

# METRALINE PAT

Test Instrument for DIN VDE 0701-0702

3-447-022-03  
2/4.19



## Table of Contents

	Page	Page
<b>1 Safety Precautions .....</b>	<b>3</b>	
1.1 General .....	3	
1.2 Meanings of Symbols on the Device .....	4	
1.3 Meanings of Symbols in the Operating Instructions .....	4	
<b>2 Applications .....</b>	<b>5</b>	
<b>3 Standard Equipment and Accessories .....</b>	<b>5</b>	
3.1 Scope of Delivery .....	5	
3.2 Accessories .....	5	
<b>4 Connection, Control and Display Elements</b>	<b>6</b>	
<b>5 Functions Description .....</b>	<b>7</b>	
5.1 Power Supply .....	7	
5.2 Measurement Data Processing .....	7	
5.3 USB Port .....	7	
5.4 Bluetooth Interface .....	8	
<b>6 Checking the Mains Connection .....</b>	<b>8</b>	
6.1 Connection Display .....	9	
6.2 Single-Phase Mains Connection .....	9	
<b>7 Display and Menu Structure .....</b>	<b>9</b>	
<b>8 Initial Startup of the Test Instrument .....</b>	<b>9</b>	
8.1 Visual Inspection .....	9	
8.2 Mains Connection .....	9	
8.3 Selecting and Starting a Test .....	9	
<b>9 Data Transmission .....</b>	<b>10</b>	
9.1 Transmitting Measured Values to the PC .....	10	
<b>10 Single Measurements .....</b>	<b>10</b>	
10.1 RSL / RPE – Protective Conductor Resistance .....	11	
10.1.1 Connection Type Selection .....	11	
10.1.2 RPE – Connecting Protection Class I Devices to the Test Socket .....	12	
10.1.3 RPE – Permanently Connected DUTs .....	13	
10.1.4 RPE – Probe-Probe Measurement .....	14	
10.1.5 RPE – Balancing the Probe Cable for the Protective Conductor Measurement .....	15	
10.2 Riso – Insulation Resistance .....	16	
10.2.1 RISO – LN-PE .....	17	
10.2.2 RISO – LN-Probe .....	18	
10.2.3 RISO – Probe-PE .....	19	
10.2.4 RISO – Probe-Probe (GND) .....	20	
10.2.5 RISO – L-N .....	21	
10.3 IEA – Equivalent Leakage Current Measurement .....	22	
10.3.1 IEA – LN-PE .....	23	
10.3.2 IEA – LN-Probe .....	24	
10.3.3 IEA – Probe-Probe (GND) .....	25	
10.4 AKTIV - Function Test and Leakage Current Measurements .....	26	
10.5 U – Testing the DUT (ELV) in the Presence of Line Voltage .....	27	
<b>11 Error Messages, Troubleshooting .....</b>	<b>28</b>	
11.1 Display is Off .....	28	
11.2 Touch Current Measurement Indicates 0.000 mA .....	28	
11.3 Touch Current Measurement Greater than 0.5 mA .....	28	
11.4 “F” Displayed for Differential Current Measurement .....	28	
11.5 Bluetooth Communication .....	28	
<b>12 Technical Data .....</b>	<b>29</b>	
<b>13 Maintenance .....</b>	<b>31</b>	
13.1 Housing .....	31	
13.2 Recalibration .....	31	
13.3 Technical Safety Inspections, .....	31	
13.4 Return and Environmentally Sound Disposal .....	31	
<b>14 Repair and Replacement Parts Service ...</b>	<b>32</b>	
<b>15 Product Support .....</b>	<b>32</b>	

# 1 Safety Precautions

## 1.1 General

The **METRALINE PAT** test instrument has been manufactured and tested in accordance with the following safety regulations:

- DIN EN 61010-1 (VDE 0411, part 1), "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, General Requirements"
- Interference immunity in accordance with DIN EN 61326, "Electrical equipment for control technology and laboratory use – EMC requirements"

Safety of the inspector, as well as that of the test instrument and the device under test, is only assured when used for intended purpose.

**Read the operating instructions carefully and completely before placing your test instrument into service. Follow all instructions contained therein. Make sure that the operating instructions are available to all users of the device.**

Tests may only be performed by a qualified electrician, or under the supervision and direction of a qualified electrician. The user must be instructed by a qualified electrician concerning performance and evaluation of the test (see also training seminars listed at [www.gossenmetrawatt.com](http://www.gossenmetrawatt.com)).

**In order to maintain safety and ensure safe operation, the user must observe the following warnings:**

Observe the warnings on the test instrument and on the mains adapter cables!



### **Warning: Voltage!**

The instrument may only be connected to electrical systems with a maximum of 230 V which comply with applicable safety regulations (e.g. IEC 60346, VDE 0100) and are protected with a fuse or circuit breaker with a maximum rating of 16 A.



### **Warning: Voltage!**

Measurements within electrical systems are prohibited.

---



### **Attention!**

#### **Before connecting a DUT,**

absence of voltage in the protective conductor at the connection must be verified by touching the finger contact. The LED must not blink. It must also be verified that < 30 V appears in the connection menu.

---



### **Warning: Voltage!**

No measurements may be conducted on unfused measuring circuits.

---

The test instrument may no longer be used if safe operation is not possible, e.g. due to

- Visible damage
- Improper storage
- Improper transport
- Phase indicator lamp failure
- Failure of measuring functions etc.

The test instrument must be removed from service immediately and secured against inadvertent start-up.



### **Attention!**

Protective conductor resistance and touch current measurements in electrical systems are only permitted under certain conditions and after installing appropriate hazard warnings.

---



### **Warning: Voltage!**

It must be observed that high voltages can occur at test objects, e.g. due to charged capacitive circuits.

---



### **Warning: Voltage!**

Do not touch the insulation measuring instrument's test probes during insulation resistance or equivalent leakage current measurements.

---



**Warning: Voltage!**

Do not connect the device under test to the test socket until it has been assured that the mains connection is in safe working order.

---



**Warning: Voltage!**

Dangerous contact voltage may be present at defective DUTs when they're connected to a test socket, or at accessible conductive parts that are not connected to the protective conductor.

---

**Opening the Instrument / Repairs**

The test instrument may only be opened by authorized, trained personnel from GMC-I Service GmbH in order to ensure flawless operation and to assure that the guarantee is not rendered null and void.

Even original replacement parts may only be installed by GMC-I Service GmbH.

If it can be ascertained that the test Instrument has been opened by unauthorized personnel, no guarantee claims can be honored by the manufacturer with regard to personal safety, measuring accuracy, compliance with applicable safety measures or any consequential damages.

**1.2 Meanings of Symbols on the Device**

**300 V CAT II** Maximum permissible voltage and measuring category between connections and ground



Warning concerning a point of danger (attention: observe documentation!)



The device may not be disposed of with household trash. Further information regarding the WEEE mark can be accessed on the Internet at [www.gossenmetrawatt.com](http://www.gossenmetrawatt.com) by entering the search term "WEEE".



European conformity marking

**1.3 Meanings of Symbols in the Operating Instructions**

General Notes:



**Note!**

---

General warning concerning a point of danger!



**Attention!**

---

Warning regarding dangerous electrical voltage:



**Warning: Voltage!**

---

## 2 Applications

The **METRALINE PAT** tester is a measuring instrument for checking the effectiveness of protective measures in electrical devices in accordance with DIN VDE 0701-0702.

## 3 Standard Equipment and Accessories

### 3.1 Scope of Delivery

- 1 **METRALINE PAT** test instrument
- 1 Red measurement cable with safety plug and test probe, 2 m
- 1 Mains power cable with inlet plug, with earthing contact – IEC 60230, 16 A, 1.5 m
- 1 Factory calibration certificate

### 3.2 Accessories

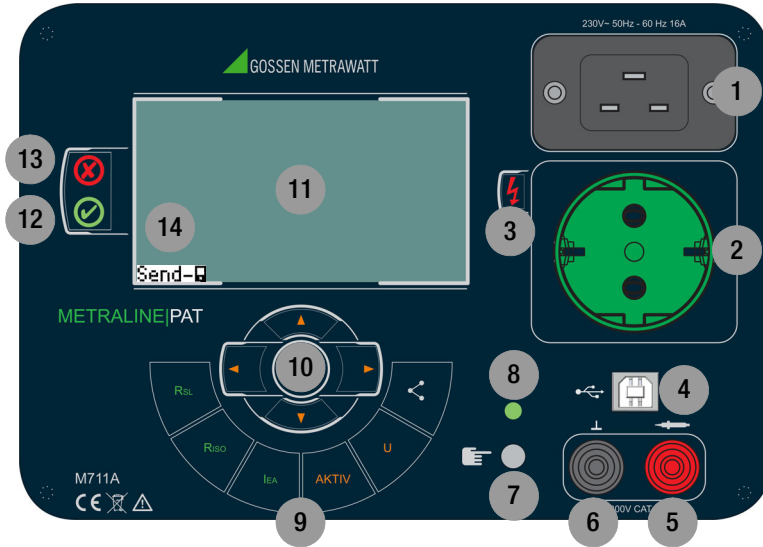
#### **VL2E (Z745W)**













Test adapter with single and 3-phase plug connectors up to CEE 32A

- For all tests without line voltage at single and 3-phase electrical devices
- For tests at single and 3-phase extension cords

#### **Z745G brush probe**

## 4 Connection, Control and Display Elements



- 1 Mains connection, IEC 60320 C-19
- 2 Test socket
- 3 Glow lamp indicates “line voltage at the test socket”
- 4 USB port for PC
- 5 Socket for red measurement cables
- 6 Socket for black measurement cables
- 7 Finger contact
- 8 LED for finger contact
- 9 Operating keys for single measurements and function test  
: Start measured value transmission
- 10  : Parameter selection  
 : Parameter settings  
: **Reset**: repeat measurement  
: **Reverse polarity N/L**: change polarity  
: **Standby**: switch to mW measurement  
**OK**:  Start measurement
- 11 LCD
- 12  Good LED
- 13  Error LED
- 14 **Send**  Ready to transmit test results

### Mains Connection (1), Finger Contact (7, 8)

The corresponding warnings in section 1, the warnings on the mains adapter cables and the warnings on any utilized accessories must be observed before connecting the test instrument to line voltage. Safety of the operator, as well as that of the instrument and the device under test, is only assured when used for intended purpose! Protective conductor potential testing is conducted via the finger contact (7, 8) after connecting the test instrument.

### Mains Connection with Earthing Contact (1)

The test instrument may only be connected to electrical systems with a maximum of 230 V which comply with applicable safety regulations (e.g. IEC 60346, VDE 0100) and are protected with a fuse or circuit breaker with a maximum rating of 16 A.

### Test Socket (2)

Earthing contact outlet up to 16 A. The test socket's protective conductor is connected to the mains protective conductor and is disconnected from the mains when measuring RSL, RISO and IEA. If the LED (3) lights up red, line voltage is present at the test socket.

**Attention!**

Dangerous contact voltage may be present at defective DUTs when they're connected to a test socket, or at accessible conductive parts that are not connected to the protective conductor.

---

**USB Port (4)**

Connection of a USB B plug for control from the PC via a virtual COM port. Drivers supplied by Future Technology Devices International Ltd. (FTDI) must be installed. These are installed to the PC along with the software.

**Red Measurement Socket, "Probe" (5)**

The measurement cable is connected when measuring protective conductor resistance and insulation resistance. Measuring input for measurement of voltage, equivalent leakage current and touch current.

**Black Measurement Socket, "GND" (6)**

Connection of an optional measurement cable for measuring protective conductor resistance, touch current, voltage and insulation resistance with the Probe-Probe setting.

**Control Elements (9, 10)**

All measurements can be selected and started manually using the control elements.

**Display (11)**

The display has a resolution of 320 x 240 pixels and is backlit. All information (user prompting, help texts) and measurement results (measuring functions, limit values, measured values and units of measure) are displayed in plain text.

## 5 Functions Description

### 5.1 Power Supply

The device is powered by mains voltage (230 V  $\pm$ 10%).

The measuring electronics are protected by means of an internal fuse.

### 5.2 Measurement Data Processing

Measured values are stored at a PC.

### 5.3 USB Port

USB port for service and remote operation: The PC is connected via a standard type AB USB cable.

The FTDI driver is installed along with the software.

The transmission rate is 19,200 baud. The interface is electrically isolated.

## 5.4 Bluetooth Interface

The Bluetooth interface is used to transfer measurement data.

The **METRALINE PAT** test instrument is equipped with a Bluetooth module for wireless communication in a Bluetooth environment, which is permanently switched on.

Configure the following parameters in order to establish communication between the **METRALINE PAT** and the PC:

- Set the Bluetooth interface to “visible” and/or “ready to pair”.
- Activate “Bluetooth” under settings.
- Select the device with the same serial number as the measuring instrument for initial pairing/use under available, additional devices or other devices.
- If applicable, the system may require a password for pairing: enter either “0000” or “8888”.



### Note!

Designations used here may vary depending on the device, the operating system and the software version.

---

## 6 Checking the Mains Connection

In accordance with the legally applicable requirements (accident prevention regulations, valid standards), the operator is responsible for the safety of electrical systems (including on-site electrical connection and equipotential bonding).

Testing of the electrical connection is not included in the test specifications for modification, testing and periodic testing of electrical devices. However, it's important to know that the mains connection is in good working order before testing electrical devices.

The test instrument does not check the electrical connection in accordance with the specifications set forth in DIN VDE 0100. Nevertheless, important and useful measurements which provide information concerning the electrical connection are made, for example:

- Mains protective conductor potential test via finger contact
- Mains protective conductor potential  $PE < 30\text{ V}$
- Testing of the N conductor for interruption (display remains off)
- Phase indicator lamp display when the relay is picked up
- Voltage measurement, phase to N (display: 1 to 260 V AC).

### Note:

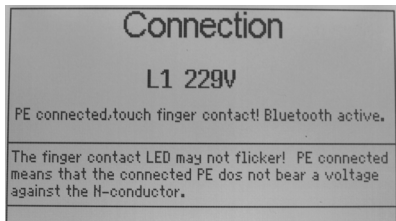
- First of all it must be determined whether or not the protective conductor is connected by touching the finger contact. If the red LED blinks, the protective conductor is not connected. If the protective conductor connection is not OK, “PE > 30 V!!” appears at the display. This is also indicated acoustically.
- No further measurements may be conducted with the test instrument until after the protective conductor has been successfully repaired.
- If N and PE are reversed, the on-site residual current circuit breaker is tripped.
- If no display appears, voltage may also be present at PE. Check this using the finger contact on the test instrument, unplug the test instrument and then



check again at another power outlet. If the device works at the second outlet, arrange to have the first outlet checked by a qualified electrician.

- When used in IT networks, and if the test instrument is connected via an isolating transformer, there's no PE connection: "PE > 30 V!!" appears at the display.

## 6.1 Connection Display



Available line voltage and the quality of the N and PE conductor connections are displayed in the first "Connection" menu.

The finger contact LED can be checked for correct functioning by touching the finger contact with the probe during the "IEA LN-Probe" single measurement. The LED must blink.

## 6.2 Single-Phase Mains Connection



### Attention!

If voltage L1 is less than 207 V or greater than 253 V ( $L1 < 207\text{ V}$  or  $L1 > 253\text{ V}$ ), reliable and meaningful measurements are no longer possible.

If "PE > 30V!!" appears and the display, the protective conductor is most likely interrupted or, under certain circumstances, interference voltage may also be present at the protective conductor (check via finger contact: respective LED must not blink). Refer to section 6 with regard to testing the protective conductor.

## 7 Display and Menu Structure

User prompting, measuring functions, limit values and measured values appear conveniently at the display.

## 8 Initial Startup of the Test Instrument

### 8.1 Visual Inspection


- Observe the safety precautions in section 1.
- Visually inspect the mains connection, the test instrument and any measuring accessories.
- Observe the warnings on the test instrument, the mains adapter cable and the measuring accessories.


### 8.2 Mains Connection

The test Instrument is supplied with power via the mains connection on the top of the instrument.

### 8.3 Selecting and Starting a Test


The single tests (measurement type) are accessed via the direct selection keys (9). A menu for selecting the type of connection appears. The corresponding start menu is displayed after acknowledging with **OK**, and the measurement is started at the same time.

Depending on the type of measurement and connection, the measured value is compared with the limit value according to the standard. If the standard value is complied with, **OK** appears at the display and the LED lights up green. 

You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out.


## 9 Data Transmission

### 9.1 Transmitting Measured Values to the PC

After pressing the  key, the respective measured value is initially transmitted via the Bluetooth interface to an Android device to which **ELEXONIQ** has been installed (Android app for **METRALINE PAT**). The data can be subsequently transferred from the Android app to a PC, where they can be imported into **IZYTRONIQ** report generating software.

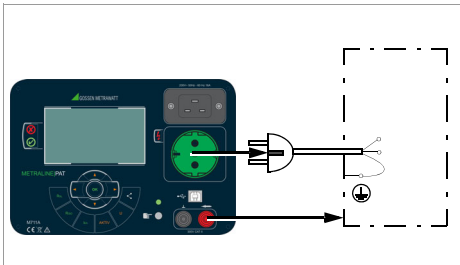
## 10 Single Measurements

The following single measurements are started with the help of the measuring function keys on the test instrument.

Key	Function
<b>RSL/RPE</b>	Protective conductor resistance measurement
<b>Riso</b>	Insulation resistance measurement
<b>IEA</b>	Equivalent leakage current measurement
<b>AKTIV</b>	Function test, standby test, touch current measurement (direct and differential method), protective conductor current measurement (differential method), Differential current measurement (always includes touch current measurement)
<b>U</b>	Voltage measurement, probe-probe
	Transmitting measured values to the PC

## 10.1 RSL / RPE – Protective Conductor Resistance

### Definition



Protective conductor resistance is the sum of the following resistances:

- Connector cable or device connector cable resistance
- Contact resistance at plug and terminal connections
- Extension cord resistance if applicable

### Resistance is measured:

- Between each exposed **conductive part of the housing** and the earthing contacts at the mains and the device plug (if a removable mains connector cable is used), or the protective conductor terminal for permanently installed devices.
- Between the earthing contacts at the mains plug and the earthing contacts at the device plug for **device connector cables**
- Between the earthing contacts at the mains plug and the earthing contacts at the coupling socket for **extension cords**

Maximum Permissible Limit Values for the Protective Conductor Resistance of Connecting Cables up to 5 Meters Long per DIN VDE 0701-0702:2008

Test Current	Open-Circuit Voltage	RSL Housing – Mains Plug
> 200 mA <sub>AC</sub>	4 V < U <sub>L</sub> < 24 V	0.3 Ω <sup>1</sup> + 0,1 Ω <sup>2</sup> for each additional 7.5 m

<sup>1</sup> This value may not exceed 1 Ω for permanently connected data processing systems (DIN VDE 0701-0702).

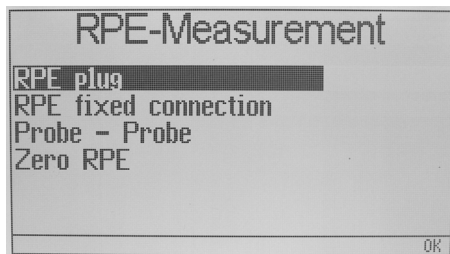
<sup>2</sup> Total protective conductor resistance: max. 1 Ω

### Notes

Insulation resistance and/or leakage current must be measured at all exposed, conductive parts for protection category II and III devices, as well as for battery powered devices.

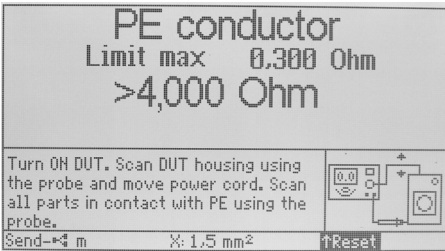
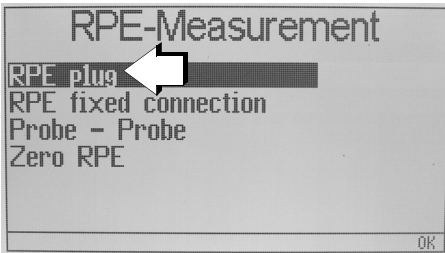
Batteries must be disconnected during testing of battery powered devices.

### 10.1.1 Connection Type Selection



Plug	See section 10.1.2
Permanent connection	See section 10.1.3
Probe-probe	See section 10.1.4
Rsl balancing	See section 10.1.5

## 10.1.2 RPE – Connecting Protection Class I Devices to the Test Socket



When the DUT is connected, resistance is measured between the protective conductor terminal at the test socket and the probe connection at the DUT (contact with conductive parts of the housing).

- In order to measure protective conductor resistance, use the probe to contact a conductive part of the housing which is connected to the protective conductor.

During measurement, the **connector cable** must only be moved to the extent to which it's accessible during repair, modification or testing.

If a change in resistance occurs during the manual test step of the continuity test, it must be assumed that the protective conductor is damaged, or that one of the connector contacts is no longer in flawless condition.



### Connection

- Connect the probe to the red probe socket.
- Insert the test object's mains plug into the test socket.
- Switch the device under test on.

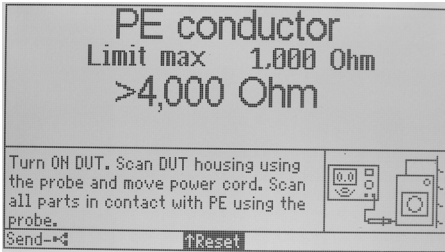
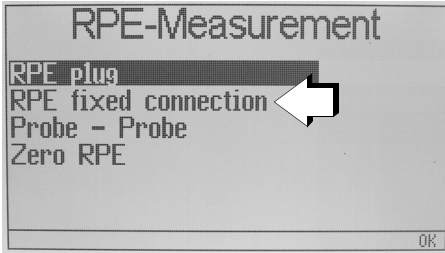
### Procedure

- Press the **RSL** key.
- Select the **"Plug"** menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- Start the measurement by pressing the **OK** key.
- Review the preconfigured parameters for cable length and cross-section, select them if necessary using the  $\triangleleft$ / $\triangleright$  scroll keys and adjust them to the momentary value using the  $\Delta$ / $\nabla$  scroll keys.

Adjusting the cable length and cross-section parameters changes the limit value which is shown at the top of the display.

- Contact the DUT's housing with the probe.
- In the case of moving parts, for example with a drill, contact the drill chuck while it's rotating – preferably with the optional brush probe.
- Move the mains power cord.
- Contact all parts connected to PE with the probe.
- If the respective measured value is smaller than the specified limit value, this is indicated acoustically, **OK** appears at the display and the  LED lights up green.
- You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out.

### 10.1.3 RPE – Permanently Connected DUTs



In the case of permanently connected devices: supply the test instrument with voltage from the DUT's electrical circuit if possible.



In this way, PE is measured via the test instrument's mains connection, the installation in the system and the DUT's mains connection.

For this reason, the limit value is higher than it is in the case of direct measurement.

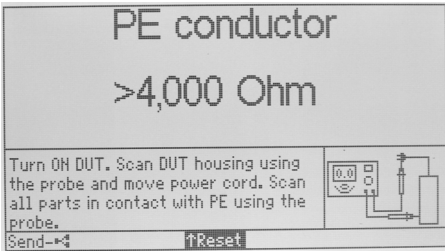
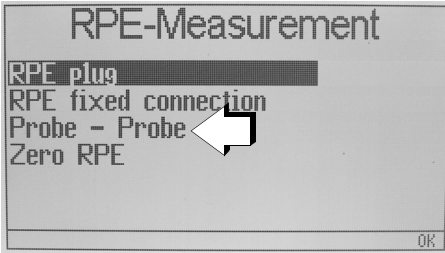
#### Connection

- ⇨ Connect the probe to the red probe socket.
- ⇨ Switch the device under test on.

#### Procedure

- ⇨ Press the **RSL** key.
- ⇨ Select the **"Permanent Connection"** menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- ⇨ Start the measurement by pressing the **OK** key.
- ⇨ Contact the DUT's housing with the probe.
- ⇨ Move the mains power cord.
- ⇨ Contact all parts connected to PE with the probe.
- ⇨ If the respective measured value is smaller than the specified limit value, this is indicated acoustically, **OK** appears at the display and the  LED lights up green.
- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out.

## 10.1.4 RPE – Probe-Probe Measurement



Not included with:

- PC I parameter, Rpe measurement No
- PC II (without PE)
- PC III

The protective conductor measurement is conducted while the device under test is switched off.

The mains connection cable must be moved around during the protective conductor measurement, especially at mechanically stressed points (protection against kinking). During measurement, the display must be checked for brief interruptions.

The maximum value is measured and stored after initially settling in.



Protective conductor resistance is measured with 200 mA direct current in accordance with the standard.

All PE parts which are not connected to each other or are flexibly connected must be contacted with the probe, one after the other. During measurement, the maximum value appears at the lower part of the display and is used for evaluation.

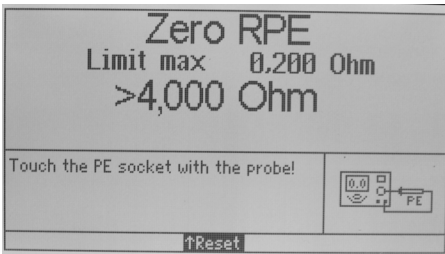
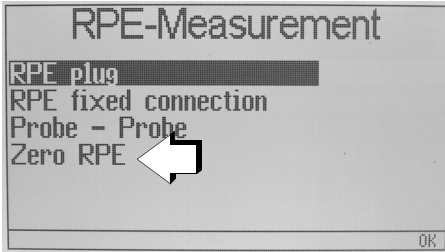
### Connection

- ⇨ Connect the first probe to the black GND socket.
- ⇨ Connect the second probe to the red probe socket.
- ⇨ Switch the device under test on.

### Procedure

- ⇨ Press the **RSL** key.
- ⇨ Select the **“Probe-Probe”** menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- ⇨ Start the measurement by pressing the **OK** key.
- ⇨ Contact the protective conductor terminal in the DUT's mains plug with the first probe.
- ⇨ Contact all parts of the DUT which are connected to PE with the second probe.
- ⇨ If the respective measured value is smaller than the specified limit value, this is indicated acoustically, **OK** appears at the display and the  LED lights up green.
- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out.

## 10.1.5 RPE – Balancing the Probe Cable for the Protective Conductor Measurement



This menu makes it possible to balance the probe cable's resistance value. The maximum offset value, which is subtracted from subsequent measured values, must not exceed  $0.100 \Omega$ .

### Connection

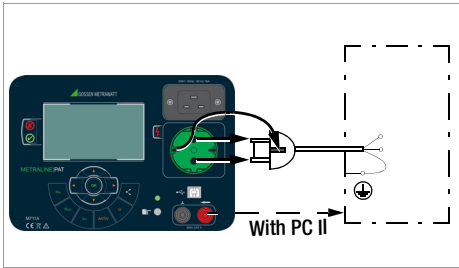
- Connect the probe to the red probe socket.

### Procedure

- Press the **RSL** key.
- Select the "**Rsl Balancing**" menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- Start the measurement by pressing the **OK** key.
- Contact one of the test socket's two protective conductor terminals.

## 10.2 Riso – Insulation Resistance

### Definition



### Protection Category I

Insulation resistance is measured between short-circuited mains terminals and the protective conductor.

### Protection Categories II and III

Insulation resistance is measured between short-circuited mains terminals and external conductive parts which can be contacted with the probe.

### Minimum Permissible Limit Values for Insulation Resistance per DIN VDE 0701-0702:2008

$R_{ISO}$			
PC I	PC II	PC III	Heating
1 M $\Omega$	2 M $\Omega$	0.25 M $\Omega$	0.3 M $\Omega$ *
2 M $\Omega$	7 M $\Omega$		

\* With activated heating elements (where heating power > 3 kW and  $R_{ISO} < 0.3$  M $\Omega$ : leakage current measurement is required)



### Note!

All insulation resistance measurements must be performed with the DUT in the de-energized state.

Observe the following safety instructions for the connections listed below:

- **Probe-PE**
- PE grounded via parallel-contact earthing switch
- **Probe-Probe**, if one side is grounded



### Warning: Voltage!

#### Insulation Resistance Measurement

Testing is conducted with up to 500 V. Current limiting is utilized ( $I < 1.0$  mA), but if the terminals are touched, electric shock may occur which could result in consequential accidents.

### Special Case: Permanently Installed Protection Class I Devices



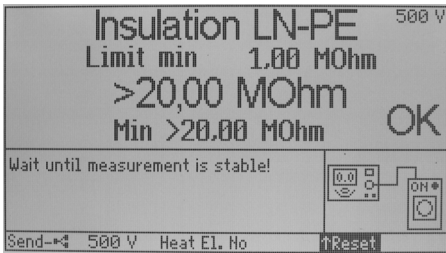
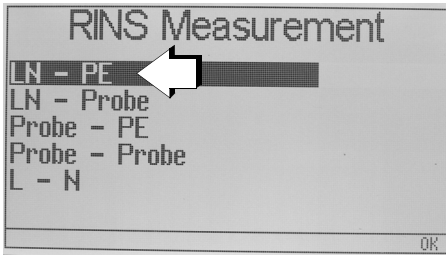
#### Attention!

Deactivate the electrical system which supplies power to the device under test before connecting the test instrument!

- Remove the mains fuses from the device under test and disconnect neutral conductor N inside the device under test.
- Connect the probe to phase conductor L at the device under test in order to measure insulation resistance.



## 10.2.1 RISO – LN-PE



### Note!

All switches at the device under test must be set to the on position during measurement of insulation resistance, including temperature controlled switches and temperature regulators as well.



Measurement must be performed in all program steps for devices equipped with program controllers.

Measurement is performed in the de-energized state.

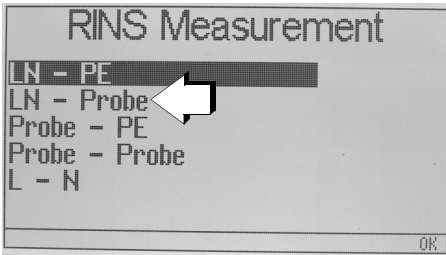
### Connection

- Insert the test object's mains plug into the test socket.

### Procedure

- Press the **Riso** key.
- Select the "**LN-PE**" menu with the help of the  $\Delta \nabla$  scroll keys.
- Start the measurement by pressing the **OK** key.
- Review the preconfigured parameters for the heating element (Heat Yes/No) and for test voltage (250 V/500 V), select them if necessary using the  $\triangle \triangleright$  scroll keys and adjust them to the momentary value using the  $\Delta \nabla$  scroll keys.
- Wait until the measurement settles in.
- If the respective measured value is larger than the specified limit value, **OK** appears at the display and the  LED lights up green.
- You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out briefly until the next measurement is performed.

## 10.2.2 RISO – LN-Probe



L and N are short-circuited in the test instrument during this measurement and a test voltage of 500 V (or 250 V with "Surge Arrester: Yes") is applied between LN and PE.

### Not Applicable for PC III

This measurement is not performed if there are no insulated and conductive parts.

Conductive, insulated parts must be contacted one after the other.



Measurement is performed with the DUT in the de-energized state.

Insulation is measured between LN at the DUT and accessible, conductive and insulated parts, as well as ELV parts if included.

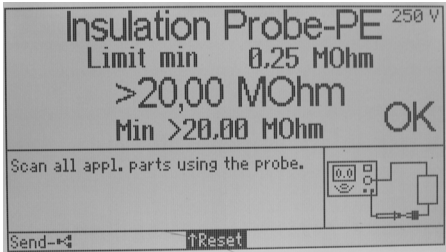
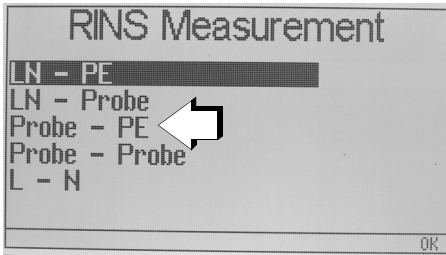
### Connection

- ⇨ Insert the test object's mains plug into the test socket.
- ⇨ Connect the probe to the red probe socket.

### Procedure

- ⇨ Press the **Riso** key.
- ⇨ Select the "**LN-Probe**" menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- ⇨ Start the measurement by pressing the **OK** key.
- ⇨ Contact all insulated, accessible, conductive (and SELV) parts with the probe.
- ⇨ If the respective measured value is larger than the specified limit value, **OK** appears at the display and the  LED lights up green.
- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out briefly until the next measurement is performed.

### 10.2.3 RISO – Probe-PE



Insulation Resistance Measurement, Probe to Conductive Parts (which are connected to PE)

#### For PC I Devices with SELV Parts



- Contact the SELV parts.

Insulation resistance of the SELV parts to PE is measured with a test voltage of 250 V.

#### Connection

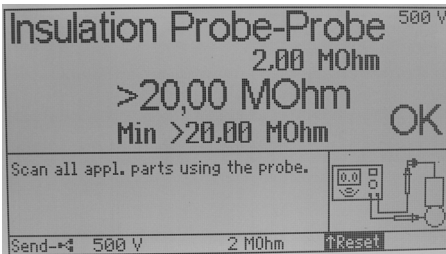
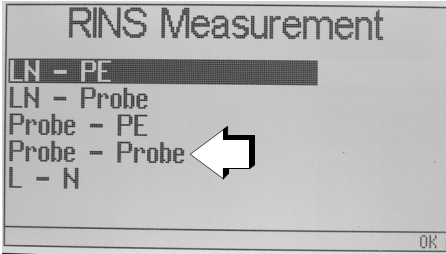
- Insert the test object's mains plug into the test socket.
- Connect the probe to the red probe socket.

#### Procedure

- Press the **Riso** key.
- Select the "**Probe-PE**" menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- Start the measurement by pressing the **OK** key.
- Contact the low-voltage output terminals with the probe.
- If the respective measured value is larger than the specified limit value, **OK** appears at the display and the  LED lights up green.
- You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out briefly until the next measurement is performed.

## 10.2.4 RISO – Probe-Probe (GND)

### Insulation Resistance Measurement, PC III



This measurement is intended exclusively for protection class III DUTs.

Insulation resistance between two points (e.g. components) can be determined with this measurement.

The test voltage and the limit value are adjustable.

This measurement is not performed if there are no insulated, conductive parts.

Conductive insulated parts must be contacted one after the other.

Measurement is performed with the DUT in the de-energized state.

Measurement is conducted with a test voltage of 250 or 500 V.

### Connection



- Connect the first probe to the black GND socket.
- Connect the second probe to the red probe socket.
- Connect phase conductors L1, L2 and L3 to N and the red probe.
- Connect PE to the black probe.

### Procedure

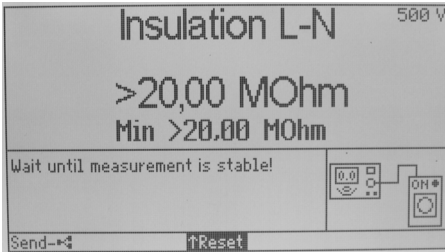
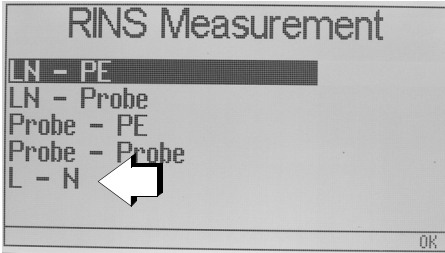
- Press the **Riso** key.
- Select the “**Probe-Probe**” menu with the help of the  $\Delta \nabla$  scroll keys.
- Start the measurement by pressing the **OK** key.
- Review the preconfigured parameters for the limit value (0.3/1/2 M $\Omega$ ) and for test voltage (250 V/500 V), select them if necessary using the  $\triangle \nabla$  scroll keys and adjust them to the momentary values using the  $\Delta \nabla$  scroll keys.

**Heating Elements:** “Yes” results in a reduction of the permissible limit value of 1 M $\Omega$  to 0.3 M $\Omega$ .

**Test Voltage:** In the case of devices with integrated surge arrester, insulation resistance measurements performed with 500 V may lead to “excessively small” measurement results. Reducing test voltage to 250 V makes it possible to perform measurement without activating overvoltage protection.

- Contact the short-circuited L and N pins in the DUT's mains plug with the first probe.
- Contact all of the DUT's insulated, conductive parts with the second probe.
- If the respective measured value is larger than the specified limit value, **OK** appears at the display and the  LED lights up green.
- You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out briefly until the next measurement is performed.

## 10.2.5 RISO – L-N



This measurement is used to test the insulation of, for example, extension cords and multiple outlets (via optional adapters) without circuitry (e.g. glow lamps).

Test voltage is applied between L and N to this end, and insulation resistance is measured.

### Connection

- Insert the test object's mains plug into the test socket.
- Connect the probe to the red probe socket.

### Procedure

- Press the **Riso** key.
- Select the "**L-N**" menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- Start the measurement by pressing the **OK** key.
- Contact all conductive parts with the probe.



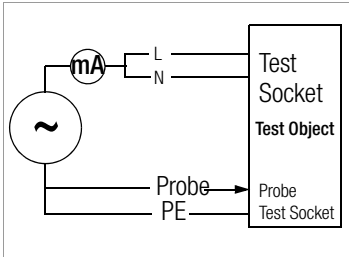
### Note!

There's no limit value for this measurement, and thus there's no corresponding LED display.

### 10.3 IEA – Equivalent Leakage Current Measurement

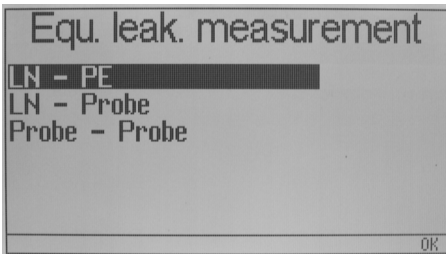
#### General

Measurement of equivalent leakage current is stipulated by DIN VDE 0701-0702 after the insulation test has been passed.



#### Warning: Voltage! Equivalent Leakage Current Measurement

Testing is conducted with up to 250 V. Current limiting is utilized ( $I < 3.5\text{mA}$ ), but if the terminals are touched, electric shock may occur which could result in consequential accidents.



#### Note!

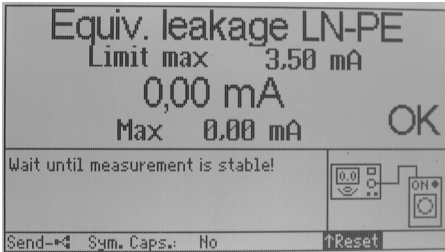
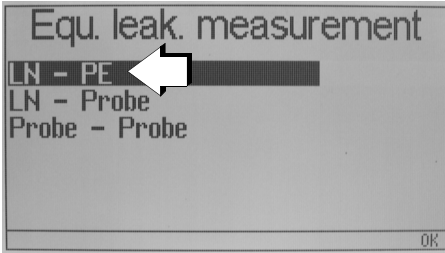
Measurement of equivalent leakage current may only be performed after the installation resistance test has been passed.



#### Note!

Equivalent leakage current measurement is not an adequate test method if the device contains switching elements which switch all poles, because circuits downstream from these are not tested by the measurement. Furthermore, leakage current caused by inverters cannot be measured. For this reason, active testing is generally preferable to this measurement.

### 10.3.1 IEA – LN-PE



Not Applicable for PC II (without PE) and PC III

Measurement is performed with the DUT in the de-energized state.

The L and N terminals at the DUT are connected to each other inside the test instrument. An alternating voltage is applied between L-N and PE and current is measured.

#### Connection

- ⇨ Insert the test object's mains plug into the test socket.



#### Procedure

- ⇨ Press the **IEA** key.
- ⇨ Select the "**LN-PE**" menu with the help of the  $\Delta \nabla$  scroll keys.
- ⇨ Start the measurement by pressing the **OK** key.
- ⇨ Review the default parameter for balanced wiring (Yes/No), select it if necessary using the  $\langle \rangle$  scroll keys and adjust it to the momentary value using the  $\Delta \nabla$  scroll keys.

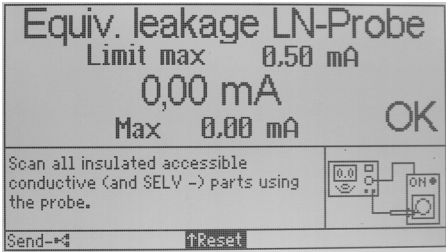
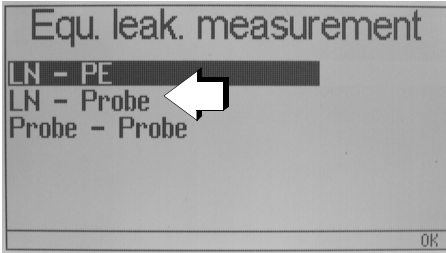


#### Note!

If "Balanced Wiring: Yes" is selected, the measured value is cut in half. This is the case when the DUT includes Y capacitors from L and N to PE.

- ⇨ If the respective measured value is smaller than the specified limit value, **OK** appears at the display and the  LED lights up green.
- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out briefly until the next measurement is performed.

## 10.3.2 IEA – LN-Probe





Measurement is performed with the DUT in the de-energized state.

This measurement is conducted between LN and accessible parts insulated from PE (also SELV parts – e.g. the secondary side of chargers).

### Connection

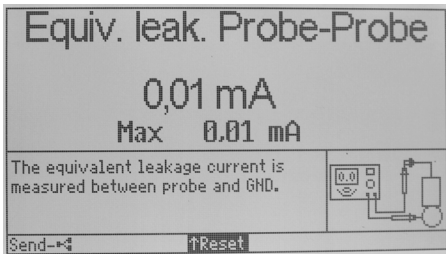
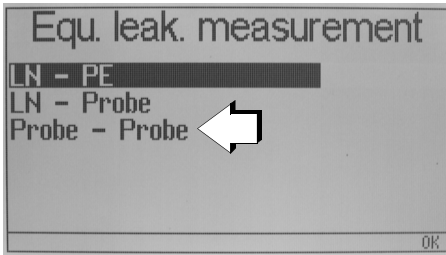
- ⇨ Insert the test object's mains plug into the test socket.
- ⇨ Connect the probe to the red probe socket.

### Procedure

- ⇨ Press the **IEA** key.
- ⇨ Select the “**LN-Probe**” menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- ⇨ Start the measurement by pressing the **OK** key.
- ⇨ Contact all insulated, accessible, conductive (and SELV) parts with the probe.
- ⇨ If the respective measured value is larger than the specified limit value, **OK** appears at the display and the  LED lights up green.
- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which the LED  goes out briefly until the next measurement is performed.



### 10.3.3 IEA – Probe-Probe (GND)



#### Connection

- ✦ Connect the first probe to the black GND socket.
- ✦ Connect the second probe to the red probe socket.

#### Procedure

- ✦ Press the **IEA** key.
- ✦ Select the "**Probe-Probe**" menu with the help of the  $\Delta$ / $\nabla$  scroll keys.
- ✦ Start the measurement by pressing the **OK** key.
- ✦ Contact the short-circuited L and N pins in the DUT's mains plug with the first probe.
- ✦ Contact all of the DUT's insulated, conductive parts with the second probe.
- ✦ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset). The max. value is cleared.



#### Note!

There's no limit value for this measurement, and thus there's no corresponding LED display.

## 10.4 AKTIV - Function Test and Leakage Current Measurements

Functional Test				
Func	MV	Max	Lim	OK/F
IB	0,000 mA	0,000 mA	0,500 mA	OK
ID	0,00 mA	0,03 mA	3,50 mA	OK
I	0,0 A	0,0 A		
U	229 V	229 V		
P	0 W	0 W		

If available, scan all insulated accessible conductive parts.

↑Standby   ↑ Exch. N/L   ↑Reset

## Standby – Measurement of Small Power Values

Functional test Standby				
Func	MV	Max	Lim	OK/F
P	0 mW	0 mW		

Power input Standby (current max. 40 mA)

Send-←   ↑Normal   ↑Reset

### Connection

- ⇨ Insert the test object's mains plug into the test socket.
- ⇨ Connect the probe to the red probe socket.

### Procedure

- ⇨ Press the **AKTIV** key.
- ⇨ Turn off the device under test.
- ⇨ Switch line voltage to the test socket by pressing the **OK** key.

As soon as line voltage is applied to the test socket, the LED for the high-voltage arrow lights up red.

- ⇨ Switch the device under test on.
- ⇨ Contact any insulated, conductive parts with the probe.

### Polarity Reversal – Devices with Alternating Voltage:

- ⇨ Repeat differential and touch current measurement with reversed polarity: Press the  $\Delta$  key in order to reverse polarity (**Reverse L/N**).

### Ending the Test

- ⇨ Press the **AKTIV** key in order to end the test and disconnect the test socket from the mains.

Current values of up to 40 mA can be measured for the display of small power values (mW range) in standby mode (DUT switched off).

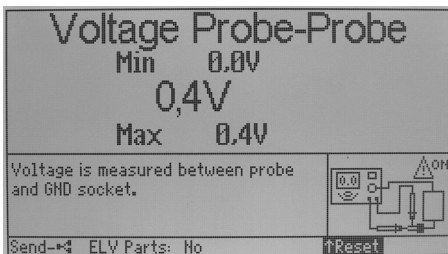
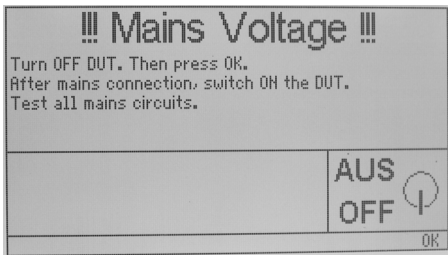
### Procedure

- ⇨ During the function test: turn off the device under test.
- ⇨ First of all, select the "Standby" function with the  $\triangleleft \triangleright$  scroll keys and activate it with the  $\Delta$  scroll key.

The momentary measured value and a measured maximum value are displayed.

- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset). The max. value is cleared.

## 10.5 U – Testing the DUT (ELV) in the Presence of Line Voltage



- ⇨ If the parameter for “ELV Parts” is set to “Yes” and if the measured value is between the specified min. and max. values, **OK** appears at the display.
- ⇨ You can repeat the measurement by pressing the  $\Delta$  scroll key (reset), after which **OK** disappears briefly until the next measurement is performed.

### Ending the Test

- ⇨ Press the **U** key in order to end the test and disconnect the test socket from the mains.

### Connection

- ⇨ Insert the test object’s mains plug into the test socket.
- ⇨ Connect the first probe to the black GND socket.
- ⇨ Connect the second probe to the red probe socket.

### Procedure

- ⇨ Press the **U** key.
- ⇨ Turn off the device under test.
- ⇨ Switch line voltage to the test socket by pressing the **OK** key.

As soon as line voltage is applied to the test socket, the LED for the high-voltage arrow lights up red.

- ⇨ Review the default parameter for “ELV Parts”, select it if necessary using the  $\triangleleft$   $\triangleright$  scroll keys and adjust it to the momentary value (“Yes” or “No”) using the  $\Delta$   $\nabla$  scroll keys.
- ⇨ Contact the DUT’s voltage output with both probes.

## 11 Error Messages, Troubleshooting

### 11.1 Display is Off

Note: The L or N conductor connection is probably faulty.  
If the mains are OK, the internal fuse may have blown.

### 11.2 Touch Current Measurement Indicates 0.000 mA

This is not an error – there simply isn't any touch current.

### 11.3 Touch Current Measurement Greater than 0.5 mA



#### Attention!

Voltage to accessible conductive parts!

- ⇨ Immediately disconnect the DUT from the mains outlet!

Conduct an insulation resistance measurement between accessible conductive parts and the DUT's mains connection. In order to ensure that all insulation is tested, all switching elements must be closed during the insulation measurement.

The measured value must be greater than 2 MΩ. After insulation measurement has been successfully completed, measure touch current. The measured value must be less than 0.5 mA.

### 11.4 "F" Displayed for Differential Current Measurement

If the test instrument's power ratings and those on the DUT's serial plate are identical, the DUT's insulation performance is inadequate!

- ⇨ Disconnect the DUT from the mains outlet.
- ⇨ Use an insulation measuring instrument to locate the fault.

#### Line voltages are displayed incorrectly.

- ⇨ Check line voltage with a measuring instrument.

If the test instrument is faulty, it must be sent to the service department or replaced.

### 11.5 Bluetooth Communication

Bluetooth is always on.

Pairing is required during initial startup with a PC.

#### The measuring instrument is not found.

The **METRALINE PAT** is still connected to another device.

- ⇨ Terminate the connection and try to connect again – restart the measuring instrument if necessary.

#### Bluetooth connection is interrupted or intermittent.

- ⇨ Make sure that the mobile device is not in the economy mode.

Distance between the measuring instrument and the mobile device may not exceed 10 meters.

- ⇨ Make sure that no devices are close by which emit electromagnetic interference (e.g. switched-mode power supplies that don't comply with EMC standards, frequency converters or switchgear).

#### Measured value transmission doesn't work.

- ⇨ Check the hardware keyboard settings at the mobile device.

## 12 Technical Data

### Mains Connection

Alternating current	230 V $\pm$ 10%
DUT connection	16 A Schuko

### Measurements

Operating error: 5% of the measured value + 1% of the range

### Protective Conductor Resistance Measurement (probe-PE, probe-PE-mains, probe-probe)

Measuring range	0.000 $\Omega$ ... 4.000 $\Omega$
Open circuit voltage:	10 V,
current:	200 mA DC

The cable length and cable cross-section parameters can be adjusted for measurement of the DUT at the test socket in order to display the limit value in accordance with the standard.

### Insulation Resistance Measurement

#### (LN-PE, LN-probe, probe-PE, probe-probe, L-N)

Measuring range	0.00 M $\Omega$ ... 20.00 M $\Omega$
Test Voltages	250 V, 500 V
Short-Circuit Current	1 mA

**LN-PE:** The heating element parameter can be set to Yes (0.3 M $\Omega$ ) or No (1.00 AM M $\Omega$ ) in order to display the limit value in accordance with the standard. Test voltage can be selected (see above).

**Probe-Probe:** limit value (0.3/1/2 M $\Omega$ ) and test voltage (250 V/500 V) can be selected.

### Equivalent Leakage Current Measurement

#### (LN-PE, LN-Probe, Probe-PE, Probe-Probe)

Measuring range	0.00 mA ... 20.00 mA
Open circuit voltage:	approx. 120 V
Current limiting	3.5 mA

**LN-PE:** Balanced wiring (Yes/No) can be selected. If "Yes" is selected, the measured value is cut in half.

### Differential Current Measurement

Measuring range	0.00 mA ... 20.00 mA
-----------------	----------------------

### Touch Current Measurement

Measuring range	0.000 mA ... 4.000 mA
-----------------	-----------------------

### Voltage Measurement, Probe-Probe

Measuring range	0.0 V ... 440 V AC/DC
Current	0.00 A ... 20 A

### Function Test

The device under test can be supplied with line voltage via the integrated test socket. The following are measured, or calculated automatically:

Touch current IB	0.000 mA ... 4.000 mA
Differential current ID	0.00 mA ... 20.00 mA
Current consumption I	0.00 A ... 20.00 A
Line voltage U	0.0 V ... 250.0 V
Active power P	0 W ... 4000 W

### Polarity Reversal During the Function Test

Polarity can be reversed during the function test for the measurement of differential and touch current by pressing a key.

### Power Measurement in Standby Mode During the Function Test

Current values of up to 40 mA can be measured for the display of small measured power values (mW range) in standby mode (DUT switched off).

### Protective Conductor Monitoring

Voltage, N-PE	> 30 V
---------------	--------

### Integrated Fault Current Shutdown

Residual current	> approx. 20 mA
------------------	-----------------

### Electrical Safety

Protection category	I per IEC 61010-1/ EN 61010-1/ VDE 0411-1
Nominal voltage	230 V
Test voltage	2.3 kV, 50 Hz
Measuring category	250 V CAT II
Pollution degree	2
Protection	IP 40
Fuse link:	permanently installed for test socket protection (may only be replaced by our service department, see section 14 for address)

## Mechanical Design

Display	Multiple display with dot matrix, 320 x 240 pixels, backlit display
Dimensions	W x H x D: 23 x 17.5 x 9.5 cm with retracted carrying handle
Weight	Approx. 1.3 kg

## 13 Maintenance

### 13.1 Housing

No special maintenance is required. Keep outside surfaces clean and dry. Use a slightly dampened cloth for cleaning. Avoid the use of solvents, cleansers and abrasives.

### 13.2 Recalibration

The measuring tasks performed with your instrument, and the stressing it's subjected to, influence aging of its components and may result in deviation from the specified levels of accuracy.

In the case of strict measuring accuracy requirements, as well as in the event of use at construction sites with frequent stress due to transport and considerable temperature fluctuation, we recommend a relatively short calibration interval of once per year. If your instrument is used primarily in the laboratory and indoors without considerable climatic or mechanical stressing, a calibration interval of once every 2 to 3 years is sufficient as a rule.

During recalibration \* at an accredited calibration laboratory (DIN EN ISO/IEC 17025), deviations from traceable standards demonstrated by your measuring instrument are documented. Ascertained deviations are used to correct display values during later use of the instrument.

We would be happy to perform DAkkS or factory calibration for you at our calibration laboratory. Further information is available on our website:

[www.gossenmetrawatt.com](http://www.gossenmetrawatt.com)  
(→ COMPANY → Quality and Certificates → DAkkS Calibration Center).

Recalibration of your instrument at regular intervals is essential for the fulfillment of requirements according to quality management systems per DIN EN ISO 9001.

According to DIN VDE 0701-0702, only test instruments which are tested and calibrated at regular intervals may be used for testing.

\* Examination of the specification, as well as adjustment, are not included in calibration. However, in the case of our own products, any required adjustment is performed and adherence to the specification is confirmed.

### 13.3 Technical Safety Inspections,

Conduct technical safety inspections on your test instrument at regular intervals. We recommend the same interval for inspections as is also used for recalibration.

#### Note

For technical reasons, insulation resistance between LN and PE inside the **METRALINE PAT** is roughly 2 MΩ.

This must be taken into consideration during technical safety inspections or, instead of the insulation resistance measurement, the protective conductor current measurement must result in a value of less than 3.5 mA (or less than 7 mA if the equivalent leakage current method is used).

There are also 3 accessible conductive parts on the **METRALINE PAT**, at which the touch current measurement must result in a value of less than 0.5 mA:

- USB port
- Metallized finger contact
- Protective conductor bar in the test socket

### 13.4 Return and Environmentally Sound Disposal

The device is a category 9 product (monitoring and control instrument) in accordance with ElektroG

(monitoring and control instruments).

This device is subject to the WEEE directive. We also make reference to the fact that in this regard, the current status can be found on the Internet at [www.gossenmetrawatt.com](http://www.gossenmetrawatt.com) by entering the search term WEEE.

We identify our electrical and electronic devices in accordance with WEEE 2012/19/EU and ElektroG

using the symbol shown at the right per DIN EN 50419. These devices may not be disposed of with household trash.

Please contact our service department regarding the return of old devices (see address below).



## 14 Repair and Replacement Parts Service

If required please contact:

GMC-I Service GmbH  
**Service Center**  
Beuthener Str. 41  
90471 Nürnberg, Germany  
Phone: +49-911-817718-0  
Fax: +49-911-817718-253  
e-mail [service@gossenmetrawatt.com](mailto:service@gossenmetrawatt.com)  
[www.gmci-service.com](http://www.gmci-service.com)

This address is only valid in Germany.  
Please contact our representatives or subsidiaries for service in other countries.

## 15 Product Support

If required please contact:

GMC-I Messtechnik GmbH  
**Product Support Hotline**  
Phone: +49-911-8602-0  
Fax: +49 911 8602-709  
e-mail [support@gossenmetrawatt.com](mailto:support@gossenmetrawatt.com)

---

Edited in Germany • Subject to change without notice • PDF version available on the Internet

 **GOSSEN METRAWATT**

GMC-I Messtechnik GmbH  
Südwestpark 15  
90449 Nürnberg • Germany

Phone: +49 911 8602-111  
Fax: +49 911 8602-777  
e-mail: [info@gossenmetrawatt.com](mailto:info@gossenmetrawatt.com)  
[www.gossenmetrawatt.com](http://www.gossenmetrawatt.com)