 V.
The appliance nominal voltage can be set in this menu.

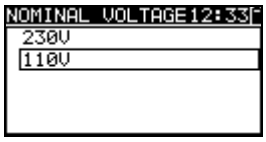


Figure 4.13: *Nominal voltage menu*

Keys:

⮝ / ⮟	Selects the appliance nominal voltage.
TEST	Confirms selection and returns to ***Setup menu*****.**
ESC	Returns to ***Setup menu*** without changes.

Note:

- The 110 icon is displayed in the Substitute leakage and Substitute leakage-P screens if the nominal voltage 110 V is set.
- The substitute leakage results will be lower if the nominal voltage is set to 110 V!
- Take care that the nominal voltage is set correctly!

4.6.7. Shortcut setup

In this menu the available list of available shortcut codes can be set. Basic Shortcuts only makes the most important shortcuts available in the Shortcut menu while the Advanced Shortcuts makes all shortcuts available from the Shortcut Menu.

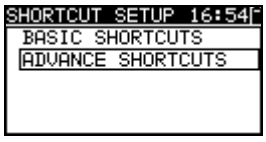


Figure 4.14: *Shortcut setup menu*

Options:

BASIC	A limited list of (most popular) test sequences is set.
ADVANCED	The complete list of test sequences (supported by METREL) is set.

Keys:

⮝ / ⮟	Selects the list.
TEST	Confirms selection and returns to ***Setup menu.***
ESC	Returns to ***Setup menu*** without changes.

4.6.8. Test speed setup

In this menu the instrument test speed can be set:

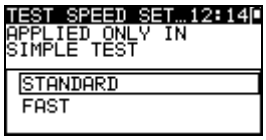


Figure 4.15: *Test speed menu*

Options:

STANDARD Default option.
FAST No pauses during tests (default).

Keys:

⮝ / ⮟	Selects the speed mode.
TEST	Confirms selection and returns to ***Setup menu.***
ESC	Returns to ***Setup menu*** without changes.

Note:

- When enabling the fast mode then Visual inspection and Functional Test will be automatically set to PASS.

4.6.9. Setting date and time

Date and time can be set in this menu.

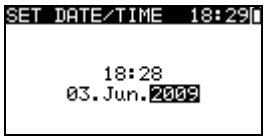


Figure 4.16: *Date and time menu*

Keys:

TAB	Selects the field to be changed.
⮝ / ⮟	Modifies selected field.
TEST	Confirms selection and returns to ***Setup menu*****.**
ESC	Returns to ***Setup menu*** without changes.

Note:

- Date is attached to each stored autotest result.

Warning:

- If the batteries are removed for more than 1 minute the set time and date will be lost.

4.6.10. User data

User data can be set in this menu.

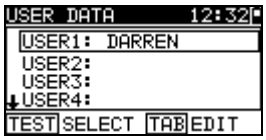


Figure 4.17: *User data menu*

Keys:

⮝ / ⮟	Selects the user name.
TEST	Confirms selection and returns to ***Setup menu*.**
ESC	Returns to ***Setup menu*** without changes.
TAB	Enters ***Edit user data menu***.

Edit user data:

Figure 4.18: *Edit user data menu*

Keys:

⮝ / ⮟	Selects a letter.
TEST	Selects the next letter.
MEM	Confirms name and returns to ***User data menu***.
ESC	Deletes last letter. Returns to ***User data menu*** without changes.

Notes:

- The selected user will be printed on the simple label (initials).
- Five different user names can be set.

4.6.11. Instrument data

In this menu the following instrument data is shown:

- producer name;
- instrument type;
- model number;
- calibration date;
- serial number;
- firmware and hardware version.

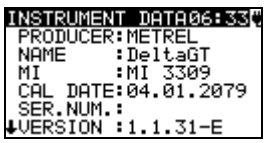


Figure 4.19: *Instrument data menu*

Keys:

▲ / ▼	Switches between Instrument data screens.
TEST, ESC	Returns to ***Setup menu*.**

4.6.12. Initial settings

In this menu the following instrument parameters can be set to their initial values:

- all measurement parameters in single test mode;
- LCD settings;
- language;
- communication settings;
- internal Bluetooth module is initialized;
- custom autotest sequences are replaced by factory pre-programmed ones.

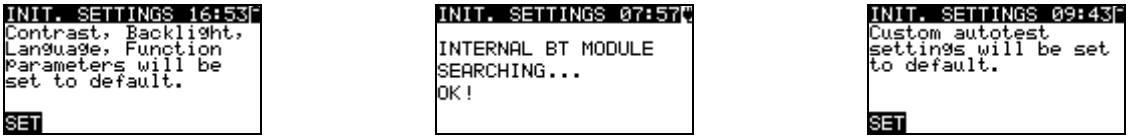


Figure 4.20: *Initial settings menu*

Keys:

TEST	Confirms selection and returns to ***Main menu*.**
ESC	Returns to ***Setup menu*** without changes.

4.6.13. Sound

In this menu audible indication of fail test result can be enabled / disabled.

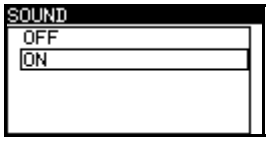


Figure 4.21: *Sound menu*

Keys:

▲ / ▼	Select sound option.
TEST	Confirms selection and returns to ***Setup menu*.**
ESC	Returns to ***Setup menu*** without changes.

5. Single test

In a Single test mode individual tests can be performed. This is especially helpful for troubleshooting.

5.1. Performing measurements in single test mode

Select appropriate test in Single test menu.

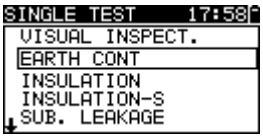


Figure 5.1: *Single test menu*

Keys:

▲ /▼	Selects a single test.
TEST	Enters ***Single test measuring menu.***
ESC	Returns to ***Main menu.***

A single test can be started from any Single test measuring menu. Before carrying out a test the parameters / limits can be edited.

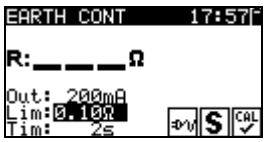


Figure 5.2: *Example of single test measuring menu*

Keys:

TAB	Selects a parameter.
▲ / ▼	Changes a parameter / limit.
TEST	Starts a single test.
ESC	Returns to ***Single test menu.***

Note:

- Last set parameters will be stored automatically.

Single measurements are stored the same way as the autotest results. See chapter *7.1 Saving autotest results* for more information.

5.2. Measurements and inspections

5.2.1. Visual inspection

A thorough visual check must be carried out before each electrical safety test.

The following items should be checked:

- Inspection of the device under test for sign of damage.
- Inspection of the flexible power supply cable for damage.
- Any signs of pollution, moisture, dirt that can jeopardize safety. Especially openings, air filters, protection covers and barriers must be checked!
- Are there signs of corrosion?
- Are there signs of overheating?
- Inscriptions and markings related to safety must be clearly readable.
- Installation of the device under test must be performed according to the instruction manual.
- During visual inspection the measuring points for the electrical testing have to be determined too.

Visual inspection procedure

- Select the VISUAL INSPECT. function.
- Check the device under test.
- Select PASS or FAIL according to the result of visual inspection.
- Store the result by pressing MEM key (optional).

Figure 5.3: *Visual inspection menu*

5.2.2. Earth continuity resistance

This test ensures that the connections between the protective conductor terminal in the mains plug of the device under test and earthed accessible conductive parts of the device under test are satisfactory and of sufficiently low resistance. This test has to be performed on Class I (earthed) appliances. The instrument measures the resistance between:

- S/EB terminal and PE of the test socket;
- PE of the IEC test terminal and PE of the test socket (for IEC Cords);
- S/EB terminal and PE terminal (for fixed installed appliances).

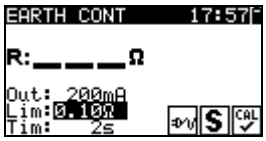


Figure 5.4*: Earth continuity menu*

Test parameters for Earth continuity resistance measurement

LIMIT	**Maximum resistance** [0.10 Ω, 0.20 Ω, 0.30 Ω, 0.40 Ω, 0.50 Ω, 0.60 Ω, 0.70 Ω, 0.80 Ω, 0.90 Ω, 1.00 Ω, 1.50 Ω, 2.00 Ω]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s (continuous measurement)]

Typical test circuits for Earth continuity resistance measurement

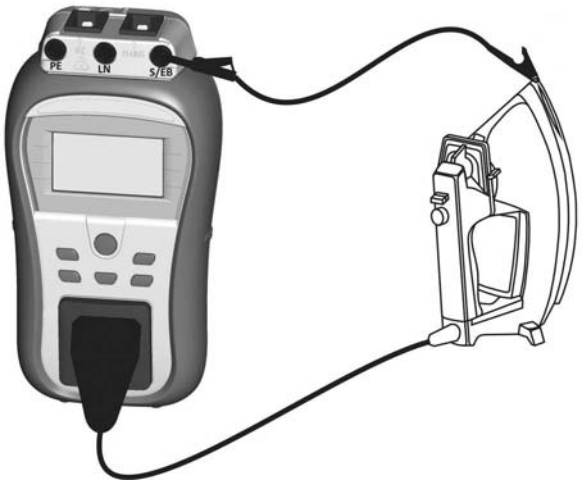


Figure 5.5: *Measurement of Earth continuity*

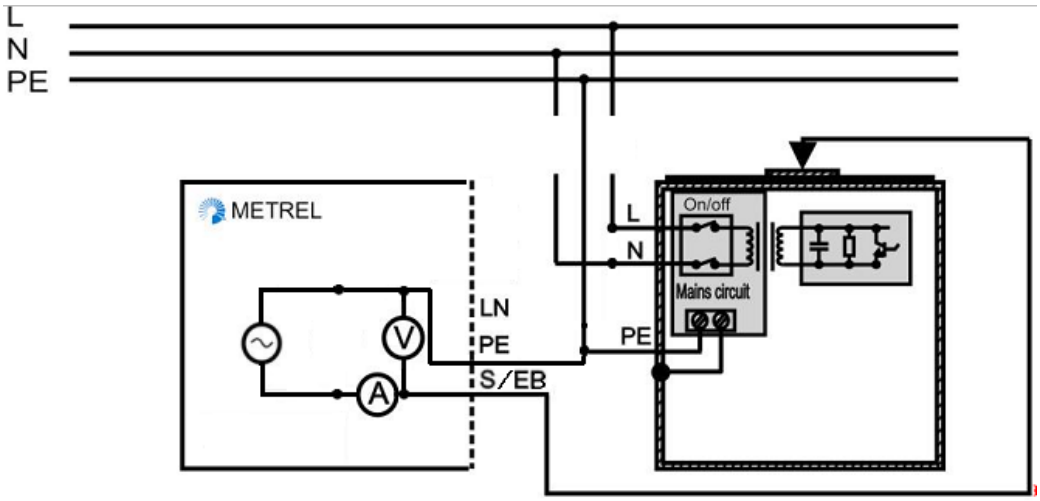


Figure 5.6: *Measurement of Earth continuity of fixed installed DUTs of Class I*

Earth continuity resistance measurement procedure

- Compensate test lead resistance (optional). See chapter *4.6.5* for details.
- Select the EARTH CONT. function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.5*** and ***Figure 5.6***).
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.7: *Examples of Earth continuity resistance measurement results*

Displayed results:
Main result ..... Earth continuity resistance

Note:

- Consider displayed warnings before starting measurement!
- It is recommended that the mains cable is folded during the test.
- CAL is displayed when result is corrected with compensated lead resistance value.
- Earth continuity result correction is disabled, when testing IEC cords between PE of the IEC test terminal and PE of the test socket.
- If the PRCD test is set in the Autotest procedure power is applied to the mains test socket during the earth continuity test. This feature enables to test special types of RCDs (PRCD-K, PRCD-S) where the PE conductor is not connected until power is applied to the device.

5.2.3. Insulation resistance

The insulation resistance test checks the resistance between live conductors and earthed (or isolated) accessible metal parts of a device under test. This test can disclose faults caused by pollution, moisture, deterioration of the insulation material etc.
The instrument measures the insulation resistance between:

- The (L+N) on test socket and PE terminal on test socket / (S/EB) terminal;
- LN terminal and PE terminal / (S/EB) terminal (for fixed installed appliances).

This function is primarily intended for testing Class I appliances.

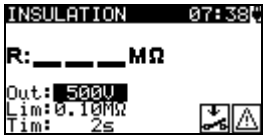


Figure 5.8: *Insulation menu*

Test parameters for insulation resistance measurement

OUTPUT	**Test voltage** [250 V, 500 V]
LIMIT	**Minimum resistance** [0.01 MΩ, 0.10 MΩ, 0.25 MΩ, 0.30 MΩ, 0.50 MΩ, 1 MΩ, 2 MΩ, 4 MΩ, 7 MΩ, 10 MΩ, --- MΩ]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s (continuous measurement)]

Test circuits for Insulation resistance measurement

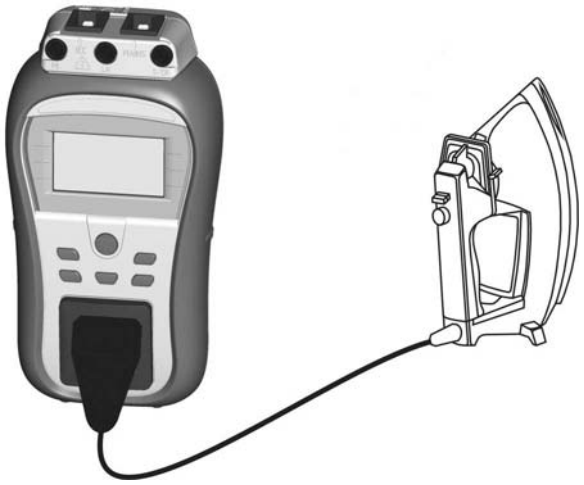


Figure 5.9: *Measurement of insulation resistance*

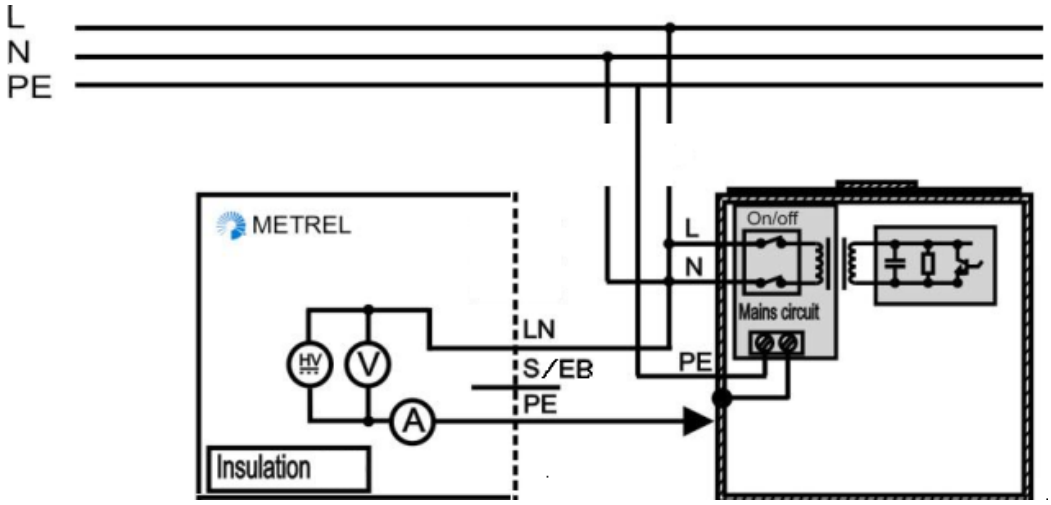


Figure 5.10: *Measurement of insulation resistance of fixed installed DUTs of Class I*

Insulation resistance measurement procedure

- Select the INSULATION function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.9*** and ***Figure 5.10***).
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.11: *Examples of Insulation resistance measurement results*

Displayed results:
Main result ..... Insulation resistance

Notes:

- When S/EB probe is connected during the test then the current through it is also considered.
- Consider any warning on the display before starting the measurement!
- Do not touch or disconnect the device under test during the measurement or before it is fully discharged! The message »Udisch …« will be displayed while the voltage on the device is higher than 10 V!

5.2.4. Insulation resistance – P

The insulation resistance test checks the resistance between live conductors and isolated accessible metal parts of the device under test. This test can disclose faults caused by pollution, moisture, deterioration of the insulation material etc.
The instrument measures the insulation resistance between:

- The (L+N) on test socket and S/EB terminal;
- LN terminal and S/EB terminal (for fixed installed appliances).

This function is primarily intended for testing Class II appliances and Class II parts of Class I appliances.

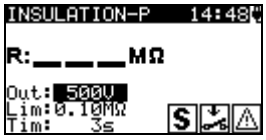


Figure 5.12: *Insulation resistance - P menu*

Test parameters for Insulation resistance - P measurement

OUTPUT	**Test voltage** [250 V, 500 V]
LIMIT	**Minimum resistance** [0.01 MΩ, 0.10 MΩ, 0,25MΩ, 0.30 MΩ, 0.50 MΩ, 1 MΩ, 2 MΩ, 4 MΩ, 7 MΩ, 10 MΩ, --- MΩ]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s (continuous measurement)]

Test circuits for Insulation resistance - P measurement

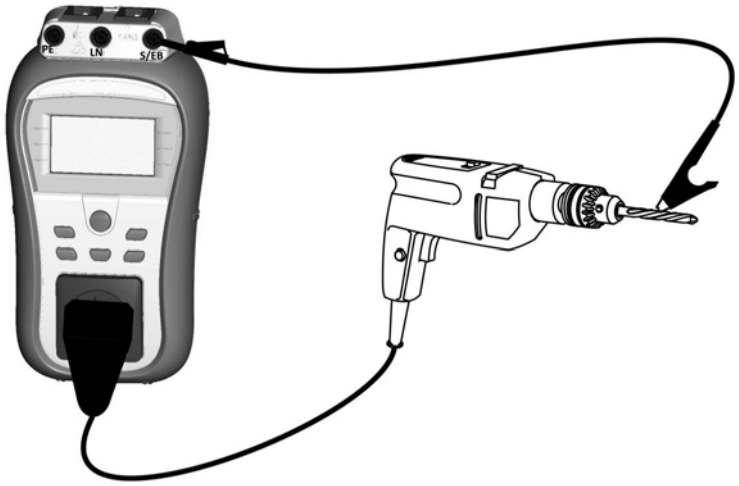


Figure 5.13: *Measurement of Insulation resistance - P*

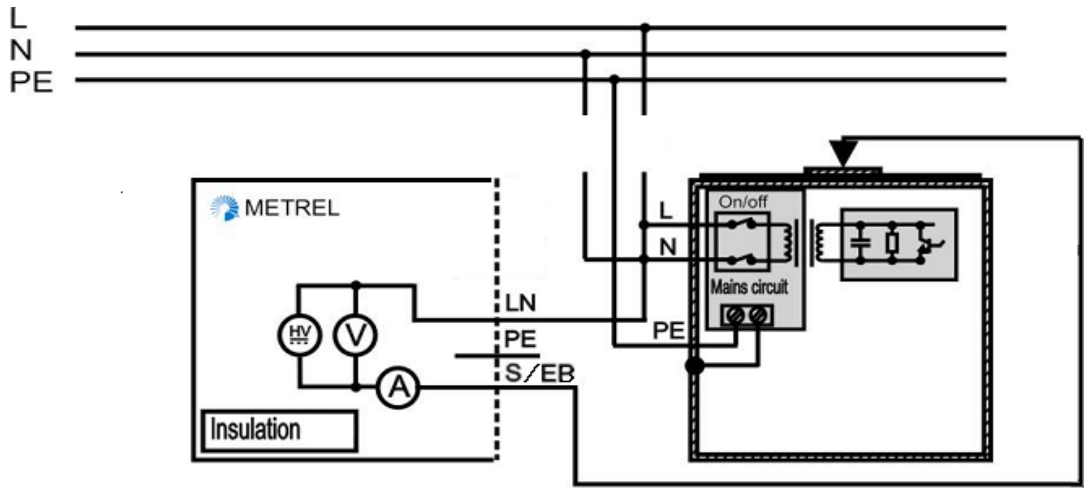


Figure 5.14: *Measurement of insulation resistance of fixed installed DUTs*

Insulation resistance - P measurement procedure

- Select the INSULATION-P function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.13*** and ***Figure 5.14***).
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.15: *Example of insulation resistance - P measurement results*

Displayed results:
Main result ..... Insulation resistance (LN – P)

Notes:

- The currents flowing through the PE terminal or PE on test socket will NOT be considered.
- Consider any warning on the display before starting the measurement!
- Do not touch / disconnect the device under test during the measurement or before it is fully discharged! The message »UDisch…« will be displayed while the voltage on the device is higher than 10 V!

5.2.5. Substitute leakage

Leakage currents between live conductors and accessible metal parts (housing, screws, handles etc.) are checked with this test. Capacitive leakage paths are included in the result too. The test measures the current flowing at a test voltage of 30 VAC and the result is scaled to the value of a nominal mains supply voltage.
The instrument measures the substitute leakage between:

- The (L+N) on test socket and PE terminal on test socket / (S/EB) terminal;
- LN terminal and PE terminal / (S/EB) terminal (for fixed installed appliances).

This function is primarily intended for testing Class I appliances.

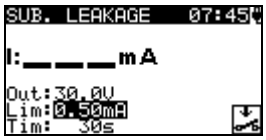


Figure 5.16: *Substitute leakage menu*

Test parameters for Substitute leakage current measurement

OUTPUT	Test voltage [30 V]
LIMIT	**Maximum current** [0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10.0 mA, 15.0 mA, --- mA]
TIME	**Measuring time** [2s, 3s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s (continuous measurement)]

Test circuits for Substitute leakage current measurement

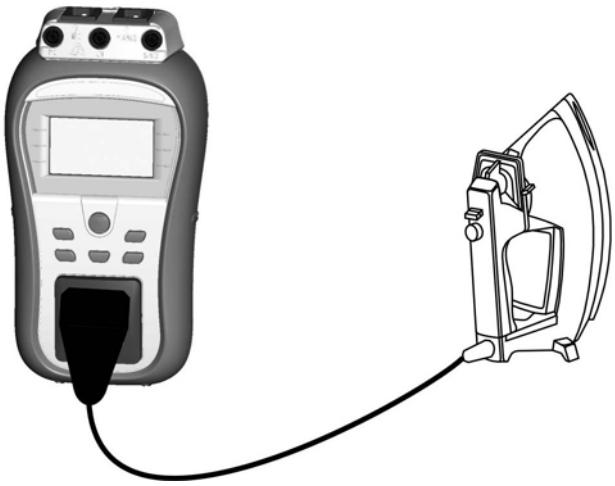


Figure 5.17: *Measurement of Substitute leakage current*

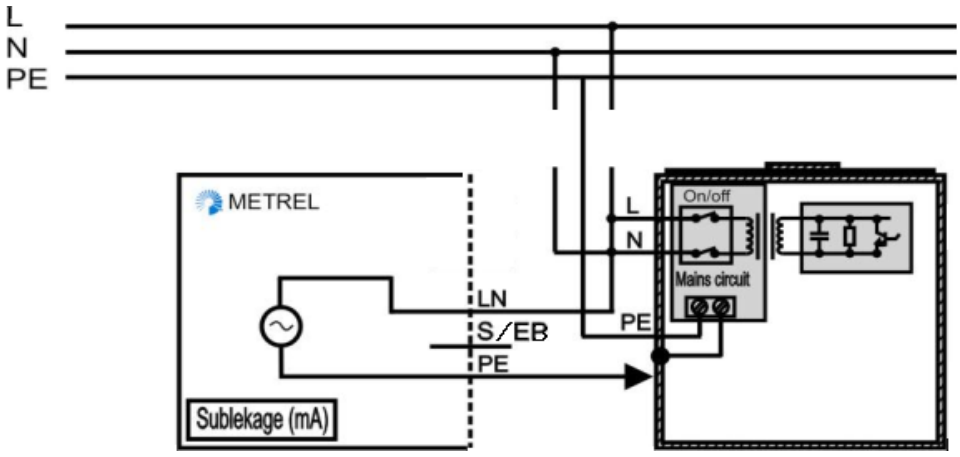


Figure 5.18: *Measurement of substitute leakage current of fixed installed DUTs*

Substitute leakage measurement procedure

- Select the SUB. LEAKAGE function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.17*** and ***Figure 5.18***).

- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.19: *Example of substitute leakage current measurement results*

Displayed results:
Main result ..... Substitute leakage current

Notes:

- Consider any displayed warning before starting measurement!
- When S/EB probe is connected during the test then the current through it is also considered.
- Substitute leakage result may differ from the leakage current test result. For example, if EM filter capacitors are connected to the phase and neutral conductors, the substitute leakage result can be 2 times higher than the differential leakage result.

5.2.6. Substitute leakage – P

Leakage currents between live conductors and isolated accessible metal parts (screws, handles etc.) are checked with this test. Capacitive leakage paths are included in the result too. The test measures the current flowing at a test voltage of 30 V AC and the result is scaled to the value of a nominal mains supply voltage.
The instrument measures the substitute leakage between:

- The (L+N) on test socket and S/EB terminal;
- LN terminal and S/EB terminal (for fixed installed appliances).

This function is primarily intended for testing Class II appliances and Class II parts of Class I appliances.

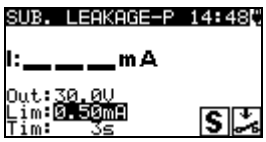


Figure 5.20: *Substitute leakage - P menu*

Test parameters for substitute leakage - P current measurement

OUTPUT	Test voltage [30 V]
LIMIT	**Maximum current** [0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, --- mA]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s (continuous measurement)]

Test circuits for substitute leakage - P measurement

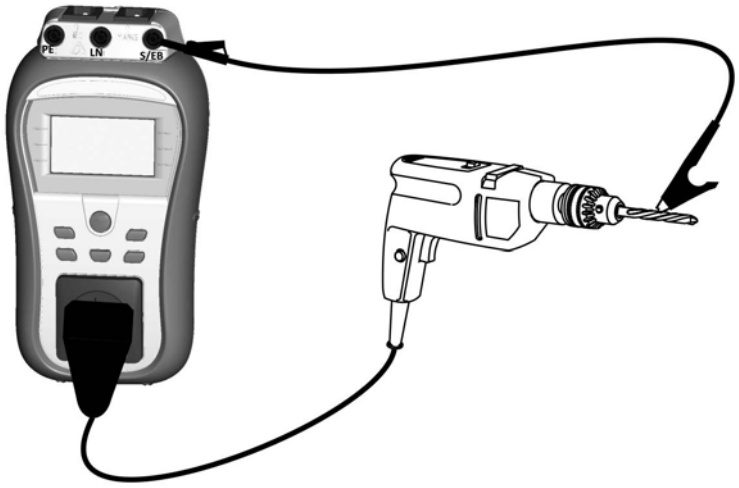


Figure 5.21: *Measurement of Substitute leakage - P current*

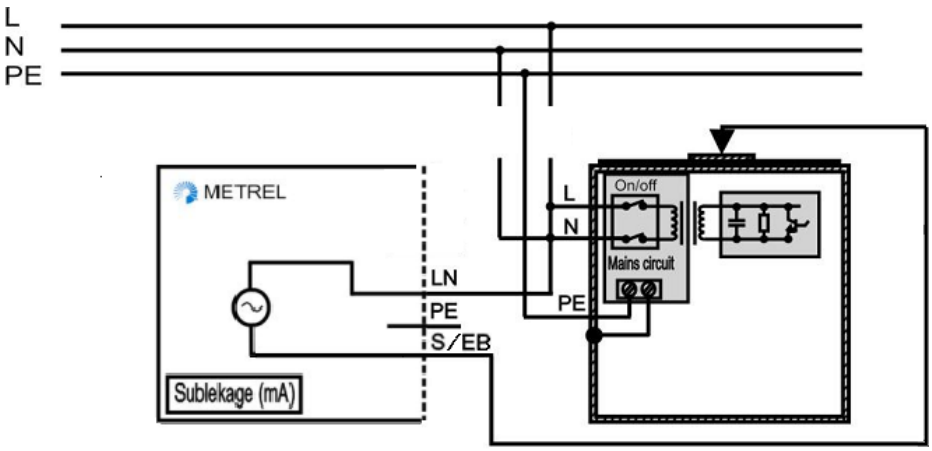


Figure 5.22: *Measurement of substitute leakage of accessible isolated conductive parts of fixed installed DUTs*

Substitute leakage - P measurement procedure

- Select the SUB. LEAKAGE-P function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.21*** and ***Figure 5.22***).
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.23: *Example of substitute leakage - P current measurement results*

Displayed results:
Main result……..Substitute leakage current (LN – P)

Notes:

- Consider any displayed warning before starting measurement!
- The currents flowing through the PE terminal or PE of the test socket will not be considered.

5.2.7. Polarity test

This test checks the polarity of supply cords. The following faults can be detected: L OPEN, N OPEN, PE OPEN, L-N CROSS, L-N SHORT, L-PE SHORT, N-PE SHORT and MULTIPLE FAULT.

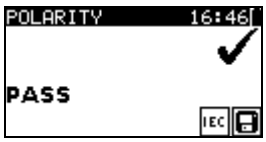
Figure 5.24: *Polarity test menu*

Test circuit for polarity test

Figure 5.25: *Polarity test of IEC cord*

Polarity test procedure

- Select the POLARITY function.
- Connect the IEC cord to the instrument as shown on ***Figure 5.25***.
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).



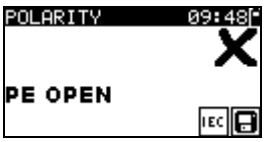


Figure 5.26: *Examples of polarity test result*

Displayed results:
Main result ..... PASS/FAIL, description of fault

Note:

- Consider any displayed warnings before starting test!

5.2.8. Differential leakage

The purpose of this test is to determine the sum of all leakages flowing from the live conductors to the earth. The differential method allows measuring the full and true leakage current, even if there are parallel current paths from the DUT to ground.
The instrument measures:

- The differential leakage of the DUT connected to the instrument test socket.

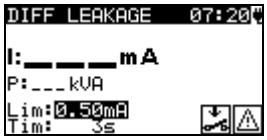


Figure 5.27: *Differential leakage current menu*

Test parameters for differential leakage current measurement

OUTPUT	Test voltage [MAINS voltage]
LIMIT	**Maximum current** [0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10.0 mA, 15.0 mA, --- mA]
TIME	**Measuring time** [2s, 3s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s, --- s (continuous measurement)]

Test circuit for differential leakage current measurement

Figure 5.28: *Measurement of differential leakage current*

Differential leakage current measurement procedure

- Select the DIFF. LEAKAGE function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.28***).
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.29: *Examples of differential leakage current measurement result*

Displayed results:
Main result I ..... Differential leakage current
Sub-result P.....Apparent power

Notes:

- For this test the instrument must be connected to the mains voltage.
- During the test, mains voltage is connected to the DUT. If DUT contains moving parts, make sure that it is safely mounted or protected to prevent possible danger to the operator or damage to the DUT or surrounding environment!
- Consider any displayed warning before starting measurement!
- Measurement is for safety reasons automatically stopped after 2 minutes if a current higher than 10 A is flowing through the DUT and the DeltaPAT.

5.2.9. Touch leakage

This test determines the current that would flow if a person touches accessible conductive parts of the DUT.
The instrument measures:

- The touch leakage current flowing through the S/EB probe into earth.

The DUT can be powered from the test socket or directly from the installation (fixed installed equipment).

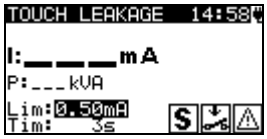


Figure 5.30: *Touch leakage menu*

Test parameters for touch leakage current measurement

OUTPUT	Test voltage [MAINS voltage]
LIMIT	**Maximum current** [0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, --- mA]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s, --- s (continuous measurement)

Test circuits for touch leakage current measurement

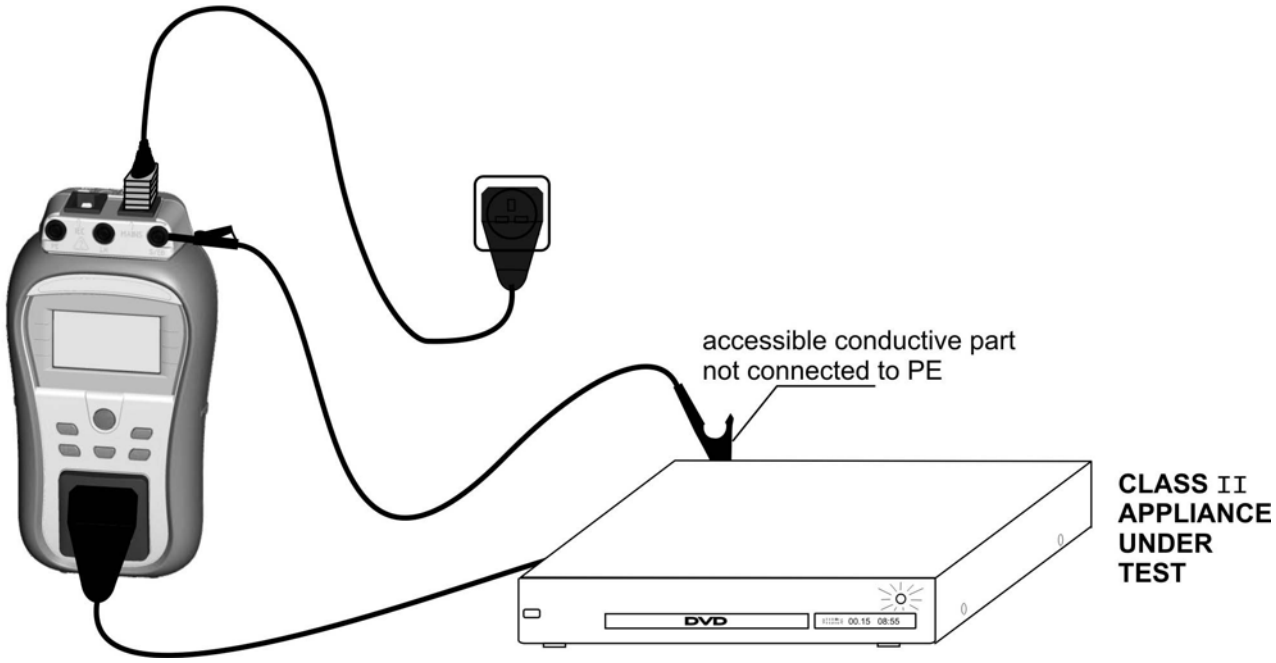


Figure 5.31: *Measurement of touch leakage current*

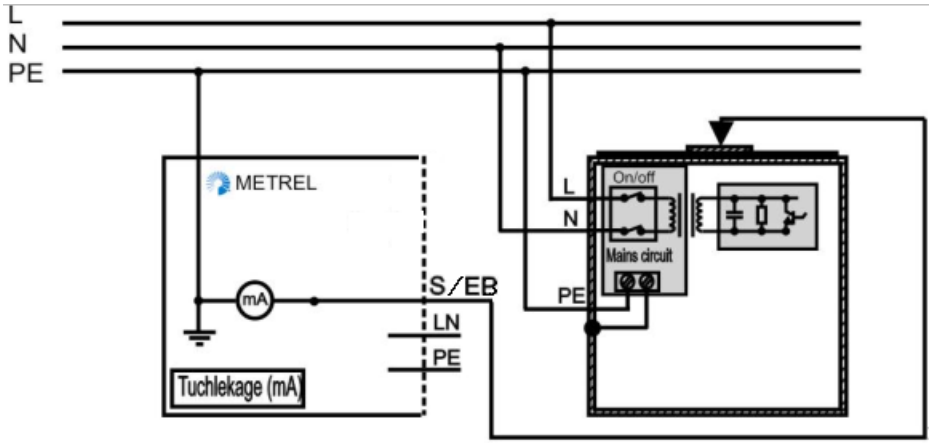


Figure 5.32: *Measurement of touch leakage current on a fixed installed DUT*

Touch leakage current measurement procedure

- Select the TOUCH LEAKAGE function.
- Set the test parameters.
- Connect device under test to the instrument (see ***Figure 5.31*** and ***Figure 5.32***).
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

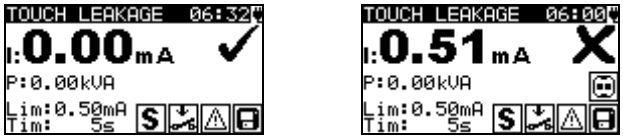


Figure 5.33: *Examples of touch leakage current measurement results*

Displayed results:
Main result I ..... Touch leakage current
Sub-result P.....Apparent power

Notes:

- For this test the instrument must be connected to the mains voltage.
- During the test, mains voltage is connected to the DUT. If DUT contains moving parts, make sure that it is safely mounted or protected to prevent possible danger to the operator or damage to the DUT or surrounding environment!
- Consider any displayed warning before starting measurement!
- Measurement is for safety reasons automatically stopped after 2 minutes if a current higher than 10 A is flowing through the DUT and the DeltaPAT.

5.2.10. (P)RCD test

The purpose of this test is to ensure the proper operation of residual current devices (RCD) built into appliances / installations and portable residual current devices (PRCD). Trip-out time measurement verifies the sensitivity of a (P)RCD at selected residual currents.
The RCD test is performed via the instrument mains supply input.

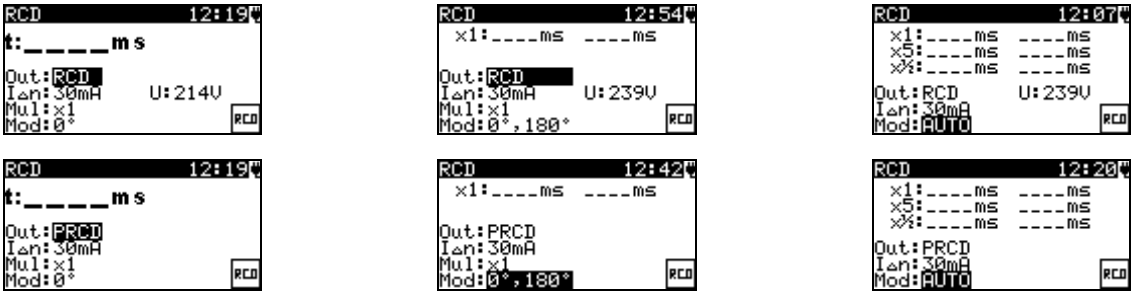


Figure 5.34: *(P)RCD single and auto test menus*

Test parameters for (P)RCD test

Test	Test function [RCD, PRCD]
$I_{\Delta N}$	Rated residual current [10 mA, 30 mA]
Mul	Test current multiplier $I_{\Delta N}$ [x ½, x 1, x 5]
Mod	(P)RCD test mode [(0°, 180°, (0°,180°), AUTO]

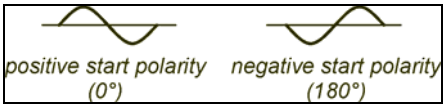
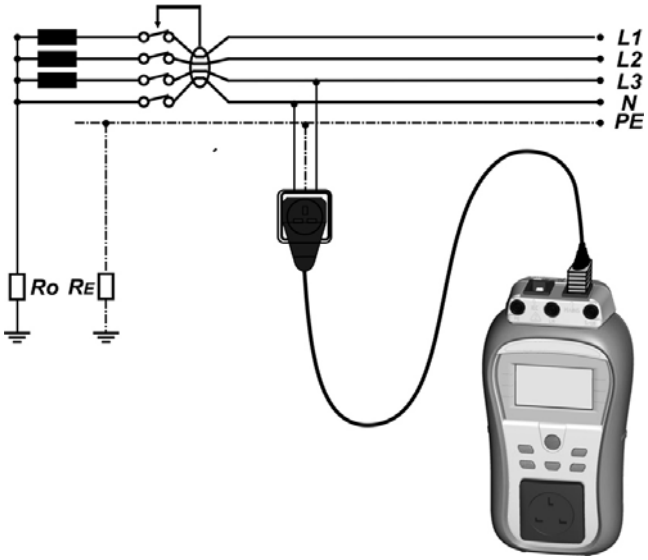


Figure 5.35: *(P)RCD test current starting polarities* 0°, 180°

Test circuits for testing RCD and PRCD



a) Testing of standard RCD

b) Testing of PRCD via mains socket

c) Testing of PRCD via test socket

Figure 5.36: *Testing of RCD and PRCD*

5.2.10.1 (P)RCD single test

In single test a fast (P)RCD test with selected test current and with one or both starting polarities is performed.

Trip-out time measurement procedure

Measuring PRCD

- Select the RCD test function.
- Select test mode.
- Set test parameters.
- Connect tested PRCD / device to an external voltage socket. Connect the IEC cord to the instrument's MAINS terminal and PRCD (see ***Figure 5.36b***).

- Depending on the type of PRCD, it may be necessary to manually switch it on.
- Press the TEST key to perform measurement.

If both starting polarities are selected:

- Reactivate tested PRCD.
- Store the result by pressing MEM key (optional).

or

- Select the PRCD test function.
- Select test mode.
- Set test parameters.
- Connect tested PRCD between test socket and IEC connector of the DeltaPAT (see ***Figure 5.36c***), and connect instrument's MAINS terminal to an external voltage socket.
- Depending on the type of PRCD, it may be necessary to manually switch it on.
- Press the TEST key to perform measurement.

If both starting polarities are selected:

- Reactivate tested PRCD.
- Store the result by pressing MEM key (optional).

Measuring RCD

- Select the RCD test function.
- Select test mode.
- Set test parameters.
- Connect the DeltaPAT MAINS terminal to mains socket protected by tested RCD (see ***Figure 5.36a***).
- Depending on the type of PRCD, it may be necessary to manually switch it on.
- Press the TEST key to perform measurement.

If both starting polarities are selected:

- Reactivate tested RCD.
- Store the result by pressing MEM key (optional).

Figure 5.37: *Examples of (P)RCD single test results*

Displayed results:
Main result(s) ..... trip out time(s) at selected starting polarity
U ..... voltage U_{L-PE}

5.2.10.2 Automatic (P)RCD test

(P)RCD autotest function is intended to perform a complete (P)RCD analysis (trip-out times at different residual currents and starting polarity phases) .

(P)RCD autotest procedure

(P)RCD Autotest steps	Notes
‣ Select the RCD (PRCD) test function. ‣ Set AUTO mode. ‣ Select test parameters.	

‣ **PRCD:** Connect tested PRCD / device to an external voltage socket. Connect the IEC cord to the instrument´s MAINS terminal and PRCD (see ***Figure 5.36b***). Or connect tested PRCD between test socket and IEC connector of the DeltaPAT Connect the instrument to mains voltage (see ***Figure 5.36c***). Depending on the type of PRCD, it may be necessary to manually switch it on. ‣ **RCD:** Connect the DeltaPAT MAINS terminal to mains socket protected by tested RCD (see ***Figure 5.36a***). ‣ Press the TEST key	
‣ Test with I∆N, 0° (step 1).	(P)RCD should trip-out
‣ Re-activate (P)RCD. ‣ Test with I∆N, 180° (step 2).	(P)RCD should trip-out
‣ Re-activate (P)RCD. ‣ Test with 5×I∆N, 0° (step 3).	(P)RCD should trip-out
‣ Re-activate (P)RCD. ‣ Test with 5×I∆N, 180° (step 4).	(P)RCD should trip-out
‣ Re-activate (P)RCD. ‣ Test with ½×I∆N, 0° (step 5).	(P)RCD should not trip-out
‣ Test with ½×I∆N, 180° (step 6).	(P)RCD should not trip-out End of test.

Displayed results:
Main results ..... trip-out times at different currents / starting polarities
U ..... voltage U_{L-PE}

Notes:
- Consider any displayed warning before starting measurement!
- Mains voltage is applied to the (P)RCD under test. Do not touch the equipment under test or the test cord during the test.

5.2.11. Power test

The DUT's power consumption is measured in this test. The apparent power is a useful indication of proper operation of the appliance.

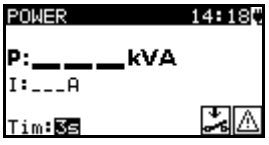


Figure 5.38: *Power test menu*

Test parameters for the Power test

OUTPUT	Test voltage [MAINS voltage]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s, --- s (continuous measurement)]

Test circuit for the power test

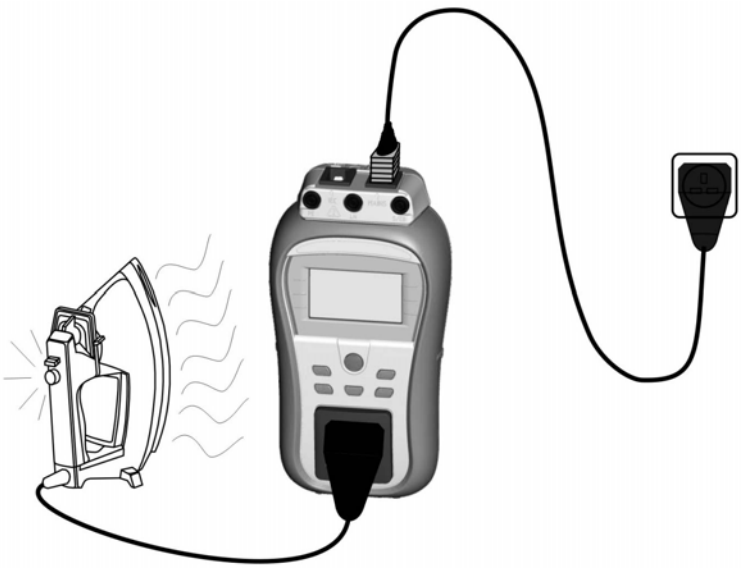


Figure 5.39: *Power test*

Power test procedure

- Select the POWER function.
- Set test parameters.
- Connect device under test to the instrument's test socket and switch it on (see ***Figure 5.39***).
- Connect the instrument to mains voltage.
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

Figure 5.40: *Example of apparent power measurement result*

Displayed results:
P: ..... Apparent power
I:..... complete current into tested appliance

Notes:

- For this test the instrument must be connected to the mains voltage.
- During the test, mains voltage is connected to the DUT. If DUT contains moving parts, make sure that it is safely mounted or protected to prevent possible danger to the operator or damage to the DUT or surrounding environment!
- Consider any displayed warning before starting measurement!
- Measurement is for safety reasons automatically stopped after 2 minutes if a current higher than 10 A is flowing through the DUT and the DeltaPAT.

5.2.12. Voltage TRMS

In this function the voltage across the MAINS terminal is measured continuously.

Test circuit for voltage measurement

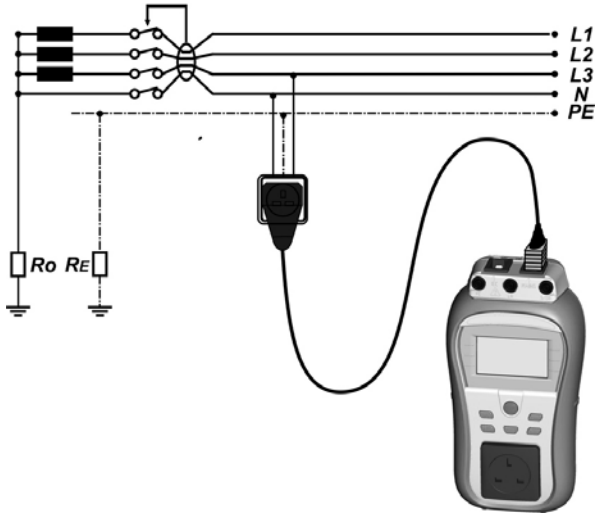


Figure 5.41: *Voltage measurement with the IEC cord*

Voltage TRMS procedure

- Select the VOLTAGE TRMS function.
- Connect the IEC cord to the instrument's MAINS terminal and to the external mains socket as shown on ***Figure 5.41***.
- Store the result by pressing MEM key (optional).

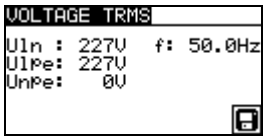


Figure 5.42: *Voltage TRMS test result*

Displayed results:
Main result ..... Voltage
f..... Frequency

Warning:

- Only for voltage range from 80 V to 300 V!

5.2.13. Clamp current measurement

This function enables the measurement of AC currents in a wide range from 0.1 mA up to 16 A with current clamps. Typical applications are:

- Measuring PE leakage currents through PE conductor in permanently installed appliances,
- Measuring load currents in permanently installed appliances,
- Measuring differential leakage currents in permanently installed appliances

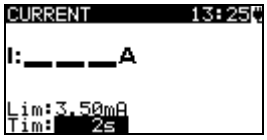


Figure 5.43: *Clamp current menu*

Test parameters for clamp current measurement

LIMIT	**Maximum current** [0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.00 mA, 2.25 mA, 2.50 mA, 3.50 mA, 4.00 mA, 4.50 mA, 5.00 mA, 5.50 mA, 6.00 mA, 7.00 mA, 8.00 mA, 9.00 mA, 10.0 mA, 15.0 mA, --- mA]
TIME	**Measuring time** [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, none]

Test circuit for clamp current measurement

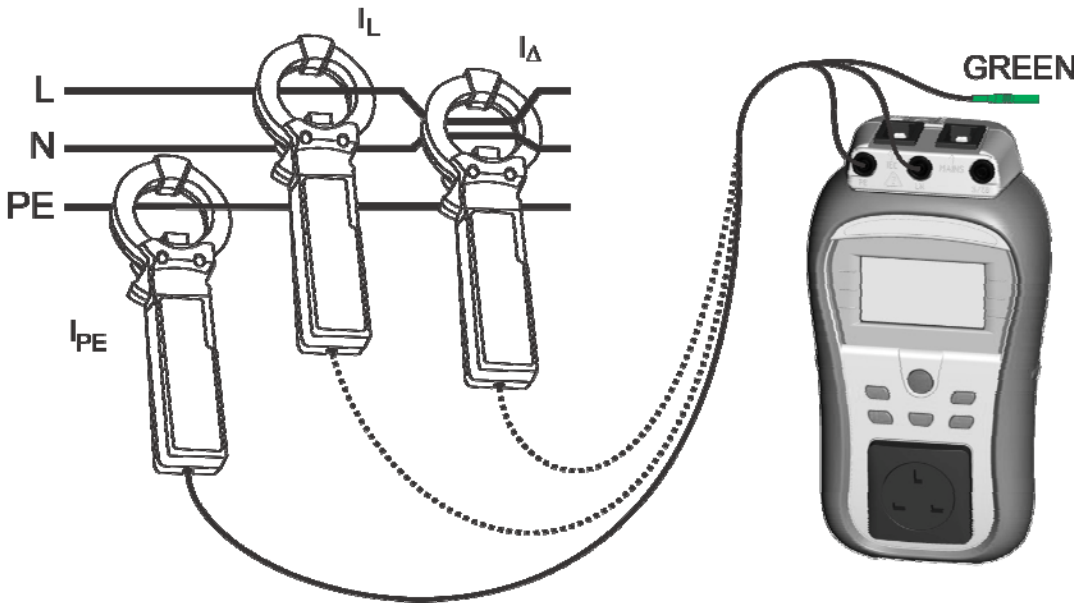


Figure 5.44: *Measurement of clamp current*

Clamp current measurement procedure

- Select the CURRENT function.
- Set test parameters.
- Connect the current clamp to the instrument (see ***Figure 5.44***).
- Embrace wire(s) that has to be measured with current clamp.
- Press the TEST key for measurement. To stop continuous measurement press TEST key once again.
- Store the result by pressing MEM key (optional).

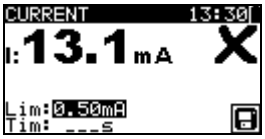


Figure 5.45: *Examples of clamp current measurement result*

Displayed results:
Main result ..... clamp current

Notes:
- When measuring leakage currents, the neighboring magnetic fields and capacitive coupling (especially from the L and N conductors) can disturb the results. It is recommended that the clamp is as close as possible to the grounded surface and away from wires and other objects under voltage or carrying current.
- METREL offers high quality current clamps for this application.
- Current clamp shield terminal connector (green terminal) can be left open.

5.2.14. Functional test

Functional test is the simplest way to ensure that the appliance is working properly.

Note:
- This test should only be performed once the DUT has passed all other tests applicable to this type of appliances.

Scope of test
Check following items while the appliance is operating:
- RCDs and other disconnection devices.
- How hot the appliance becomes during operation.
- Rotating parts, fans, etc.
- Power consumption.
- Lamps and indicators.
- Etc.

Especially safety relevant functions should be checked.

Functional test procedure

- Select the FUNCTIONAL TEST function.
- Plug the device under test to the instrument's test socket and supply the instrument.
- Select and start **POWER** sub-function. Switch on the appliance and check that it operates correctly.
- Select PASS or FAIL according to the result of functional test.
- Store the result by pressing MEM key (optional).

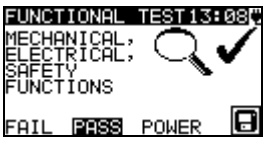


Figure 5.46: *Functional test menu*

6. Automatic test sequences

Simple test and Shortcut autotest are the fastest (autotest) modes for testing appliances. In both test modes pre-programmed measurements run automatically in a sequential order. The complete autotest results can be stored together with the associated appliance ID, appliance NAME, Re-test period, and Location.

6.1. Simple test

Up to 50 customized sequences can be pre-programmed in this test mode. Typical simple test sequences are added to the list by default.
The simple test sequences can be also uploaded from the PC software PATLink PRO. Refer to chapter *8 Communication* for more information. The pre-programmed sequences can be restored to default settings by selecting *Initial settings* in *Setup menu*.
The list of pre-programmed simple test sequences can be found in Appendix B of this manual.
Select Simple test in PAT testing Main menu.

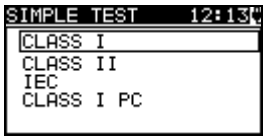


Figure 6.1: *Simple test menu*

Keys:

⮟ / ⮝	Selects the test sequence from the list.
START	Starts the selected test. See chapter *6.3 Carrying out (Simple, Shortcut) test sequences*.
ESC	Returns to Main menu.

Note:

- If more than 50 autotests are saved, »Out of custom autotest memory« message is displayed.

6.2. Shortcut test sequences

In the Shortcut menu any of the pre-defined autotest procedures can be selected. Pre-programmed sequences cover almost all *in-service* tests, regardless of appliance type and safety class.
All limits and tests are in compliance with currently valid standards and regulations. In case of any changes, new firmware will be available at your distributor or from Metrel directly.
The number of autotest shortcut sequences that are offered by the instrument can be set in the SHORTCUT SETUP menu. The complete list of autotest shortcut sequences can be found in Appendix C of this manual.

Note:

- The DeltaPAT instrument does not include all test functions and parameters covered in the Shortcut codes. If such a Shortcut code is set the instrument automatically perform alternative tests :
  - a 200 mA Earth continuity test if a test current of more than 200 mA is set.
  -a Normal polarity test If Active polarity test is set.
  The operator must decide by itself if the alternative tests are applicable. Refer to chapter *1.1 Warnings* for more information.

6.2.1. Selecting the autotest shortcut sequence

Select SHORTCUT MENU in Main menu. The autotest sequence can be selected with three-digit test code or on base of selected appliances type, class and other parameters.

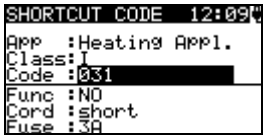


Figure 6.2: *Shortcut menu*

The three-digit autotest code can also be selected by using the barcode reader or RFID reader/writer. In this case connect barcode reader or RFID reader/writer to the instrument first (RS232 / PS2 connector). Set RS 232 communication port using **Communication** function in **Setup menu.** Select SHORTCUT MENU in Main menu. A successfully scanned barcode or RFID tag is confirmed by two short confirmation beeps. A new autotest sequence will be accepted by the instrument.

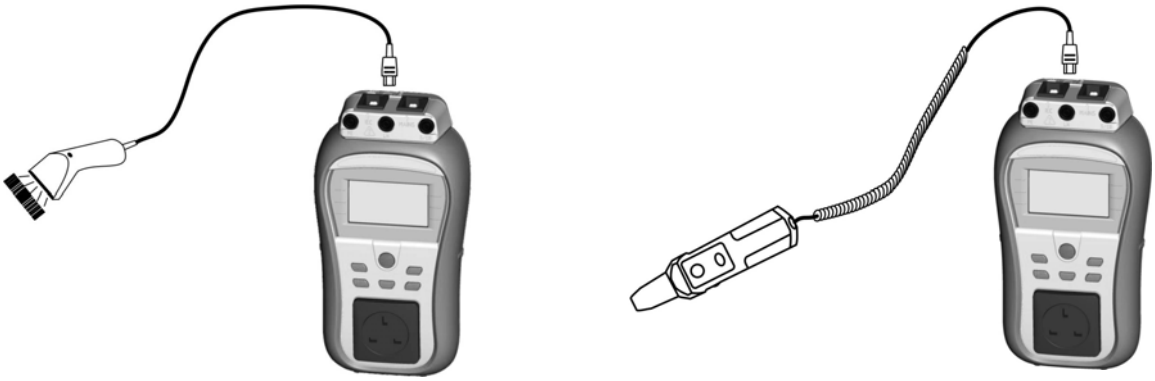


Figure 6.3: *Connection of the barcode reader and RFID reader/writer*

Keys:

⮝ / ⮟	Sets Shortcut code Sets parameter or value in selected (highlighted) item.
ESC	Cancels selection of Shortcut test sequence and returns to Main menu.
TEST	Starts selected test sequence.

Reading and executing the autotest shortcut sequence (Android application on mobile devices)

Pair the instrument with the mobile device (Smart phones, Tablets). Using PATLink Android application autotest sequence QR codes or barcodes can be scanned and tests can be executed remotely.

For more information refer to Chapter 8.3 *Bluetooth communication* and *PATLink Android instructions*.

6.3. Carrying out (Simple, Shortcut) test sequences

General meaning of keys during a Simple or Shortcut test sequence:

TAB, ⮝/⮟	Sets option. Sets limit value in selected (highlighted) item.
ESC	Cancels test sequence and returns to the top of the test menu without changes.
TEST	Starts / repeats selected measurement or proceeds to next step.

Notes

- If any of the inspections are marked as failed or if any test fails the test sequence is stopped and the instrument automatically goes to the Result menu.
- If a test parameter (limit, duration, output voltage) is changed the setup is valid only for the particular test.
- Codes of test sequences with implemented substitute tests are marked with (*).

6.3.1. Visual inspection

Measurement is described in chapter *5.2.1 Visual inspection*.

Figure 6.4: *Visual test menu*

Options in Visual inspection:
PASS / FAIL To be applied manually.

6.3.2. Earth continuity resistance measurement

The test is offered if it is applicable according to the autotest setting. The Earth continuity starting screen is displayed first. Measurement and options in Earth continuity starting screen are described in chapter *5.2.2 Earth continuity resistance*.

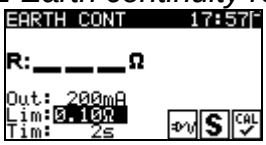


Figure 6.5: *Earth continuity starting screen*

After the measurement is carried out the Earth continuity result screen is displayed.

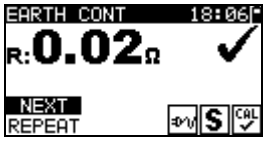


Figure 6.6: *Earth continuity result screen*

Options in Earth continuity result screen:

NEXT	Proceeds to next step.
REPEAT	Repeat the test (use in case of multiple earthed points). Highest result will be stored.

6.3.3. Insulation resistance measurement

The test is offered if it is applicable according to the autotest setting. The Insulation starting screen is displayed first. Measurement and options in Insulation starting screen are described in chapter *5.2.3 Insulation resistance*.

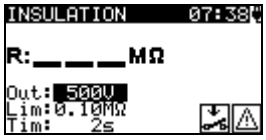


Figure 6.7: *Insulation resistance starting screen*

After the measurement is carried out the Insulation result screen is displayed.

Figure 6.8: *Insulation result screen*

There are no special options to be set in the Insulation resistance result screen.

6.3.4. Substitute leakage measurement

The test is offered if it is applicable according to the autotest setting. The Substitute leakage current starting screen is displayed first. Measurement and options in Substitute leakage starting screen are described in chapter *5.2.5 Substitute leakage*.

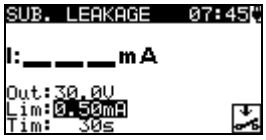


Figure 6.9: *Substitute leakage starting screen*

After the measurement is carried out the Substitute leakage result screen is displayed.

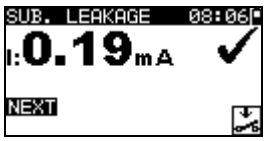


Figure 6.10: *Substitute leakage result screen*

There are no special options to be set in the Substitute leakage result screen.

6.3.5. Differential leakage measurement

The test is offered if it is applicable according to the autotest setting. The Differential leakage current starting screen is displayed first. Measurement and options in Differential leakage starting screen are described in chapter *5.2.8 Differential leakage*.

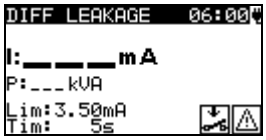


Figure 6.11: *Differential leakage starting screen*

After the measurement is carried out the Differential leakage result screen is displayed.

Figure 6.12: *Differential leakage result screen*

There are no special options to be set in the Differential leakage result screen.

6.3.6. Insulation resistance - P measurement

The test is offered if it is applicable according to the autotest setting. The Insulation resistance - P starting screen is displayed first. Measurement and options in Insulation resistance - P starting screen are described in chapter *5.2.4 Insulation resistance - P*.

Figure 6.13: *Insulation resistance - P starting screen*

After the measurement is carried out the Insulation resistance - P result screen is displayed.

Figure 6.14: *Insulation resistance - P result screen*

Options in Insulation resistance - P result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated / SELV / PELV accessible points). Lowest result will be stored.

6.3.7. Substitute Leakage - P measurement

The test is offered if it is applicable according to the autotest setting. The Substitute leakage - P starting screen is displayed first. Measurement and options in Substitute leakage - P starting screen are described in chapter *5.2.6 Substitute leakage - P*.

Figure 6.15: *Substitute leakage - P starting screen*

After the measurement is carried out the Substitute leakage - P result screen is displayed.

Figure 6.16: *Substitute leakage - P result screen*

Options in Substitute leakage - P result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated / SELV / PELV accessible points). Highest result will be stored.

6.3.8. Touch Leakage measurement

The test is offered if it is applicable according to the autotest setting. The Touch leakage - starting screen is displayed first. Measurement and options in Touch leakage screen are described in chapter *5.2.9 Touch leakage*.

Figure 6.17: *Touch leakage starting screen*

After the measurement is carried out the Touch leakage result screen is displayed.

Figure 6.18: *Touch leakage result screen*

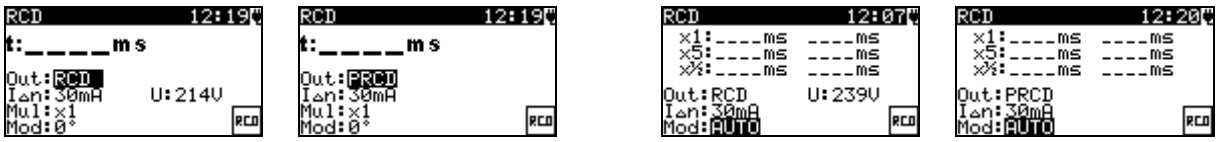
Options in Touch leakage result screen:

NEXT Proceeds with the next measurement.

REPEAT Repeats the test (use in case of multiple isolated / SELV / PELV accessible points). Highest result will be stored.

6.3.9. (P)RCD test

The test is offered if it is applicable according to the autotest setting. The (P)RCD test starting screen is displayed first.
Measurement and options in (P)RCD test starting screen are described in chapter *5.2.10 RCD test.*



(P)RCD single test menus *(P)RCD autotest menu*

Figure 6.19: *(P)RCD test starting screen*

After the measurement is carried out the (P)RCD test result screen is displayed.

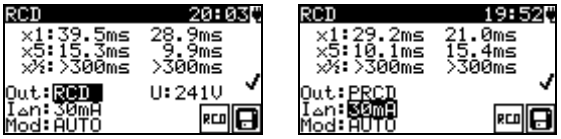


Figure 6.20: *Example of Custom / Code Autotest – (P)RCD test result screen*

There are no special options to be set in the (P)RCD result screen.

6.3.10. Polarity test

The test is offered if it is applicable according to the autotest setting. The Polarity test starting screen is displayed first. Measurement and options in Polarity test starting screen are described in chapter *5.2.7 Polarity test*.

Figure 6.21: *Polarity test starting screen*

After the measurement is carried out the Polarity test result screen is displayed.

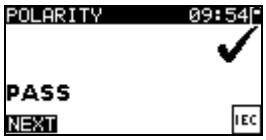


Figure 6.22: *Polarity test result screen*

There are no special options to be set in the Polarity test result screen.

6.3.11. Power test

The test is offered if it is applicable according to the autotest setting. The Power starting screen is displayed first. Measurement and options in Power starting screen are described in chapter *5.2.11 Power test*.

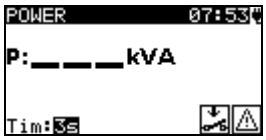


Figure 6.23: *Power starting screen*

After the measurement is carried out the Power result screen is displayed.

Figure 6.24: *Power result screen*

There are no special options to be set in the Power result screen.

6.3.12. Clamp current measurement

The test is offered if it is applicable according to the autotest setting. The Clamp current starting screen is displayed first. Measurement and options in Clamp current starting screen are described in chapter *5.2.13 Clamp current measurement.*

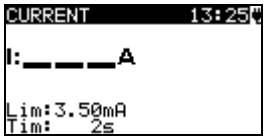


Figure 6.25: *Clamp current starting screen*

After the measurement is carried out the Clamp current result screen is displayed.

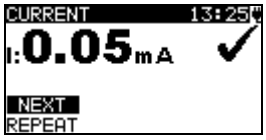


Figure 6.26: *Clamp current result screen*

There are no special options to be set in the Clamp current result screen.

6.3.13. Functional test

The test is offered if it is applicable according to the autotest setting. The Functional test starting screen is displayed first. For more information regarding measurement and test parameters see chapter *5.2.14 Functional test*.

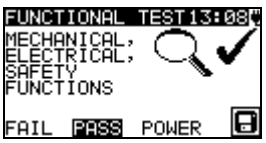


Figure 6.27: *Functional result screens*

Options in Functional test result screen:

PASS / FAIL To be applied manually.
POWER Starts Power test.

6.4. Handling autotest results

After the Simple / Shortcut autotest is finished, the Main autotest result screen will be displayed including an overall ✓ / ✕ indication.

Figure 6.28: *Main autotest result screen*

Options in Autotest results screen:

VIEW RESULTS	Views individual results.
NEW TEST	Returns to Simple or Shortcut menu.
SAVE RESULTS	Saves Autotest results. Refer to chapter *7.1 Saving autotest results* for more information regarding saving of autotest results.
SAVE AS SIMPLE	Saves test setup as Simple test. Refer to chapter *6.1 Simple test* for more information regarding Simple test.
ESC	Returns to Simple or Shortcut menu.

Viewing autotest results

In the ***View results*** screen performed tests, results and their PASS / FAIL status are displayed. Furthermore the selected test results can be displayed with full details.

Options in View result screen:

⮝ / ⮟	Selects result of measurement.
TEST	Enters selected result of measurement (to be displayed in full details).
ESC	Returns to previous result screen.

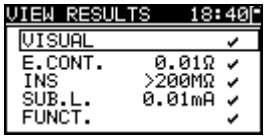


Figure 6.29: *Overall result screen*

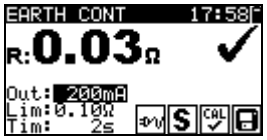


Figure 6.30: *Detailed result screen*

Saving autotest as Simple autotest

In the ***Save as simple*** screen last autotest can be stored as SIMPLE TEST.

Options in Save as simple screen:

⮟ / ⮝, TEST	Edit autotest name.
MEM (SAVE)	Saves autotest name.
ESC (DEL)	Deletes last character of autotest name.
ESC (CANCEL)	Returns to the previous menu.

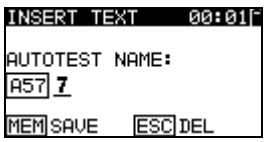


Figure 6.31: *Save as simple screen*

7. Working with autotest results

7.1. Saving autotest results

After selecting ***Save results*** in ***Autotest results*** menu, the autotest results will be stored in the internal memory of the instrument.
The appliance ID number, NAME, Re-Test period and LOCATION can be added to the test results before the results are saved:

Figure 7.1: *Save results menu (Appliance ID)*

Keys:

⮟ / ⮝, TEST	Edit Appliance ID data.
MEM (OK)	Saves Appliance ID.
ESC (DEL)	Deletes last character of Appliance ID.
ESC (CANCEL)	Returns to the previous menu.

An Appliance ID of up to 14 alphanumeric characters can be entered. The Appliance ID can also be scanned with a barcode scanner, RFID reader/writer writer or using PATLink android application on mobile devices (QR codes).

Figure 7.2: *Save results menu (Appliance NAME)*

Keys:

⮟ / ⮝, TEST	Edit Appliance NAME data.
TAB (LIST)	Offers last forty entered names with optional filtering.
ESC (DEL)	Deletes last character of Appliance NAME.
ESC (CANCEL)	Returns to the previous menu.
MEM (OK)	Saves Appliance NAME.

An Appliance NAME of up to 14 alphanumeric characters can be entered. Using TAB key last 40 names can be selected from the LIST. Filter is applied to the LIST if any character is written on Appliance NAME. The Appliance NAME can also be scanned with a barcode scanner, RFID reader/writer or using PATLink android application on mobile devices (QR codes).
.

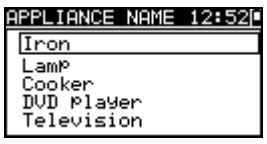


Figure 7.3: *List menu (Appliance NAME)*

The Re-Test period can be entered.

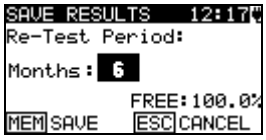


Figure 7.4: *Save results menu (Re-Test period)*

Keys:

⮟ / ⮝, TEST	Set Re-Test period in months.
ESC (CANCEL)	Returns to the previous menu.
MEM (SAVE)	Saves Re-Test period and returns to Autotest result menu.

The Re-Test period can also be scanned with RFID reader/writer or using PATLink android application on mobile devices (QR codes).

Notes:

- 40 custom made appliance names can be entered including 27 factory pre-programmed names that are set by default.
- Re-Test period from 1 to 60 months can be set or disabled (---)

The LOCATION of appliance can be entered.

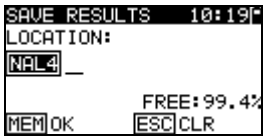


Figure 7.5: *Save results menu (Location)*

Keys:

⮟ / ⮝, TEST	Edit Location.
MEM (OK)	Saves Location and returns to *Autotest Results* menu.
ESC (DEL)	Deletes last character of Location.
ESC (CANCEL)	Returns to the previous menu.

An Appliance LOCATION of up to 14 alphanumeric characters can be entered. The Appliance LOCATION can also be scanned with a barcode scanner, RFID reader/writer or using PATLink android application on mobile devices (QR codes).

7.2. Recalling results

Saved autotest results can be recalled, printed or deleted from the ***Memory*** menu. Enter the ***Memory*** menu from the ***Setup*** menu.

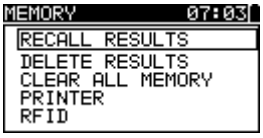


Figure 7.6: *Memory menu*

To enter the Recall results menu select ***Recall results*** in ***Memory*** menu. A list of Appliance ID's and NAMES are displayed in a chronological order (last performed measurement is displayed at the bottom of the list).
In the lower display the following data is displayed:

- Appliance ID, NAME;
- Date and time of the selected test;
- The overall ✓ / ✕ status of the selected test.

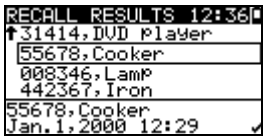


Figure 7.7: *Recall results menu*

Keys:

▲/▼, TEST	Enters View results menu for viewing autotest results.
ESC	Returns to Memory menu.

Note:

- MEM key can be used as shortcut to enter ***Recall results*** menu.

In the ***View results*** screen performed tests, results and their PASS / FAIL status are displayed. Furthermore the selected test results can be displayed with full details.

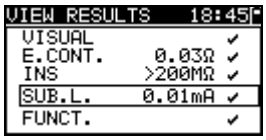


Figure 7.8: *Overall result screen*

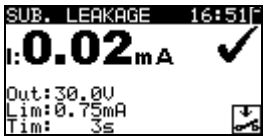


Figure 7.9: *Detailed result screen*

Options in View result screen:

▲/▼	Selects result of measurement.
TEST	Enters selected result of measurement (to be displayed in full details).
ESC	Returns to previous result screen.

7.3. Deleting individual autotest results

To enter the Delete results menu select ***Delete results*** in ***Memory*** menu. A list of Appliance ID's and NAMES are displayed in a chronological order (last performed measurement will be displayed at the bottom of the list).
In the lower window of the display the following data is displayed:

- Appliance ID, NAME;
- date and time of the selected test;
- the overall ✓ / ✕ status of the selected test.

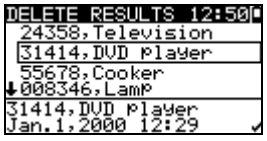


Figure 7.10: *Delete results menu*

Keys:

▲ / ▼	Select autotest result to be deleted.
TEST	Deletes selected autotest result.
ESC	Returns to *Setup menu*.

7.4. Clearing complete memory content

Select ***CLEAR ALL MEMORY*** in ***Memory*** menu. A warning will be displayed.

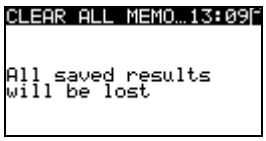


Figure 7.11: *Clear all memory menu*

Keys:

TEST	Confirms clearing of complete memory content.
ESC	Exits back to Memory menu without changes.

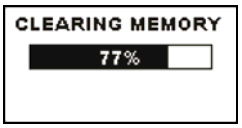


Figure 7.12: *Clearing memory in progress*

7.5. Printing labels and writing RFID tags with autotest results

Labels can be printed and RFID tags can be written from the ***Autotest Results*** and ***Setup/ Memory*** menus.

7.5.1. Printing labels / writing in RFID tags from Autotest Results menu

To print a label or write data to a TAG an Autotest must be saved first. Refer to chapter *7.1 Saving Autotest results for more information*.

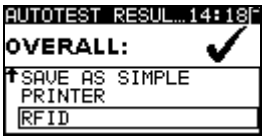


Figure 7.13: *Autotest result screen*

Options in Autotest results screen (after Autotest is saved):

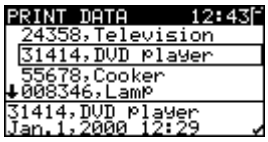
VIEW RESULTS	Views individual results.
NEW TEST	Returns to Shortcut or Simple menu.
SAVE AS SIMPLE	Saves test setup as Simple test. Refer to chapter *6.1 Simple*

	test for more information regarding Simple test.
PRINTER	Proceeds to menu for printing barcode or QR code labels.
RFID	Proceeds to menu for writing RFID tag.
ESC	Returns to Shortcut or Simple menu.

7.5.2. Printing labels / writing in a RFID tag from Setup/ Memory menu

To print a label / write a TAG select ***Printer*** or ***RFID*** in ***Memory*** menu.
A list of Appliance ID's and NAMES is displayed in a chronological order (last performed measurement will be displayed at the bottom of the list).
In the lower window of the display the following data is displayed:

- Appliance ID, NAME;
- date and time of the selected test;
- the overall ✓ / × status of the selected test.



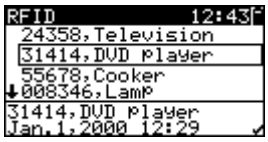
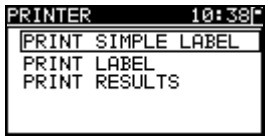


Figure 7.14: *Print label / write TAG menu*

Keys:

▲ / ▼	Selects saved individual result.
TEST	Confirms selected result and enters ***Printer*** or ***RFID*** menu.
ESC	Exits back to Memory menu without changes.

In the ***Printer*** menu four options can be selected: Print simple label, Print label, Print results, and Print QR label. Possible options depend on the selected printer.



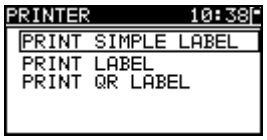


Figure 7.15: *Options in Printer menu*

Print Simple label
A simple appliance label will be printed.

Print label
An appliance label with barcode will be printed.

Print results
All the data stored at the specified location will be printed. That includes Appliance ID, Appliance NAME, Test date and time, Overall and individual measurement result (Pass or Fail), individual measurement values, limits and other settings.

Print QR label
An appliance label with QR code will be printed.
Keys:

⮝ / ⮟	Selects action.
TEST	Confirms and executes selected action.
ESC	Exits back to previous menu without changes.

In the ***RFID*** menu a RFID tag can be written.

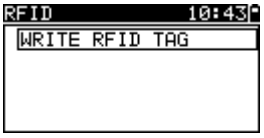


Figure 7.16: *RFID tag menu*

Write RFID tag
The test information is copied to RFID reader/writer. Pressing a **R/W** key on the RFID reader/writer writes Appliance ID, Name, Test Date,Time, Location and autotest code to RFID tag (for detailed information see RFID reader/writer instruction manual).

Keys:

TEST	Confirms and executes selected action.
ESC	Exits back to previous menu without changes.

8. Communication

There are three communication interfaces for communication with PC and other external devices: USB, RS232 and Bluetooth. See chapter *4.6.3 Communication* for more information.

8.1. USB communication

How to establish an USB link:

- *COM PORT: USB* should be selected in *Communication* menu. Connect the PC USB port to the instrument USB connector using the USB interface cable.
- Switch on the PC and the instrument.
- Run the PATLink PRO program.
- Set communication port and baud rate speed.
- The instrument is prepared to upload / download data to the PC.

Notes:

- USB drivers should be installed on PC before using the USB interface. Refer to USB installation instructions available on installation CD.
- USB interface is recommended for communication with the PC software because of the high communication speed.

8.2. RS232 communication

How to establish an RS232 link:

- *COM PORT: RS232* should be selected in Communication menu. Connect the COM port of PC or external device to the instrument PS/2 connector using the PS/2 - RS232 serial communication cable.
- Switch on the PC (Run the PATLink PRO program) or external device and the instrument.
- Set communication port and baud rate speed on PC or external device (optionally)
- The instrument is prepared to upload / download data to the PC.

How to establish an RS232 link between instrument and Zebra TL2824 Plus printer:

- Connect the COM port of Zebra TL2824 Plus printer with modified MINI GENDER CHANGER and PS/2 - RS232 serial communication cable.
- Switch on the Zebra TL2824 Plus printer and the instrument.
- Be sure that settings in Communication menu (see chapter ***Error! Reference source not found. Error! Reference source not found.)*** are as following:
  COM PORT: RS232
  PRINTER: ZEBRA
- The instrument and the printer are ready to communicate.

8.3. Bluetooth communication

The internal Bluetooth module enables easy communication via Bluetooth with PC and Android devices.

How to configure a Bluetooth link between instrument and PC:

- Switch On the instrument.
- On PC configure a Standard Serial Port to enable communication over Bluetooth link between instrument and PC. Usually no code for pairing the devices is needed.
- Run the *PATlinkPRO* program.
- Set communication port and baud rate speed.
- The instrument is prepared to communicate with the PC.

How to configure a Bluetooth link between instrument and Android device:

- Switch On the instrument.
- Some Android applications automatically carry out the setup of a Bluetooth connection. It is preferred to use this option if it exists.
  This option is supported by Metrel's Android applications.
- If this option is not supported by the selected Android application then configure a Bluetooth link via Android device's Bluetooth configuration tool. Usually no code for pairing the devices is needed.
- The instrument and Android device are ready to communicate.

Notes:

- Sometimes there will be a demand from the PC or Android device to enter the code. Enter code 'NNNN' to correctly configure the Bluetooth link.
- The name of correctly configured Bluetooth device must consist of the instrument type plus serial number, eg. *MI 3309 BT-12240429I*. If the Bluetooth module got another name, the configuration must be repeated.
- In case of serious troubles with the Bluetooth communication it is possible to reinitialize the internal Bluetooth module. The initialization is carried out during the Initial settings procedure. In case of a successful initialization "INTERNAL BLUETOOTH SEARCHING OK!" is displayed at the end of the procedure. See chapter *4.6.12 Initial settings*.

How to configure a Bluetooth link between instrument / Android device / Zebra TL2824 Plus printer:

- Switch Off and On the instrument.
- Switch On the printer. The Bluetooth dongle A 1436 must be inserted to the printer's COM port.
- Be sure that settings in Communication menu (see chapter *4.6.3 Communication)* are as following:
  PRINTER: ZEBRA BT
  PRN NAME: ZebraPRN
  The dongle should be properly initialized (see chapter *4.6.3 Communication)*.
- If printing from Android device be sure that Zebra printer is selected in the Metrel

Android application as the Bluetooth printer. The configuration tool is available in the Metrel's Android application.
- The instrument and printer are ready to communicate.

Notes:
- The name of a correctly configured Bluetooth device must consist of the instrument type plus serial number, eg. *MI 3309 BT-12240429I*.
- The name of a correctly configured Bluetooth device for the Zebra printer is ZebraPRN.

9. Measuring 110 V appliances

The DeltaPAT instrument allows measurements to be performed on 110 V appliances. When the 110 V adapter is used only the following measurements can be performed:

- Earth continuity resistance,
- Insulation resistance,
- Insulation resistance - P,
- Substitute leakage current,
- Substitute leakage current - P.

Other measurements are prohibited in order to prevent damage of the tested appliance.

9.1. How to perform measurements by using 110 V adapter

In order to test 110 V appliances, first plug a 110 V adapter into the main test socket of the instrument.

Figure 9.1: *Connecting 110 V adapter to the instrument*

Select the appliance nominal voltage in the Setup menu (nominal voltage selection).
If the 110 V nominal voltage is selected the following symbol (***Figure 9.2***) will be displayed after starting Substitute leakage and Substitute leakage - P measurement.

Figure 9.2: *110 V symbol*

Figure 9.3: *Substitute leakage screen (110 V)*

See chapter *4.6.6 Nominal voltage selection* for more information.

Note:

- Ensure correct lead compensation for Earth continuity function, when measuring 110 V appliances, 110 V adapter shall be included in lead compensation.

10. Maintenance

10.1. Periodic calibration

It is essential that all measuring instruments are regularly calibrated in order for the technical specification listed in this manual to be guaranteed. We recommend an annual calibration. The calibration has to be done by an authorized technical person only.

10.2. Replacement of the fuses

The DeltaPAT MI 3309 BT instrument contains two accessible fuses:

- F1, F2 fuse type:
  T 16 A / 250 V, 20×5 mm, breaking capacity 1500 A
  General input protection fuses.

Warnings:

- ⚠ Disconnect all measuring accessories, mains supply and power off the instrument before opening the battery or fuse compartment cover, hazardous voltage inside!
- Replace blown fuse with same type only, otherwise the instrument may be damaged and / or operator's safety impaired!

Position of fuses F1, F2 can be seen in *figure 2.2* in chapter *2.2 Connector panel*.

10.3. Service

For repairs under or out of warranty please contact your distributor for further information. Unauthorized person is not allowed to open the DeltaPAT instrument. There are no user replaceable parts inside the instrument.

10.4. Cleaning

Use a soft cloth, slightly moistened with soapy water or alcohol to clean the surface of the instrument. Leave the instrument to dry totally before using it.

Notes:

- Do not use liquids based on petrol or hydrocarbons!
- Do not spill cleaning liquid over the instrument!

11. Instrument set and accessories

Standard set of the instrument

- Instrument MI 3309 BT DeltaPAT
- Test probe, black
- Crocodile clip, black
- Test lead, 1.5 m, black
- 2 x IEC cord, 1.5 m
- NiMH batteries, type HR 6 (size AA),, 6 pcs
- USB cable
- RS232 - PS/2 cable
- PC SW PATLink PRO
- Instruction manual
- Small soft carrying bag
- Calibration certificate

Optional accessories

See the attached sheet for a list of optional accessories that are available on request from yours distributor.

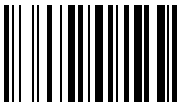
Appendix A – Barcode and QR code formats

Barcode formats

The instrument DeltaPAT supports two barcode formats (single and double).

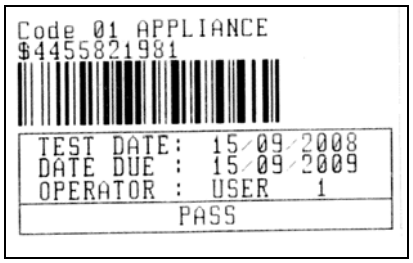
Autotest code and appliance ID

Autotest codes are represented as a three digits code. These autotest codes can also be represented by the barcode.
Using the barcode scanner, the instruments can accept autotest code from barcode label.

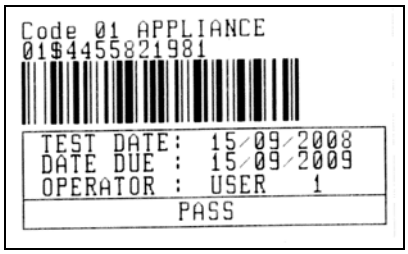


Autotest code

Also appliance ID can be read from barcode label.



barcode system: single



barcode system: double

Examples of appliance labels

A01	Autotest code
$	Separator
4455821981	Appliance ID

Note:

- Special character »$« between autotest code and appliance ID is used to distinguish code from appliance ID.

QR code formats

The instrument DeltaPAT also supports QR code format.
Autotest code, Appliance ID, Appliance name, Re-Test period, Location, and results of tests can be represented by QR code.

Example of QR code

Appendix B – Simple test codes (UK)

Type	Class	Earth continuity Limit	Out	Insulation Limit	Out	S. Leakage Limit	Polarity
CLASS I	I	0.20 Ω	200 mA	1.00 MΩ	500 V	0.75 mA	-
CLASS II	II	-	-	2.00 MΩ	500 V	0.25 mA	-
IEC	-	0.20 Ω	200 mA	1.00 MΩ	500 V	-	✓
CLASS I PC	I	0.20 Ω	200 mA	1.00 MΩ	250 V	0.75 mA	-

Appendix C – Autotest shortcut codes (UK)

Autotests marked bold are available if SHORTCUT setup is set to BASIC. Refer to chapter 4.6.7 Shortcut Setup for more information.

Type	Class	Fuse	Cord	Earth Bond Limit	Earth Bond Out	Insulation Limit	Insulation Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
Portable or Handheld											
	I	3 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	0.75 mA	-	001
	I	6 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	0.75 mA	-	002
	I	10 A	short	0.10 Ω	25 A	1.00 MΩ	500 V	-	0.75 mA	-	003
	I	**13 A**	**short**	**0.10 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**0.75 mA**	**-**	**004**
	I	3 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	-	-	005
	I	6 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	-	-	006
	I	10 A	short	0.10 Ω	25 A	1.00 MΩ	500 V	-	-	-	007
	I	**13 A**	**short**	**0.10 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**-**	**-**	**008**
	I	3 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	0.75 mA	-	009
	I	6 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	0.75 mA	-	010
	I	10 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	0.75 mA	-	011
	I	**13 A**	**midd**	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**0.75 mA**	**-**	**012**
	I	3 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	013
	I	6 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	014
	I	10 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	-	-	015
	I	**13 A**	**midd**	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**-**	**-**	**016**
	I	3 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	0.75 mA	-	017
	I	6 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	0.75 mA	-	018
	I	10 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	0.75 mA	-	019
	I	**13A**	**long**	**0.50 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**0.75 mA**	**-**	**020**
	I	3 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	-	-	021
	I	6 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	-	-	022
	I	10 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	-	-	023
	I	**13 A**	**long**	**0.50 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**-**	**-**	**024**
	II	-	-	-	-	2.00 MΩ	500 V	-	0.25 mA	-	025
	II	**-**	**-**	**-**	**-**	**2.00 MΩ**	**500 V**	**-**	**-**	**-**	**026**

Type	Class	Fuse	Cord	Earth Bond Limit	Earth Bond Out	Insulation Limit	Insulation Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
Heating and Cooking											
	I	**3 A**	**short**	**0.10Ω**	**10 A**	**-**	**-**	**-**	**0.75 mA**	**-**	**027**
	I	6 A	short	0.10 Ω	10 A	-	-	-	1.00 mA	-	028
	I	10 A	short	0.10 Ω	25 A	-	-	-	1.50 mA	-	029
	I	**13 A**	**short**	**0.10 Ω**	**25 A**	**-**	**-**	**-**	**2.25 mA**	**-**	**030**
	I	3 A	short	0.10 Ω	10 A	-	-	0.75 mA	-	-	031
	I	6 A	short	0.10 Ω	10 A	-	-	1.00 mA	-	-	032
	I	10 A	short	0.10 Ω	25 A	-	-	1.50 mA	-	-	033
	I	13 A	short	0.10 Ω	25 A	-	-	2.25 mA	-	-	034
	II	-	-	-	-	2.00 MΩ	500 V	-	0.25 mA	-	035
	II	**-**	**-**	**-**	**-**	**2.00 MΩ**	**500 V**	**-**	**-**	**-**	**036**

Type	Class	Fuse	Cord	Earth Bond Limit	Earth Bond Out	Insulation Limit	Insulation Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
IT equipment EN 60950											
	I	-	short	0.10 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	037
	I	-	midd	0.30 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	038
	I	-	long	0.50 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	039
IT equipment EN 60950 – 250V											
	I	**-**	**long**	**0.50 Ω**	**100 mA**	**1.00 MΩ**	**250 V**	**3.5 mA**	**-**	**-**	**040**

Type	Class	Fuse	Cord	Earth Bond Limit	Earth Bond Out	Insulation Limit	Insulation Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
OTHER											
	I	3 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	041
	I	6 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	042
	I	10 A	short	0.10 Ω	25A	1.00 MΩ	500 V	-	3.50 mA	-	043
	I	**13 A**	**short**	**0.10 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**3.50 mA**	**-**	**044**
										-	
	I	3 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	-		045
	I	6 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	-	-	046
	I	10 A	short	0.10 Ω	25 A	1.00 MΩ	500 V	-	-	-	047
	I	**13 A**	**short**	**0.10 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**-**	**-**	**048**
	I	3 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	049
	I	6 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	050
	I	10 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	051
	I	**13 A**	**midd**	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**3.50 mA**	**-**	**052**
	I	3 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	053
	I	6 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	054
	I	10 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	-	-	055
	I	**13 A**	**midd**	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**-**	**-**	**056**
	I	3 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	057
	I	6 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	058
	I	10 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	059
	I	**13 A**	**long**	**0.50 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**3.50 mA**	**-**	**060**
	I	3 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	-	-	061
	I	6 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	-	-	062
	I	10 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	-	-	063
	I	**13 A**	**long**	**0.50 Ω**	**25 A**	**1.00 MΩ**	**500 V**	**-**	**-**	**-**	**064**
	II	-	-	-	-	2.00 MΩ	500 V	-	0.25 mA	-	065
	II	**-**	**-**	**-**	**-**	**2.00 MΩ**	**500 V**	**-**	**-**		**066**

IEC leads **Surge protected = OFF / RCD protected = OFF**							
	Length	**Earth Bond**		**Insulation**		**Polarity**	**Code**
		Limit	**Out**	**Limit**	**Out**		
0.5mm² / 3A							
	<=5 m	**0.30 Ω**	**10 A**	**1.00 MΩ**	**500 V**	✓	**067**
	7.5 m	0.40 Ω	10 A	1.00 MΩ	500 V	✓	068
	10 m	0.50 Ω	10 A	1.00 MΩ	500 V	✓	069
	12 m	0.60 Ω	10 A	1.00 MΩ	500 V	✓	070
	15 m	0.70 Ω	10 A	1.00 MΩ	500 V	✓	071
	20 m	0.80 Ω	10 A	1.00 MΩ	500 V	✓	072
	30 m	1.00 Ω	10 A	1.00 MΩ	500 V	✓	073
	40 m	2.00 Ω	10 A	1.00 MΩ	500 V	✓	074
	50 m	2.00 Ω	10 A	1.00 MΩ	500 V	✓	075
0.75mm² / 6 A							
	<=5 m	0.20 Ω	10 A	1.00 MΩ	500 V	✓	076
	7.5 m	**0.30 Ω**	**10 A**	**1.00 MΩ**	**500 V**	✓	**077**
	10 m	0.40 Ω	10 A	1.00 MΩ	500 V	✓	078
	12 m	0.40 Ω	10 A	1.00 MΩ	500 V	✓	079
	15 m	0.50 Ω	10 A	1.00 MΩ	500 V	✓	080
	20 m	0.60 Ω	10 A	1.00 MΩ	500 V	✓	081
	30 m	0.90 Ω	10 A	1.00 MΩ	500 V	✓	082
	40 m	1.00 Ω	10 A	1.00 MΩ	500 V	✓	083
	50 m	1.00 Ω	10 A	1.00 MΩ	500 V	✓	084
1 mm²/ 10 A							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓	**085**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	086
	10 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓	**087**
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	088
	15 m	0.40 Ω	25 A	1.00 MΩ	500 V	✓	089
	20 m	0.50 Ω	25 A	1.00 MΩ	500 V	✓	090
	30 m	0.70 Ω	25 A	1.00 MΩ	500 V	✓	091
	40 m	0.90 Ω	25 A	1.00 MΩ	500 V	✓	092
	50 m	1.00 Ω	25 A	1.00 MΩ	500 V	✓	093
1.25mm²/ 13A							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓	**094**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	095
	10 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	096
	12 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓	**097**
1.5mm²/ 15 A							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓ standard	**103**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓ standard	104
	10 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓ standard	105
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓ standard	106
	15 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓ standard	**107**
UNKNOWN							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓ standard	**112**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓ standard	113
	10 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓ standard	114
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓ standard	115
	15 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**500 V**	✓ standard	**116**
	20 m	0.40 Ω	25 A	1.00 MΩ	500 V	✓ standard	117
	30 m	0.50 Ω	25 A	1.00 MΩ	500 V	✓ standard	118
	40 m	0.60 Ω	25 A	1.00 MΩ	500 V	✓ standard	119
	50 m	0.80 Ω	25 A	1.00 MΩ	500 V	✓ standard	120

IEC leads **Surge protected = ON RCD protected = OFF**							
	Length	**Earth Bond**		**Insulation**		**Polarity**	**Code**
		Limit	**Out**	**Limit**	**Out**		
0.5mm² / 3A							
	<=5 m	**0.30 Ω**	**10 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**167**
	7.5 m	0.40 Ω	10 A	1.00 MΩ	250 V	✓ standard	168
	10 m	0.50 Ω	10 A	1.00 MΩ	250 V	✓ standard	169
	12 m	0.60 Ω	10 A	1.00 MΩ	250 V	✓ standard	170
	15 m	0.70 Ω	10 A	1.00 MΩ	250 V	✓ standard	171
	20 m	0.80 Ω	10 A	1.00 MΩ	250 V	✓ standard	172
	30 m	1.00 Ω	10 A	1.00 MΩ	250 V	✓ standard	173
	40 m	2.00 Ω	10 A	1.00 MΩ	250 V	✓ standard	174
	50 m	2.00 Ω	10 A	1.00 MΩ	250 V	✓ standard	175
0.75mm² / 6 A							
	<=5 m	0.20 Ω	10 A	1.00 MΩ	250 V	✓ standard	176
	7.5 m	**0.30 Ω**	**10 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**177**
	10 m	0.40 Ω	10 A	1.00 MΩ	250 V	✓ standard	178
	12 m	0.40 Ω	10 A	1.00 MΩ	250 V	✓ standard	179
	15 m	0.50 Ω	10 A	1.00 MΩ	250 V	✓ standard	180
	20 m	0.60 Ω	10 A	1.00 MΩ	250 V	✓ standard	181
	30 m	0.90 Ω	10 A	1.00 MΩ	250 V	✓ standard	182
	40 m	1.00 Ω	10 A	1.00 MΩ	250 V	✓ standard	183
	50 m	1.00 Ω	10 A	1.00 MΩ	250 V	✓ standard	184
1 mm²/ 10 A							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**185**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	186
	10 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**187**
	12 m	0.30 Ω	25 A	1.00 MΩ	250 V	✓ standard	188
	15 m	0.40 Ω	25 A	1.00 MΩ	250 V	✓ standard	189
	20 m	0.50 Ω	25 A	1.00 MΩ	250 V	✓ standard	190
	30 m	0.70 Ω	25 A	1.00 MΩ	250 V	✓ standard	191
	40 m	0.90 Ω	25 A	1.00 MΩ	250 V	✓ standard	192
	50 m	1.00 Ω	25 A	1.00 MΩ	250 V	✓ standard	193
1.25mm²/ 13A							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**194**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	195
	10 m	0.30 Ω	25 A	1.00 MΩ	250 V	✓ standard	196
	12 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**197**
1.5mm²/ 15 A							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**203**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	204
	10 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	205
	12 m	0.30 Ω	25 A	1.00 MΩ	250 V	✓ standard	206
	15 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**207**
UNKNOWN							
	<=5 m	**0.20 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**212**
	7.5 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	213
	10 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	214
	12 m	0.30 Ω	25 A	1.00 MΩ	250 V	✓ standard	215
	15 m	**0.30 Ω**	**25 A**	**1.00 MΩ**	**250 V**	✓ **standard**	**216**
	20 m	0.40 Ω	25 A	1.00 MΩ	250 V	✓ standard	217
	30 m	0.50 Ω	25 A	1.00 MΩ	250 V	✓ standard	218
	40 m	0.60 Ω	25 A	1.00 MΩ	250 V	✓ standard	219
	50 m	0.80 Ω	25 A	1.00 MΩ	250 V	✓ standard	220

IEC leads **Surge protected = OFF RCD protected = ON**							
	Length	**Earth Bond Limit**	**Out**	**Leakage Limit**	**RCD**	**Polarity**	**Code**
0.5mm^2 / 3A							
	<=5 m	**0.30 Ω**	**10 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**267**
	7.5 m	0.40 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	268
	10 m	0.50 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	269
	12 m	0.60 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	270
	15 m	0.70 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	271
	20 m	0.80 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	272
	30 m	1.00 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	273
	40 m	2.00 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	274
	50 m	2.00 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	275
0.75mm^2 / 6 A							
	<=5 m	0.20 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	276
	7.5 m	**0.30 Ω**	**10 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**277**
	10 m	0.40 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	278
	12 m	0.40 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	279
	15 m	0.50 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	280
	20 m	0.60 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	281
	30 m	0.90 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	282
	40 m	1.00 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	283
	50 m	1.00 Ω	10 A	0.75 mA	PRCD: 30 mA Auto	✓ active	284
1 mm^2/ 10 A							
	<=5 m	**0.20 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	✓ active	**285**
	7.5 m	0.20 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	286
	10 m	**0.30 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**287**
	12 m	0.30 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	288
	15 m	0.40 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	289
	20 m	0.50 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	290
	30 m	0.70 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	291
	40 m	0.90 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	292
	50 m	1.00 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	293
1.25mm^2/ 13A							
	<=5 m	**0.20 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**294**
	7.5 m	0.20 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	295
	10 m	0.30 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	296

	12 m	**0.30 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**297**
1.5mm²/ 15 A							
	<=5 m	**0.20 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**303**
	7.5 m	0.20 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	304
	10 m	0.20 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	305
	12 m	0.30 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	306
	15 m	**0.30 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**307**
UNKNOWN							
	<=5 m	**0.20 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**312**
	7.5 m	0.20 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	313
	10 m	0.20 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	314
	12 m	0.30 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	315
	15 m	**0.30 Ω**	**25 A**	**0.75 mA**	**PRCD: 30 mA Auto**	**✓ active**	**316**
	20 m	0.40 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	317
	30 m	0.50 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	318
	40 m	0.60 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	319
	50 m	0.80 Ω	25 A	0.75 mA	PRCD: 30 mA Auto	✓ active	320

Type	**Portable RCD**					
	Earth Bond Limit	**Out**	**Leakage Limit**	**RCD**	**Polarity**	**Code**
	0.10 Ω	25 A	0.75 mA	PRCD: 30mA Auto	✓ active	400

Type	**Class III equipment**	
	Visual	**Code**
	✓	**500**

Meaning of symbols used in autotest shortcut codes tables:
✓ test/measurement enabled
- test/measurement disabled