



**GammaPAT**  
**MI 3311**  
**Instruction manual**  
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## Table of contents

<b>1</b>	<b>General description.....</b>	<b>5</b>
1.1	Warnings .....	6
1.2	Battery and charging .....	7
1.3	New battery cells or cells unused for a longer period .....	8
1.4	Standards applied.....	9
<b>2</b>	<b>Instrument description .....</b>	<b>10</b>
2.1	Front panel .....	10
2.2	Connector panel .....	11
2.3	Back side.....	12
2.4	Meaning of symbols and messages on the instrument display.....	13
2.5	<i>Battery indication .....</i>	<i>14</i>
<b>3</b>	<b>Technical specifications.....</b>	<b>15</b>
3.1	Earth continuity.....	15
3.2	Insulation resistance.....	15
3.3	Substitute leakage current.....	16
3.4	Polarity test.....	16
3.5	Voltage measurement .....	16
3.6	Checkbox specification.....	17
3.7	General data.....	17
<b>4</b>	<b>Main menu and test modes .....</b>	<b>19</b>
4.1	Instrument Main menu .....	19
4.2	Simple test menu.....	19
4.3	Shortcut menu .....	20
4.4	Single test menu.....	20
4.5	Help menu .....	20
4.6	Setup menu .....	21
4.7	<i>Memory.....</i>	<i>21</i>
4.8	<i>Language selection.....</i>	<i>21</i>
4.9	<i>LCD contrast and backlight.....</i>	<i>22</i>
4.10	<i>Checkbox.....</i>	<i>22</i>
4.11	<i>Nominal voltage selection .....</i>	<i>24</i>
4.12	<i>Shortcut setup.....</i>	<i>25</i>
4.13	<i>Test speed setup .....</i>	<i>25</i>
4.14	<i>Setting date and time .....</i>	<i>26</i>
4.15	<i>User data .....</i>	<i>26</i>
4.16	<i>Instrument data.....</i>	<i>27</i>
4.17	<i>Initial settings .....</i>	<i>27</i>
<b>5</b>	<b>Single test.....</b>	<b>28</b>
5.1	Performing measurements in single test mode.....	28
5.2	Measurements and inspections .....	29
5.3	<i>Visual inspection.....</i>	<i>29</i>
5.4	<i>Earth continuity resistance.....</i>	<i>30</i>
5.5	<i>Insulation resistance .....</i>	<i>31</i>
5.6	<i>Insulation resistance - P.....</i>	<i>32</i>

5.7	Substitute leakage .....	33
5.8	Substitute leakage - P.....	34
5.9	Polarity test.....	36
5.10	Functional test.....	37
5.11	Voltage TRMS.....	38
<b>6</b>	<b>Automatic test sequences.....</b>	<b>39</b>
6.1	Simple test.....	39
6.2	Shortcut test sequences .....	39
6.3	<i>Selecting the autotest shortcut sequence</i> .....	40
6.4	Carrying out (Simple, Shortcut) test sequences .....	41
6.5	<i>Visual inspection</i> .....	41
6.6	<i>Earth continuity measurement</i> .....	41
6.7	<i>Insulation resistance measurement</i> .....	42
6.8	<i>Substitute leakage measurement</i> .....	42
6.9	<i>Insulation resistance - P measurement</i> .....	43
6.10	<i>Substitute Leakage - P measurement</i> .....	43
6.11	<i>Polarity test</i> .....	44
6.12	<i>Functional test</i> .....	44
6.13	Handling autotest results .....	45
<b>7</b>	<b>Working with autotest results .....</b>	<b>46</b>
7.1	Saving autotest results .....	46
7.2	Recalling results .....	47
7.3	Deleting individual autotest results .....	48
7.4	Clearing complete memory content.....	48
7.5	Printing and RFID tagging of individual autotest results .....	49
<b>8</b>	<b>Communication .....</b>	<b>50</b>
<b>9</b>	<b>Measuring 110 V appliances .....</b>	<b>51</b>
9.1	How to perform measurements by using 110 V adapter.....	51
<b>10</b>	<b>Maintenance .....</b>	<b>52</b>
10.1	Periodic calibration .....	52
10.2	Service .....	52
10.3	Cleaning .....	52
<b>11</b>	<b>Instrument set and accessories.....</b>	<b>53</b>
<b>Appendix A – Barcode formats .....</b>		<b>54</b>
<b>Appendix B – Simple test codes (UK).....</b>		<b>55</b>
<b>Appendix C – Autotest shortcut codes (UK) .....</b>		<b>56</b>

# 1 General description

The multifunctional portable appliance tester GammaPAT is intended to perform measurements for testing the electrical safety of portable electrical equipment.

The following tests can be performed:

- earth continuity resistance;
- insulation resistance;
- insulation resistance of isolated accessible conductive parts;
- substitute leakage current;
- substitute leakage current of isolated accessible conductive parts;
- functional and visual inspection;
- IEC cord polarity test;
- TRMS voltage meter.

Some instrument's highlights:

- graphic LCD with resolution of 128 x 64 dots, with backlight;
- large data flash memory for storing test results & parameters (approx 1500 tests can be stored);
- two communication ports (USB and RS232C) for communication with PC, barcode reader, printer and RFID reader/writer;
- built in real time clock;
- fully compatible with new METREL PATLink PRO PC software package;
- In built calibration unit.

Powerful functions for fast and efficient periodic testing are included:


- pre-programmed test sequences;
- fast testing with the help of barcodes and RFID tags;
- 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!**
- › **Appliances MUST be fully disconnected from the mains supply before it is connected to the MI3311 GammaPAT in order to perform a PAT test.**
- › **Do not touch any test leads/terminals while the appliance is connected to the MI3311 GammaPAT.**
- › **Do not use the instrument and accessories if any damage is noticed!**
- › **The Instrument should not be used for measurements while charging.**
- › **Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!**
- › **Use only standard or optional test accessories, supplied by your distributor!**
- › **Instrument servicing and adjustment is only allowed 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 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 standard alkaline battery cells while power supply adapter is connected, otherwise they may explode!**
- › **If a test code with an earth bond test current higher than 200 mA is selected (manually, with barcode reader or with RFID reader/writer) the GammaPAT 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!**
- › **The Substitute leakage current / Substitute leakage - P tests can be carried out as an alternative for the Leakage and Touch leakage tests if there are no mains supply dependent switches inside the equipment. The operator must be competent to decide if performing the Substitute leakage current test is applicable!**
- › **If a test code with a Leakage current is selected (manually, with barcode reader or with RFID reader/writer) the GammaPAT instrument will automatically perform a Substitute leakage test. Other test parameters remain unchanged. The operator must be competent to decide if performing the Substitute leakage test is acceptable!**
- › **If a test code with a Touch leakage current is selected (manually, with barcode reader or with RFID reader/writer) the GammaPAT instrument will automatically perform a Substitute leakage - P test. Other test parameters remain unchanged. The operator must be competent to decide if performing the Substitute leakage - P test is acceptable!**

## 1.2 Battery and charging

The instrument uses six AA size alkaline or rechargeable Ni-Cd or Ni-MH battery cells. 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.

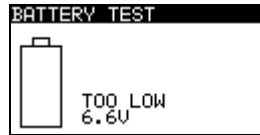


Figure 1.1: Discharged battery indication

Whenever the power supply adapter is connected, the instrument will automatically start charging the batteries. The power supply socket polarity is shown in figure 1.2. The instrument's internal circuitry controls the charging and to ensure maximum battery life.

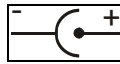


Figure 1.2: Power supply socket polarity

Symbols:

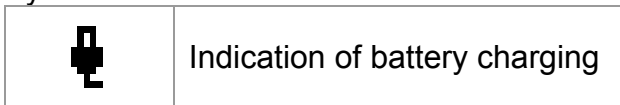


Figure 1.3: Charging indication on display

- ▶ **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.
- ▶ Alkaline or rechargeable Ni-Cd or Ni-MH batteries (size AA) can be used. Metrel recommends only using rechargeable batteries with a capacity of 2100mAh or higher.
- ▶ Do not recharge alkaline battery cells!
- ▶ Use only power supply adapters delivered from the manufacturer or distributor of the test equipment to avoid possible fire or electric shock! Maximum short-term voltage of external power supply adapter is 14 V!

### 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). Ni-MH and Ni-Cd 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
<ul style="list-style-type: none"> <li>› Completely charge the battery.</li> </ul>	At least 14h with the in-built charger.
<ul style="list-style-type: none"> <li>› Completely discharge the battery.</li> </ul>	This can be performed by using the instrument normally until the instrument is fully discharged.
<ul style="list-style-type: none"> <li>› Repeat the charge / discharge cycle at least 2-4 times.</li> </ul>	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 Gamma PAT is manufactured and tested in accordance with the following regulations:

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### *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)
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### *Safety (LVD)*

EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
EN 61010-031	Safety requirements for hand-held probe assemblies for electrical measurement and test

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### *Functionality*

EN 61557	Electrical safety in low voltage distribution systems up to 1000 V <sub>AC</sub> and 1500 V <sub>AC</sub> – Equipment for testing, measuring or monitoring of protective measures Part 2 Insulation resistance Part 4 Resistance of earth connection and equipotential bonding Part 10 Combined measuring equipment for testing, measuring and monitoring of protective measures
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

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### *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 3 <sup>rd</sup> 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 1.1: Front panel

*Legend:*

1	LCD	128 x 64 dots matrix display with backlight.
2	FAIL	Red indicator
3	PASS	Green indicator
		Indicates PASS/ FAIL of result.
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.
		Switches the instrument power on or off.
9	ON / OFF	To switch the instrument Off the key must be pressed for 2 seconds.
	ESC	The instrument automatically turns off 15 minutes after the last key was pressed.
		Returns to previous level.
10		Mains test socket.

## 2.2 Connector panel

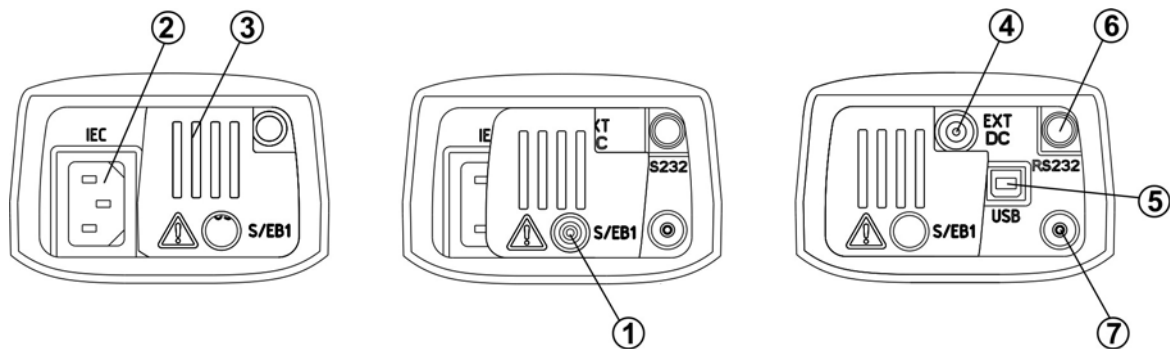


Figure 1.2: Connector panel

### Legend:

1	S/EB1	Probe and Earth continuity terminal
2	IEC	IEC / Voltage input
3	Protection cover	
4	Charger socket	For connection of external charger
5	USB connector	Communication with PC USB (1.1) port
6	PS/2 connector	Communication with barcode reader
		Communication with printer
		Communication with RFID reader/writer
7	PE terminal	For checking S/EB test lead

### Warnings!

- › **Maximum allowed voltage between IEC test terminals is 300 V (CAT II)!**
- › **Maximum short-term voltage of external power supply adapter is 14 V!**

### 2.3 Back side



Figure 1.3: 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



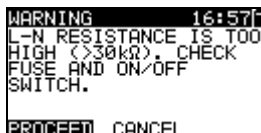
Figure 1.4: Battery compartment

Legend:

1	Battery cells	Size AA, alkaline or 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.



```

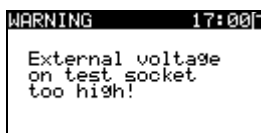
WARNING 16:57
L-N RESISTANCE IS TOO
HIGH (>30kΩ). CHECK
FUSE AND ON/OFF
SWITCH.
PROCEED CANCEL
  
```

### WARNING!

An excessively high resistance was measured in the fuse pre-test. This indication means that the device under test has extremely low power consumption or it is:

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

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



```

WARNING 17:00
External voltage
on test socket
too high!
  
```

### WARNING!

Voltage on mains test socket between LN - PE terminals 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!



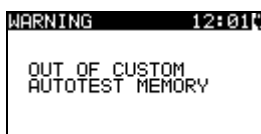
```

WARNING 09:40
Leakage test
S/EB1-PE too
high!
  
```

### WARNING!

Current on test probe (S/EB1 - PE) is higher than approximately 10mA (AC or DC)!

Disconnect the test probe from the device under test and determine why an external current was detected!

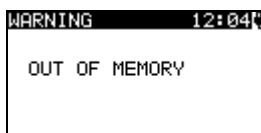


```

WARNING 12:01
OUT OF CUSTOM
AUTOTEST MEMORY
  
```

### WARNING!

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

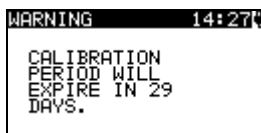


```

WARNING 12:04
OUT OF MEMORY
  
```

### WARNING!

The internal memory is full!

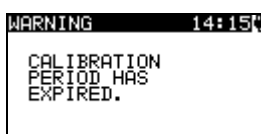


```

WARNING 14:27
CALIBRATION
PERIOD WILL
EXPIRE IN 29
DAYS.
  
```

### WARNING!

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



```

WARNING 14:15
CALIBRATION
PERIOD HAS
EXPIRED.
  
```

### WARNING!

The calibration period has expired. Recalibrate the instrument!

**WARNING!**

A high insulation test 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 in progress.



Test result can be saved.



Connect the test lead to the S/EB1 test socket.



Flex the mains cable of appliance during the test.



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 based on a 110V power supply.



Test passed.



Test failed.

## 2.5 Battery indication

The indication indicates 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.



Recharging in progress (if external charger is connected).

### 3 Technical specifications

#### 3.1 Earth continuity

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

Test currents ..... 200 mA into 2.00  $\Omega$   
 Open circuit voltage ..... <9 V AC  
 Pass levels ..... 0.10  $\Omega$ , 0.20  $\Omega$ , 0.30  $\Omega$ , 0.40  $\Omega$ , 0.50  $\Omega$ , 0.60  $\Omega$ , 0.70  $\Omega$ ,  
 0.80  $\Omega$ , 0.90  $\Omega$ , 1.00  $\Omega$ , 1.50  $\Omega$ , 2.00  $\Omega$   
 Test duration ..... 2 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s  
 Test method ..... 2-wire measurement

Test terminals:

Earth continuity	PE (mains test socket) ↔ S/EB1 (probe)
------------------	--

#### 3.2 Insulation resistance

Range	Resolution	Accuracy
0.00 M $\Omega$ ÷ 19.99 M $\Omega$	0.01 M $\Omega$	$\pm$ (5 % of reading + 3 digits)
20.0 M $\Omega$ ÷ 49.9 M $\Omega$	0.1 M $\Omega$	Indication only
50.0 M $\Omega$ ÷ 199.9 M $\Omega$	0.1 M $\Omega$	

Nominal voltages ..... 250 V DC, 500 V DC (- 0 %, + 10 %)  
 Measuring current ..... min. 1 mA at 250 k $\Omega$  (250 V), 500 k $\Omega$  (500 V)  
 Short circuit current ..... max. 2.0 mA  
 Pass levels ..... 0.01 M $\Omega$ , 0.10 M $\Omega$ , 0.25 M $\Omega$ , 0.30 M $\Omega$ , 0.50 M $\Omega$ , 1 M $\Omega$ ,  
 2 M $\Omega$ , 4 M $\Omega$ , 7 M $\Omega$ , 10 M $\Omega$ , --- M $\Omega$   
 Test duration ..... 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s

Test terminals:

Insulation	LN (mains test socket) ↔ PE (mains test socket)
Insulation-P	LN (mains test socket) ↔ S/EB1 (probe)

### 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 ÷ 19.9 mA	0.1 mA	

Open circuit voltage ..... <50 V AC at rated mains voltage

Short circuit current..... <2,5 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

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 or 230 V) x 1.06.

**Note:**

- See chapter 9 *Measuring 110 V appliances* for more information.

*Test terminals:*

Sub. leakage	LN (mains test socket) ↔ PE ( mains test socket)
Sub. leakage-P	LN (mains test socket) ↔ S/EB1 (probe)

### 3.4 Polarity test

Test voltage ..... <50 V AC

Detects..... PASS, L OPEN, N OPEN, PE OPEN, L-N CROSS, MULTIPLE FAULT.

*Test terminals:*

Polarity	Main test socket ↔ IEC test socket
----------	------------------------------------

### 3.5 Voltage measurement

Range	Resolution	Accuracy
0 ÷ 300 V	1 V	±(2 % of reading + 2 digits)

Result type ..... True r.m.s. (trms)

Nominal frequency range..... 0 Hz, 50 Hz ÷ 60 Hz

Frequency accuracy ..... Indication only

*Test terminals:*

Voltage TRMS	IEC test socket
--------------	-----------------



### 3.6 Checkbox specification

#### Instrument

Function	Reference value	Accuracy
Earth continuity	0.50 $\Omega$	+/- 1 % of value
Earth continuity	2.00 $\Omega$	+/- 1 % of value
Substitute leakage current	5.90 mA	+/- 1 % of value
Substitute leakage current	0.50 mA	+/- 1 % of value
Insulation resistance	1.20 M $\Omega$	+/- 1 % of value
Insulation resistance	10.00 M $\Omega$	+/- 1 % of value

#### S/EB test lead

Function	Reference value	Accuracy
Earth continuity	0.00 $\Omega$	+/- 0.05 $\Omega$

#### IEC test cord

Function	Reference value	Accuracy
Earth continuity	0.00 $\Omega$	+/- 0.05 $\Omega$
Polarity	PASS	n.a.

### 3.7 General data

Power supply voltage.....	9 V <sub>DC</sub> (6×1.5 V battery or accu, size AA)
Operation.....	typical 8 h
Charger socket input voltage.....	12 V ± 10 %
Charger socket input current.....	400 mA max.
Battery charging current.....	250 mA (internally regulated)
Oversvoltage category.....	300 V CAT II
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 × 23 cm
Weight.....	0.86 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)

Memory.....1500 memory locations

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.

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

Protection pre-tests

- External voltage between LN and PE (DC and AC).
- Excessive leakage between S/EB1 and PE (DC and AC).

Connectivity (fuse) pre-test

- Appliance not switched on or 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 three operation modes, Help and Setup that can be selected.

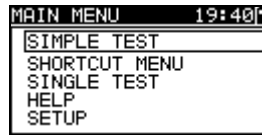


Figure 1.5: Instrument Main menu

Keys:

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

### 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.

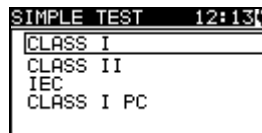


Figure 1.6: Simple test menu

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.

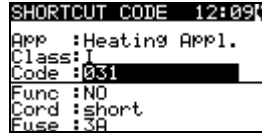


Figure 1.7: Autotest shortcut menu example

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

### 4.4 Single test menu

In single test menu individual tests can be performed.

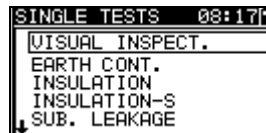


Figure 1.8: Single test Main menu

See chapter 5 *Single test* for more information.

### 4.5 Help menu

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

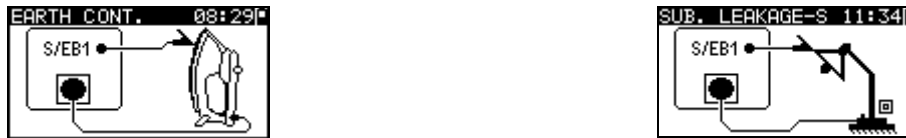


Figure 1.9: Example of help screen

Keys:

▲/▼	Selects next / previous help screen.
TEST, ESC	Returns to the <b>Main menu</b> .

### 4.6 Setup menu

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



Figure 1.10: Setup menu

Keys:

▲ / ▼	Select the setting to adjust or view: < <b>MEMORY</b> > to recall, print or clear stored results, print labels and write RDIF tags; < <b>LANGUAGE</b> > instrument language; < <b>LCD</b> > LCD contrast and backlight settings; < <b>CHECKBOX</b> > to access the internal calibration function; < <b>NOMINAL VOLTAGE</b> > used for calculation in Substitute leakage function; < <b>SHORTCUT SETUP</b> > to select the advance or basic shortcut codes; < <b>TEST SPEED SETUP</b> > to select the speed of the test; < <b>DATE/TIME</b> > date and time; < <b>USER DATA</b> > user data settings (initials); < <b>INSTRUMENT DATA</b> > basic instrument information; < <b>INIT. SETTINGS</b> > factory settings.
<b>TEST</b>	Confirms selection.
<b>ESC</b>	Returns to the <i>Main menu</i> .

### 4.7 Memory

Stored results can be recalled, printed or deleted. Labels can be printed and RFID tags can be written in this menu.

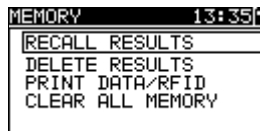


Figure 1.11: Memory menu

See chapter 7 Working with autotest results for more information.

### 4.8 Language selection

The instrument language can be set in this menu.

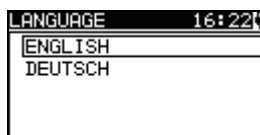


Figure 1.12: Language menu

Keys:

▲ / ▼	Selects the language.
<b>TEST</b>	Confirms selection and returns to <i>Setup menu</i> .

<b>ESC</b>	Returns to <b>Setup menu</b> without changes.
------------	---

## 4.9 LCD contrast and backlight

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

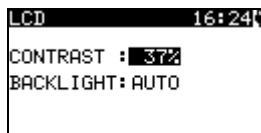


Figure 1.13: LCD menu

*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:*

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

**Note:**

- If you press the down (▼) key while starting up the instrument you will automatically jump to the LCD contrast menu.

## 4.10 Checkbox

The in-built Checkbox provides a simple and effective means of checking the calibration of the GammaPAT instrument and accessories. According to the Code of Practice the ongoing accuracy of the PAT tester should be verified at regular intervals and recorded. This is of special importance if the PAT tester is used on a daily basis. The GammaPAT includes an in-built Calibration Unit ('Checkbox') that is independent from the other instrument's electronic circuitry and connected directly to the output terminals of the instrument. During the calibration with the in-built Checkbox all main instrument functions and accessories can be verified. The calibration results are automatically stored into the instrument's memory and can be viewed with the PATLink PRO PC software.

**Note:**

- The Checkbox feature should be used to ensure that the meter is reading correctly between calibrations but should not be regarded as a substitute for a full manufacturers calibration on the unit.

The Checkbox starting screen is displayed first. In the REF column the Checkbox reference values are displayed.



Figure 1.14: Checkbox starting screen

Keys:

<b>TEST</b>	Starts instrument calibration procedure.
<b>▲ / ▼</b>	Switches between Checkbox screens.
<b>ESC</b>	Returns to <b>Setup menu</b> without changes.

**Carrying out the instrument calibration**

The Checkbox instrument calibration starting screen is displayed first. Before conducting calibration, disconnect all accessories connected to the instrument.

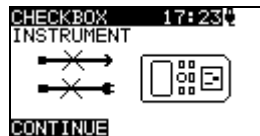


Figure 1.15: Instrument calibration starting screen

Keys:

<b>TEST</b>	Starts instrument calibration procedure.
<b>ESC</b>	Skips calibration procedure.

**Checking the S/EB test lead**

The connection for checking the S/EB test lead is displayed. Before conducting the check, connect the S/EB test lead.



Figure 1.16: S/EB test lead check starting screen

Keys:

<b>TEST</b>	Starts test lead checking procedure.
<b>ESC</b>	Skips further tests.

### Checking the IEC test cord

The connection for checking the IEC test cord is displayed. Before conducting the check, connect the IEC test cord.



Figure 1.17: IEC test cord check starting screen

Keys:

<b>TEST</b>	Starts IEC test cord checking procedure.
<b>ESC</b>	Skips IEC test cord check.

After all steps were carried out the measured values together with an overall indication are displayed in the CAL column.

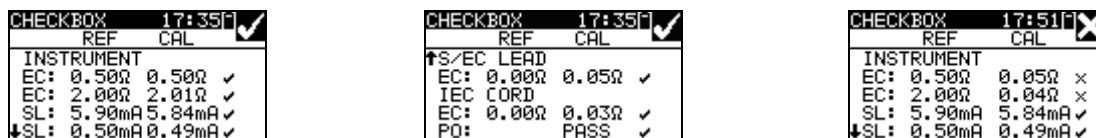


Figure 1.18: Examples of Checkbox result screens

Meaning of indications:

- ✓ Accuracy of result is inside the given accuracy limits.
- \* Accuracy of result is close to the specified accuracy limits.  
**Warning:**  
The accuracy of the instrument could lie slightly out of specified limits!
- ✗ **Warning:**  
The accuracy of the instrument lies out of specified limits!

Keys:

▲ / ▼	Displays all calibration results.
<b>TEST</b>	Starts new calibration procedure.
<b>ESC</b>	Returns to <b>Setup menu</b> .

### 4.11 Nominal voltage selection

The GammaPAT 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.

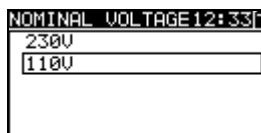



Figure 1.19: Language menu

Keys:

▲ / ▼	Selects the appliance nominal voltage.
<b>TEST</b>	Confirms selection and returns to <b>Setup menu</b> .
<b>ESC</b>	Returns to <b>Setup menu</b> without changes.



**Note:**

- ▶ The  icon is displayed in the Substitute leakage 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!

**4.12 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.

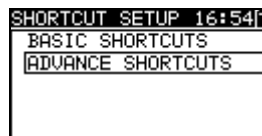


Figure 1.15: Original settings menu

**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.
<b>TEST</b>	Confirms selection and returns to <b>Setup menu</b> .
<b>ESC</b>	Returns to <b>Setup menu</b> without changes.

**4.13 Test speed setup**

In this menu the instrument test speed can be set:

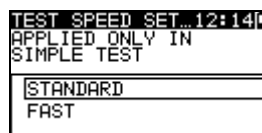


Figure 1.20: Test speed menu

**Options:**

- STANDARD** Default option.  
**FAST** No pauses during tests.

**Keys:**

▲ / ▼	Selects the list.
<b>TEST</b>	Confirms selection and returns to <b>Setup menu</b> .
<b>ESC</b>	Returns to <b>Setup menu</b> without changes.

**Note:**

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

**4.14 Setting date and time**

Date and time can be set in this menu.



Figure 1.21: Date and time menu

Keys:

<b>TAB</b>	Selects the field to be changed.
<b>▲ / ▼</b>	Modifies selected field.
<b>TEST</b>	Confirms selection and returns to <b>Setup menu</b> .
<b>ESC</b>	Returns to <b>Setup menu</b> without changes.

**Note:**

- Date is attached to each stored autotest result and 'Checkbox' calibration.

**Warning:**

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

**4.15 User data**

User data can be set in this menu.



Figure 4.18: User data menu

Keys:

<b>▲ / ▼</b>	Selects the user name.
<b>TEST</b>	Confirms selection and returns to <b>Setup menu</b> .
<b>ESC</b>	Returns to <b>Setup menu</b> without changes.
<b>TAB</b>	Enters <b>Edit user data menu</b> .

Edit user data:



Figure 4.19: Edit user data menu

Keys:

<b>▲ / ▼</b>	Selects a letter.
--------------	-------------------

<b>TEST</b>	Selects the next letter.
<b>MEM</b>	Confirms name and returns to <b>User data menu</b> .
<b>ESC</b>	Deletes last letter. Returns to <b>User data menu</b> without changes.

**Notes:**

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

**4.16 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.

```

INSTRUMENT DATA 18:29
PRODUCER : METREL
NAME      : GAMMA PAT
MI        : MI 3311
CAL DATE  : 04.01.2009
SER. NUM. :
↓VERSION  : 1.0.35-E

```

Figure 4.20: Instrument data menu

**Keys:**

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

**4.17 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;
- › test speed setting;
- › language;
- › user data;
- › appliances names (27 factory pre-programmed ones);
- › simple test sequences are replaced by factory pre-programmed ones;

```

INIT. SETTINGS 16:53
Contrast, Backlight,
Language, Function
Parameters will be
set to default.
SET

```

```

INIT. SETTINGS 20:34
Simple tests settings
will be set to
default.
SET

```

Figure 4.21: Initial settings menu

**Keys:**

<b>TEST</b>	Confirms selection and returns to <b>Main menu</b> .
<b>ESC</b>	Returns to <b>Setup menu</b> 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 Single test in Single test Main menu.

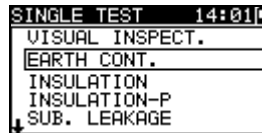


Figure 1.22: Single test Main menu

Keys:

▲ / ▼	Selects a single test.
TEST	Enters <b>Single test Measuring menu.</b>
ESC	Returns to <b>Main menu.</b>

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



Figure 1.23: Example of single test measuring menu

Keys:

TAB	Selects a parameter.
▲ / ▼	Changes a parameter / limit.
TEST	Starts a single test.
ESC	Returns to <b>Single test Main menu.</b>

**Note:**

- Last set parameters will be stored automatically.

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

## 5.2 Measurements and inspections

### 5.3 Visual inspection

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

The following items should be checked:

- › Inspection of 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 1.24: Visual inspection menu

### 5.4 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:

- › Mains test socket's PE terminal and the S/EB1 terminal.

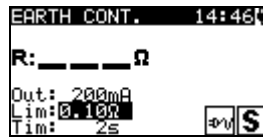


Figure 1.25: Earth continuity menu

#### Test parameters for Earth continuity resistance measurement

LIMIT	<b>Maximum resistance</b> [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	<b>Measuring time</b> [2 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

#### Test circuits for earth continuity resistance measurement

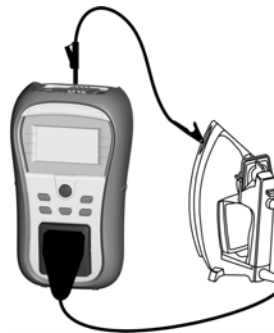


Figure 1.26: Measurement of Earth continuity resistance

#### Earth continuity resistance measurement procedure

- › Select the EARTH CONT. function.
- › Set the test parameters.
- › Connect device under test to the instrument (see figure 5.5).
- › Press the TEST key for measurement.
- › Store the result by pressing MEM key (optional).

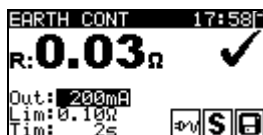


Figure 1.27: Examples of Earth continuity resistance measurement results

Displayed results:

Main result ..... Earth continuity resistance

**Note:**

- › Consider displayed warnings before starting measurement!

### 5.5 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 mains test socket (L+ N) and PE / (S/EB1) terminals.

This function is primarily intended for testing Class I appliances.



Figure 1.28: 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]

#### Test circuits for Insulation resistance measurement

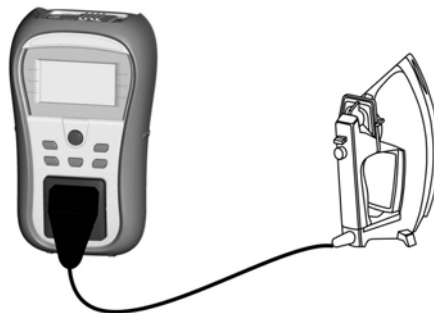


Figure 1.29: Measurement of insulation resistance

#### Insulation resistance measurement procedure

- Select the INSULATION function.
- Set the test parameters.
- Connect device under test to the instrument (see figure 5.8).
- Press the TEST key for measurement.
- Store the result by pressing MEM key (optional).



Figure 1.30: Examples of Insulation resistance measurement results

Displayed results:

Main result ..... Insulation resistance

**Notes:**

- › When S/EB1 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 20 V!

**5.6 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:

- › Main test socket (L+N) and S/EB1 test terminal

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



Figure 1.31: Insulation resistance - P menu

**Test parameters for Insulation resistance - P measurement**

OUTPUT	<b>Test voltage</b> [250 V, 500 V]
LIMIT	<b>Minimum resistance</b> [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	<b>Measuring time</b> [2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

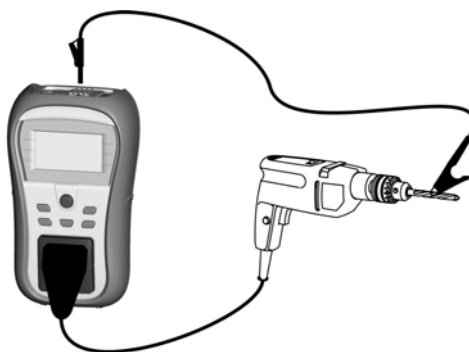
**Test circuits for Insulation resistance - P measurement**

Figure 1.32: Measurement of Insulation resistance - P

**Insulation resistance - P measurement procedure**

- › Select the INSULATION-P function.
- › Set the test parameters.
- › Connect device under test to the instrument (see figure 5.11).
- › Press the TEST key for measurement.
- › Store the result by pressing MEM key (optional).





Figure 1.33: Example of insulation resistance - P measurement results

Displayed results:

Main result ..... Insulation resistance (LN – P)

**Notes:**

- › The currents flowing through the PE terminal of the mains 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 »Disch...« will be displayed while the voltage on the device is higher than 20 V!

**5.7 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 insulation resistance between:

- › Main test socket (L+N) and PE / (S/EB1) test terminals

This function is primarily intended for testing Class I appliances.



Figure 1.34: Substitute leakage menu

**Test parameters for Substitute leakage current measurement**

OUTPUT	Test voltage [30 V]
LIMIT	<b>Maximum current</b> [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 mA, 15 mA, --- mA]
TIME	<b>Measuring time</b> [2s, 3s, 5 s, 10 s, 30 s, 60 s, 120 s, --- s]

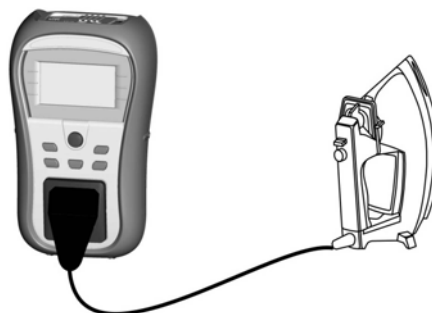


Figure 1.35: Measurement of Substitute leakage current

**Substitute leakage measurement procedure**

- ▶ Select the SUB. LEAKAGE function.
- ▶ Set the test parameters.
- ▶ Connect device under test to the instrument (see figure 5.14).
- ▶ Press the TEST key for measurement.
- ▶ Store the result by pressing MEM key (optional).



Figure 1.36: Example of substitute leakage current measurement results

Displayed results:

Main result ..... Substitute leakage current

**Notes:**

- ▶ Consider any displayed warning before starting measurement!
- ▶ When S/EB1 probe is connected during the test then the current through it is also considered.
- ▶ Substitute leakage current may differ substantially from that of leakage current test because of the way the test is performed. For example, the difference in both leakage measurements will be affected by the presence of filter capacitors between neutral and earth.

**5.8 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 insulation resistance between:

- ▶ Main test socket (L+N) and S/EB1 test terminals

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

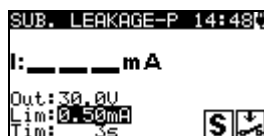


Figure 1.37: Substitute leakage - P menu

**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]

### Test circuits for substitute leakage - P measurement

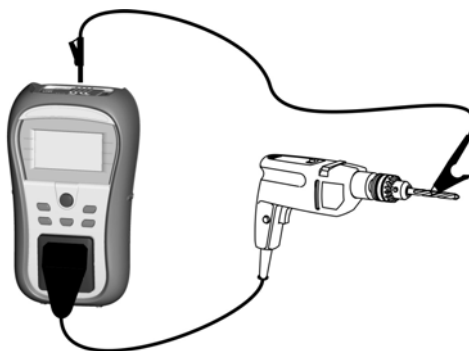


Figure 1.38: Measurement of Substitute leakage - P current

### Substitute leakage - P measurement procedure

- › Select the SUB. LEAKAGE-P function.
- › Set the test parameters.
- › Connect device under test to the instrument (see figure 5.17).
- › Press the TEST key for measurement.
- › Store the result by pressing MEM key (optional).

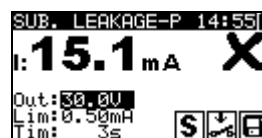
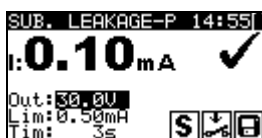


Figure 1.39: Example of substitute leakage - P current measurement results

Displayed results:

Main result.....Substitute leakage current LN – P

#### Notes:

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

### 5.9 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 and MULTIPLE FAULT.



Figure 1.40: Polarity test menu

#### Test circuit for polarity test



Figure 1.41: Polarity test of IEC cord

#### Polarity test procedure

- › Select the POLARITY function.
- › Connect the IEC cord to the instrument as shown on figure 5.20.
- › Press the TEST key for measurement.
- › Store the result by pressing MEM key (optional).



Figure 1.42: Examples of polarity test result

Displayed results:

Main result ..... PASS/FAIL, description of fault

**Note:**

- › Consider any displayed warnings before starting test!

## 5.10 Functional test

In its simplest form a functional test is a check to ensure that the appliance is working properly.

**Note:**

- › This test should only be performed once the appliance has passed all other tests applicable to the device under test.

### 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 into the mains supply. Switch on the appliance and check that it operates correctly.
- › Select PASS or FAIL according to the result of functional inspection.
- › Store the result by pressing MEM key (optional).

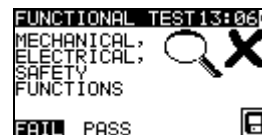
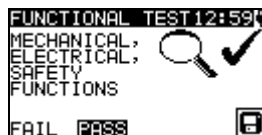


Figure 1.43: Functional test menu

## 5.11 Voltage TRMS

It is a simple function that continuously measures the voltage across the IEC cord connector.

### Test circuit for voltage measurement

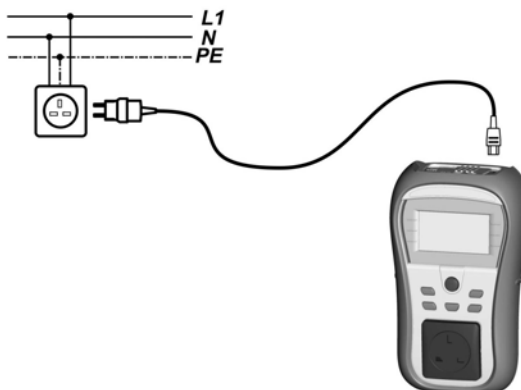


Figure 1.44: IEC cord voltage measurement

### Voltage TRMS procedure

- Select the VOLTAGE TRMS function.
- Connect the IEC cable to the instrument and into the normal mains supply as shown on figure 5.23.
- Store the result by pressing MEM key (optional).

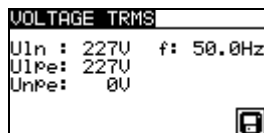


Figure 1.45: Voltage TRMS test result

Measured voltage in function VOLTAGE TRMS can be stored (optional).

#### Note:

- One of the safety features incorporated into the GammaPAT is that the voltage measurement will start automatically from any mode when a voltage higher than approximately 50 V (AC or DC) is applied to the IEC connector! If the voltage test has not been preselected then the voltage cannot be stored, but all measurements were prohibited until the voltage is removed.

## 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 and appliance NAME.

### 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.

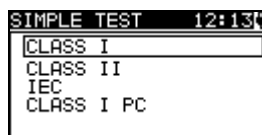


Figure 1.46: Simple test menu

Keys:

▼ / ▲	Selects the test sequence from the list.
<b>START</b>	Starts the selected test. See chapter 6.3 <i>Carrying out (Simple, Shortcut) test sequences</i> .
<b>ESC</b>	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 GammaPAT 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 Substitute leakage and Insulation resistance test if Leakage test is selected.

- a Substitute leakage - P and Insulation resistance - P test if Touch leakage test is selected.

The operator must decide by itself if the alternative tests are applicable. Refer to chapter 1.1 *Warnings* for more information.

### 6.3 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 1.47: 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). A successfully scanned barcode or RFID tag is confirmed by two short confirmation beeps.

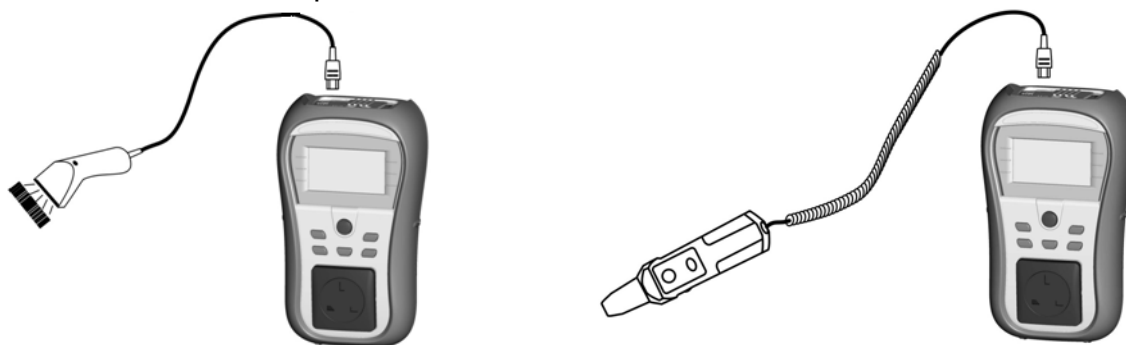


Figure 1.48: Connection of the barcode reader and RFID reader/writer

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.



## 6.4 Carrying out (Simple, Shortcut) test sequences

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

<b>TAB, <math>\Delta/\nabla</math></b>	Sets option. Sets limit value in selected (highlighted) item.
<b>ESC</b>	Cancels test sequence and returns to the top of the test menu without changes.
<b>TEST</b>	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.
- If the test limit, output voltage or test duration is changed in Shortcut autotest sequence the autotest code will not be stored (as the settings do not correspond with the code anymore).

## 6.5 Visual inspection

Measurement is described in chapter 5.2.1 *Visual inspection*.



Figure 1.49: Visual test menu

Options in Visual test:

**PASS / FAIL** To be applied manually.

## 6.6 Earth continuity measurement

The test is offered if it is applicable according to the test 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 1.50: Earth continuity starting screen

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



Figure 1.51: 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.

## 6.7 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*.

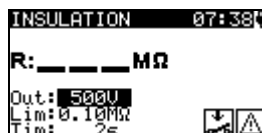


Figure 1.52: Insulation resistance starting screen

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



Figure 1.53: Insulation result screen

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

## 6.8 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 current starting screen are described in chapter 5.2.5 *Substitute leakage current*.



Figure 1.54: Substitute leakage starting screen

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



Figure 1.55: Substitute leakage result screen

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

## 6.9 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 1.56: Insulation resistance - P starting screen

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



Figure 1.57: 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.

## 6.10 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 1.58: Substitute leakage - P starting screen

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



Figure 1.59: 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.

## 6.11 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 1.60: Polarity test starting screen

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



Figure 1.61: Polarity test result screen

There are no special options in the Polarity test starting screen.

## 6.12 Functional test

The test is offered if it is applicable according to the autotest setting. The Functional test starting screen is displayed first.

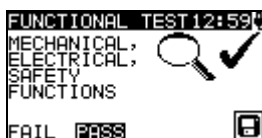


Figure 1.62: Functional result screens

Options in Functional test result screen:

**PASS / FAIL** To be applied manually.

For more information regarding measurement and test parameters see chapter 5.2.8 *Functional test*.

### 6.13 Handling autotest results

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



Figure 1.63: 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 (to be displayed with in full details).
<b>TEST</b>	Enters selected result of measurement (to be displayed in full details).
<b>ESC</b>	Returns to previous result screen.

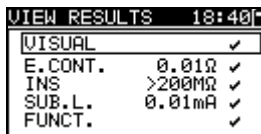


Figure 1.64: Overall result screen



Figure 1.65: Detailed result screen

#### Saving autotest as Simple test

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

Options in Save as simple screen.

▼ / ▲, <b>TEST</b>	Edit Autotest name.
<b>MEM (SAVE)</b>	Saves Autotest name.
<b>ESC (DEL)</b>	Deletes last character of Autotest name.
<b>ESC (CANCEL)</b>	Returns to the previous menu.

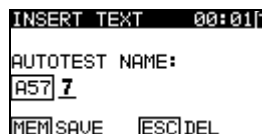


Figure 1.21: Save as simple screen

## 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 and NAME can be added to the test results before the results are saved:



Figure 1.66: 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 numeric characters can be entered. The Appliance ID can also be scanned with a barcode reader or RFID reader/writer.



Figure 1.67: Save results menu (Appliance NAME)

Keys:

▼ / ▲, TEST	Edit Appliance NAME data.
TAB (LIST)	Offers last forty entered names.
ESC (DEL)	Deletes last character of Appliance NAME.
ESC (CANCEL)	Returns to the previous menu.
MEM (SAVE)	Saves Appliance NAME and returns to Autotest result menu.

An Appliance NAME of up to 14 numeric characters can be entered.

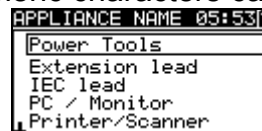


Figure 1.68: List menu (Appliance NAME)

**Note:**

- 40 custom made appliance names can be entered including 27 factory pre-programmed names that are set by default.

## 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.

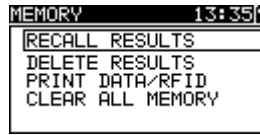


Figure 1.69: Memory menu

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 top 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 1.70: Recall results menu

Keys:

<b>▲/▼, TEST</b>	Enters View results menu for viewing autotest results.
<b>ESC</b>	Returns to previous 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.

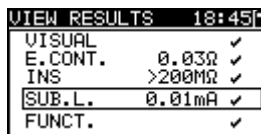


Figure 1.71: Overall result screen



Figure 1.72: Detailed result screen

Options in View result screen

<b>▲/▼</b>	Selects result of measurement (to be displayed in full details)
<b>TEST</b>	Enters selected result of measurement (to be displayed in full details).
<b>ESC</b>	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 top 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.

DELETE RESULTS 12:50	
24358, Television	
31414, DVD Player	
55678, Cooker	
008346, Lamp	
31414, DVD Player	
Jan. 1, 2000 12:29	✓

Figure 1.73: Delete results menu

Keys:

▲ / ▼, 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.

CLEAR ALL MEMO... 13:09	
All saved results will be lost	

Figure 1.74: Clear all memory menu

Keys:

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

CLEARING MEMORY	
77%	

Figure 1.75: Clearing memory in progress



## 7.5 Printing and RFID tagging of individual autotest results

To print labels or results and write RFID tags select **Print data / RFID** 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 top 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 1.76: Print data / RFID menu

Keys:

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

In the Printer / RFID menu four options can be selected: Print simple label, Print label, Print results and Write RFID tag.

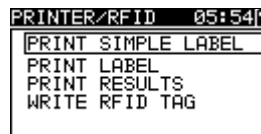


Figure 1.77: Printer / RFID menu

Keys:

▲ / ▼	Selects action.
<b>TEST</b>	Confirm s and executes selected action.
<b>ESC</b>	Exits back to Print data / RFID menu without changes.

### Print Simple label

Printed label includes: Appliance Id, Name, Test date, Initials and Overall result (Pass or Fail).

### Print label

Printed label includes: Appliance Id, Barcode, Test date and Overall result (Pass or Fail).

### 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.

### 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, Test Date, Time and autotest code to RFID tag. (For detail information look at RFID reader/writer instruction manual.)

## 8 Communication

The instrument can communicate with the PATLink PRO PC software. The following actions are supported:

- › Saved results can be downloaded and stored to a PC.
- › Checkbox results can be downloaded and stored to the PC.
- › Customized Simple test sequences can be uploaded to the instrument.

A special communication program on the PC automatically identifies the instrument and enables data transfer between the instrument and the PC.

There are two communication interfaces available on the instrument: USB or RS 232.

The instrument automatically selects the communication mode according to the detected interface. USB interface has priority.

How to transfer stored data:

- › RS 232 communication: connect a PC COM port to the instrument PS/2 connector using the PS/2 - RS232 serial communication cable.
- › USB communication: connect a 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.
- › The PC and the instrument will automatically recognize each other.
- › The instrument is prepared to upload / download data to the PC.

**Note:**

- › USB drivers should be installed on PC before using the USB interface. Refer to USB installation instructions available on installation CD.

## 9 Measuring 110 V appliances

The GammaPAT 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 1.78: Connecting 110 V adapter to the instrument

Selects 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 1.79: 110 V symbol



Figure 1.80: Substitute leakage screen (110 V)

See chapter 4.6.5 *Nominal voltage selection* for more information.

## 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 should be done by an authorized technical person only.

### 10.2 Service

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

### 10.3 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 GammaPAT
- › Small soft carrying bag
- › Soft hand strap
- › Test lead with crocodile clip (1.5 m, black)
- › IEC cord 2 m
- › 6x AA NiMH batteries
- › Power supply adapter
- › Instruction manual
- › Calibration certificate

## Optional accessories

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

## Appendix A – Barcode formats

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

### Autotest shortcut code and appliance ID

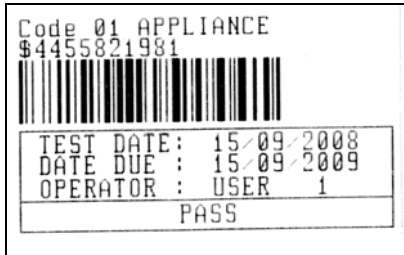
Autotest shortcut codes are represented as a three digit code. These autotest codes can also be represented by the barcode.

Using the barcode reader, the instruments can accept autotest shortcut code from barcode label.

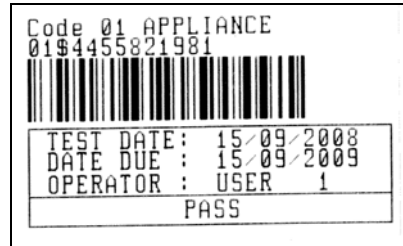


Autotest shortcut code

Also appliance ID can be read from barcode label.



*barcode system: single*



*barcode system: double*

Examples of appliance labels

001	Autotest shortcut code
\$	Separator
4455821981	Appliance ID

**Note:**

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

## Appendix B – Simple test codes (UK)

Type	Class	Earth continuity		Insulation		S. Leakage Limit	Polarity
		Limit	Out	Limit	Out		
CLASS I	I	0.20 $\Omega$	200 mA	1.00 M $\Omega$	500 V	0.75 mA	-
CLASS II	II	-	-	2.00 M $\Omega$	500 V	0.25 mA	-
IEC	-	0.20 $\Omega$	200 mA	1.00 M $\Omega$	500 V	-	✓
CLASS I PC	I	0.20 $\Omega$	200 mA	1.00 M $\Omega$	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 4.6.6 Shortcut Setup for more information.

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



Type	Class	Fuse	Cord	Earth Bond Limit	Out	Insulation Limit	Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
<b>Heating and Cooking</b>											
	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	Out	Insulation Limit	Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
<b>IT equipment EN 60950</b>											
	I	-	short	0.10 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	037
	I	-	mid	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
<b>IT equipment EN 60950 – 250V</b>											
	I	-	long	0.50 Ω	100 mA	1.00 MΩ	250 V	3.5 mA	-	-	040

Type	Class	Fuse	Cord	Earth Bond Limit	Out	Insulation Limit	Out	S. Leakage Limit	Leakage Limit	T. Leakage Limit	Code
<b>OTHER</b>											
	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	25 A	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	mid	0.30 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	049
	I	6 A	mid	0.30 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	050
	I	10 A	mid	0.30 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	051
	I	13 A	mid	0.30 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	052
	I	3 A	mid	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	053
	I	6 A	mid	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	054
	I	10 A	mid	0.30 Ω	25 A	1.00 MΩ	500 V	-	-	-	055
	I	13 A	mid	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 M $\Omega$	500 V	-	0.25 mA	-	065
	II	-	-	-	-	<b>2.00 M<math>\Omega</math></b>	<b>500 V</b>	-	-	-	<b>066</b>

IEC leads											
Surge protected = OFF / RCD protected = OFF											
	Length	Earth Bond		Insulation		Polarity	Code				
		Limit	Out	Limit	Out						
<b>0.5mm<sup>2</sup> / 3A</b>											
	<b>&lt;=5 m</b>	<b>0.30 <math>\Omega</math></b>	<b>10 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>067</b>				
	7.5 m	0.40 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	068				
	10 m	0.50 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	069				
	12 m	0.60 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	070				
	15 m	0.70 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	071				
	20 m	0.80 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	072				
	30 m	1.00 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	073				
	40 m	2.00 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	074				
	50 m	2.00 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	075				
<b>0.75mm<sup>2</sup> / 6 A</b>											
	<b>&lt;=5 m</b>	<b>0.20 <math>\Omega</math></b>	<b>10 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>076</b>				
	<b>7.5 m</b>	<b>0.30 <math>\Omega</math></b>	<b>10 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>077</b>				
	10 m	0.40 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	078				
	12 m	0.40 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	079				
	15 m	0.50 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	080				
	20 m	0.60 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	081				
	30 m	0.90 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	082				
	40 m	1.00 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	083				
	50 m	1.00 $\Omega$	10 A	1.00 M $\Omega$	500 V	✓	084				
<b>1 mm<sup>2</sup> / 10 A</b>											
	<b>&lt;=5 m</b>	<b>0.20 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>085</b>				
	7.5 m	0.20 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	086				
	<b>10 m</b>	<b>0.30 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>087</b>				
	12 m	0.30 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	088				
	15 m	0.40 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	089				
	20 m	0.50 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	090				
	30 m	0.70 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	091				
	40 m	0.90 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	092				
	50 m	1.00 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	093				
<b>1.25mm<sup>2</sup> / 13A</b>											
	<b>&lt;=5 m</b>	<b>0.20 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>094</b>				
	7.5 m	0.20 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	095				
	10 m	0.30 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓	096				
	<b>12 m</b>	<b>0.30 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓	<b>097</b>				
<b>1.5mm<sup>2</sup> / 15 A</b>											
	<b>&lt;=5 m</b>	<b>0.20 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓ standard	<b>103</b>				
	7.5 m	0.20 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	104				
	10 m	0.20 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	105				
	12 m	0.30 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	106				
	<b>15 m</b>	<b>0.30 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓ standard	<b>107</b>				
<b>UNKNOWN</b>											
	<b>&lt;=5 m</b>	<b>0.20 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓ standard	<b>112</b>				
	7.5 m	0.20 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	113				
	10 m	0.20 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	114				
	12 m	0.30 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	115				
	<b>15 m</b>	<b>0.30 <math>\Omega</math></b>	<b>25 A</b>	<b>1.00 M<math>\Omega</math></b>	<b>500 V</b>	✓ standard	<b>116</b>				
	20 m	0.40 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	117				
	30 m	0.50 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	118				
	40 m	0.60 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	119				
	50 m	0.80 $\Omega$	25 A	1.00 M $\Omega$	500 V	✓ standard	120				

IEC leads							
Surge protected = ON RCD protected ? = OFF							
	Length	Earth Bond Limit Out		Insulation Limit Out		Polarity	Code
<b>0.5mm<sup>2</sup> / 3A</b>							
	<=5 m	<b>0.30 Ω</b>	<b>10 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>167</b>
	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
<b>0.75mm<sup>2</sup> / 6 A</b>							
	<=5 m	0.20 Ω	10 A	1.00 MΩ	250 V	✓ standard	176
	<b>7.5 m</b>	<b>0.30 Ω</b>	<b>10 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>177</b>
	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
<b>1 mm<sup>2</sup> / 10 A</b>							
	<=5 m	<b>0.20 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>185</b>
	7.5 m	0.20 Ω	25 A	1.00 MΩ	250 V	✓ standard	186
	<b>10 m</b>	<b>0.30 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>187</b>
	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
<b>1.25mm<sup>2</sup> / 13A</b>							
	<=5 m	<b>0.20 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>194</b>
	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
	<b>12 m</b>	<b>0.30 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>197</b>
<b>1.5mm<sup>2</sup> / 15 A</b>							
	<=5 m	<b>0.20 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>203</b>
	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
	<b>15 m</b>	<b>0.30 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>207</b>
<b>UNKNOWN</b>							
	<=5 m	<b>0.20 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>212</b>
	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
	<b>15 m</b>	<b>0.30 Ω</b>	<b>25 A</b>	<b>1.00 MΩ</b>	<b>250 V</b>	✓ standard	<b>216</b>
	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

Type	Portable RCD						
	Earth Bond Limit		Out	Leakage Limit	RCD	Polarity	Code
	0.10 $\Omega$	25 A		0.75 mA	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