



## Portable Appliance Testers

# OmegaPAT MI 2140 BetaPAT MI 2141 User Manual

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

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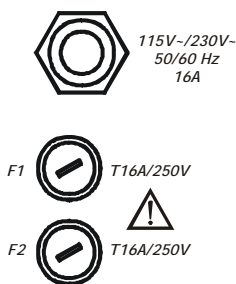
# 1. 1. General presentation

## 1.1. Safety in use

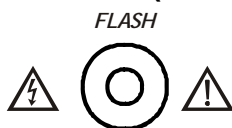
- If the test equipment is used in manner not specified in this user manual the protection provided by the equipment may be impaired!
- Read this instruction manual carefully, or use of the instrument may be dangerous for the operator, for the instrument or for the equipment under test!
- Use only earthed mains outlets to supply the instrument!
- Do not use any damaged instrument, mains outlet, measurement leads or damaged mains connection cable!
- A competent authorized person must carry out service, adjustment, or calibration procedure!
- Only a competent person, familiar with hazardous voltage operations, should use OmegaPAT and BetaPAT testers!
- During the measurements the appliance under test or the test leads should NOT be touched – possible hazardous voltage.
- In case of abnormal behavior disconnect the instrument and return it to manufacturer / distributor for service.
- Always handle the instrument as if the test sockets and leads have hazardous voltages present.
- In some countries the leakage and touch leakage current measurements shall be executed for normal connection of tested equipment and also for the connection with changed L and N. It is advised to prepare appropriate test set-up for the test with the changed lines. Consider local regulations.

Meaning of ,  signs on front panel:

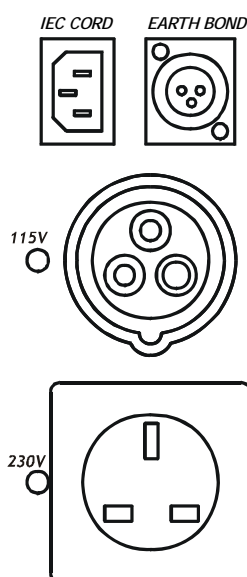
**Input section** ..... **Switch off** the instrument and disconnect all test cables and mains cord before replacing the fuses or opening the instrument



**Flash terminal (MI2140 only)**..... **Dangerous voltage** may be present. **Always** handle as if the test leads are energized.



**Other terminals** ..... **Disconnect** all equipment from the instrument during the test except for the equipment under test.



**IEC cord** connector is for test purposes only; do not connect it to mains supply!

**Dangerous voltage** is present on the test sockets during the measurement. Measurements should only be carried out on de-energized appliances.

**Test sockets** are intended only for connection of tested appliance!

**Maximum output current** of any of two test sockets (230 V / 115 V) is 16 A.

## 1.2. Features

Portable appliance testers MI2140 and MI2141 are instruments intended for testing the safety of portable electrical equipment.

General functions of MI2140 and MI2141:

- Visual test.
- Earth bond test.
- Insulation test.
- Substitute leakage test.
- Flash test (MI2140 only).
- Leakage test.
- Touch leakage test.
- Functional (power) test.
- IEC cord test.

Benefits of MI2140 and MI2141:

- Fast and reliable performance of all tests necessary for testing the safety of portable appliances.
- Large graphic LCD display with resolution of 240 x 128 dots, with back-light.
- Over 4000 memory locations in data flash memory.
- Two RS232C communication ports for communication with PC, bar code reader or printer.
- Soft touch keyboard with cursor keys.
- Built in real time clock.

The instrument is supplied with all necessary accessories for carrying out the tests.

### **1.3. Connection**

The tester may be powered with 115 V or 230 V supply voltage, and will test appliances for both voltages (depending on supply voltage). LED indicator adjacent to the test socket denotes which test socket is active.

The supply must include an earth connection.

### **1.4. Applied standards**

Instrument operation:

- British standards BS 89,
- German standards VDE 0701 and VDE 0702.

Safety and electromagnetic compatibility (EMC):

- EN 61010 -1,
- IEC 61326.

## 2. 2. Instrument description

### 2.1 Front panel description

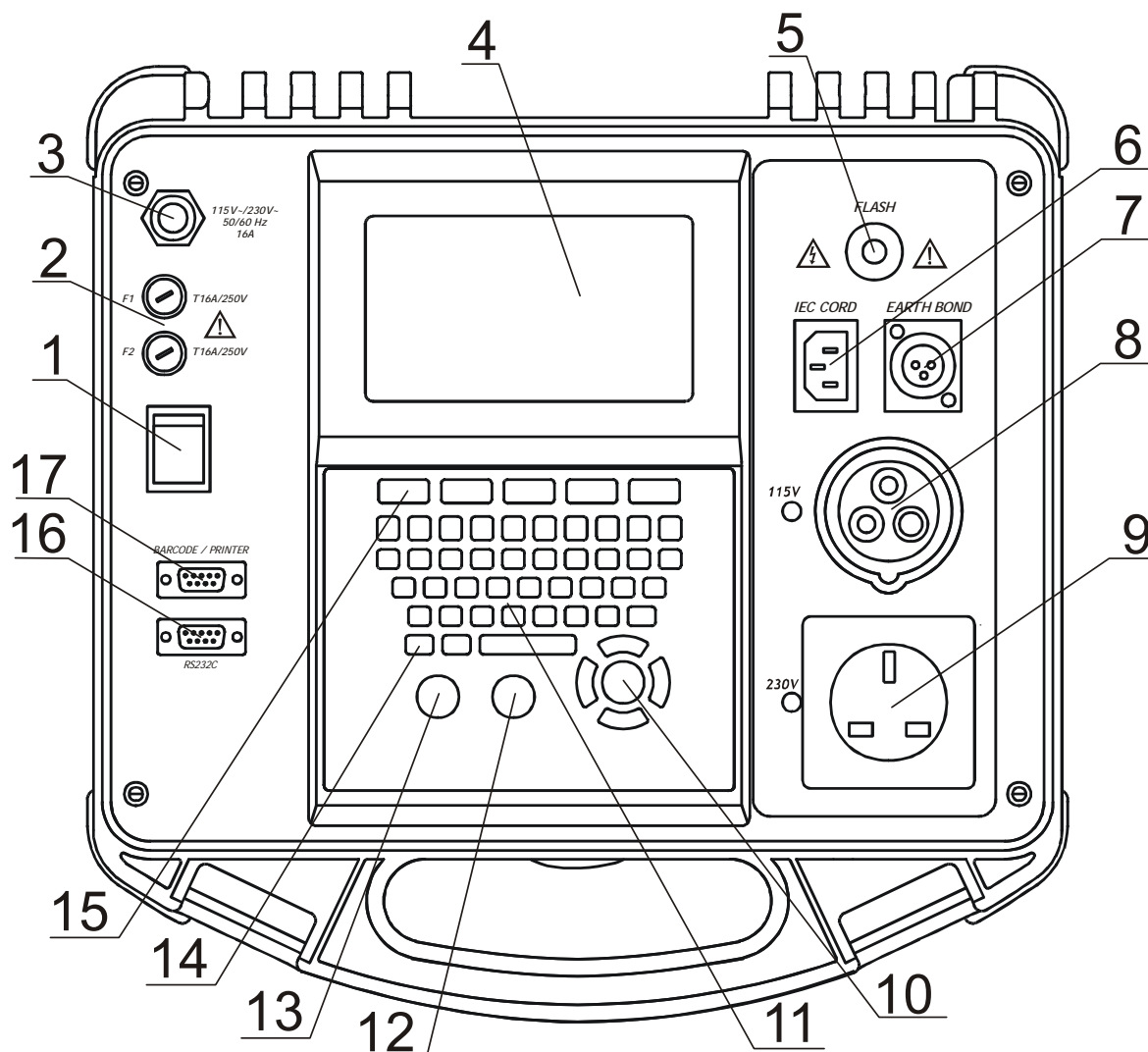


Fig. 2.1 Front panel layout

#### Legend:

1. **Power ON/OFF switch** with indication lamp.
2. **T 16A 250V fuses** protect instrument power supply.
3. **Mains supply.**
4. **Graphic LCD**, 240 x 128 dots, with backlight.
5. **Flash test terminal (MI2140 only).**
6. **IEC lead connector.**
7. **EARTH BOND connector**, also used as touch leakage input for some Class II tests.
8. **115 V socket**
9. **230 V socket**

















**10. Cursor keys:**

- **UP / DOWN key**, to increase / decrease edited value,
- **LEFT / RIGHT key**, to move between edited values,
- **ENTER key**, to confirm selection in menu.

**11. Keyboard.****12. STOP key.****13. START key.****14. ESC key**, to return to previous page in menu.**15. Function keys**, to set various parameters in each function. The purpose of a specific key in each function is marked on display.**16. RS 232 connector** for communication with a PC.**17. Barcode reader / printer connector.****2.2. Instrument messages**

Description of displayed messages:

L and N are CROSSED. Press Start to continue	Check the wiring of supply.
 Mains voltage is not correct or PE not connected. Check Mains voltage and PE connection!	Check for incorrect wiring of supply – there is no earth connection or mains voltage is incorrect.
 L-N RESISTANCE TOO HIGH (>30 k $\Omega$ ) CHECK SWITCH OR FUSE Do you wish to PROCEED (Y/N)?	Resistance between L and N of appliance under test is higher than 30 k $\Omega$ – check the appliance power switch or fuse.
 L-N SHORTED (< 3.0 $\Omega$ ) Do you wish to PROCEED (Y/N)?	Resistance between L and N of appliance under test is lower than 3 $\Omega$ - possible short-circuit or high inrush current – check the appliance.
 L-N RESISTANCE TOO LOW ( 8.0 $\Omega$ ) Do you wish to PROCEED (Y/N)?	Resistance between L and N of appliance under test is lower than 20 $\Omega$ - current may be higher than 16 A – check the appliance.
 LEAKAGE TOO HIGH (>20.0mA) Do you wish to PROCEED (Y/N)?	Leakage current in pre-test is too high – potential danger to operator and damage to appliance if test is continued.
 NAME OF TEST Test was skipped for SAFETY	Potential hazardous tests were skipped because one or more results were out of limit in measurements of earth bond, insulation or substitute leakage.

 <b>VOLTAGE ON SOCKET FROM APPLIANCE</b> Measurement is ABORTED	An external voltage is present on test socket – check measurement circuit.
 <b>OVERHEATED</b> Measurement is ABORTED	The instrument was overheated during the measurement of earth bond – allow the instrument to cool down before proceeding with the measurements.
	High DC voltage between L-N and PE on test socket (during insulation test).
(MI2140 only)     <b>FLASH TIP</b>	Presence of dangerous HV voltage during Flash test. 1500V between L-N and PE on test socket 3000V between Flash terminal and L-N on test socket.
	Dangerous mains voltage on test socket (during Leakage/Power and Touch Leakage tests).
	Device under test must be switched on during test
<b>EB CLIP</b>	Use Earth Bond clip in this test.
	Ensure that the Earth Bond clip is not connected to any part of the appliance that may heat up or rotate when switched on.
<b>IEC PLUG</b>	Connect the lead to be tested to the IEC plug.

**Note:**

- The '**L-N resistance too high**' message is shown if the L-N circuit pretest fails. In this case it is recommended to check whether the power switch is switched on and/or the mains fuse is not broken.

This pretest is performed:

- Before the first Insulation, SubLeakage, Leakage, Touch Leakage test in the SINGLE TEST menu.
- Before the one test of Insulation, SubLeakage, Leakage, Touch Leakage (whichever is selected first) in AUTOTEST – SHORTCUT and AUTOTEST – CUSTOM menus. This pretest is skipped for Polarity test.

### 3. 3. Technical specification

#### 3.1 Earth bond test

Earth bond resistance (4 A, 10 A, 25 A)

Range R	Resolution	Accuracy (after calibration)
0.00 –1.99 $\Omega$	0.01 $\Omega$	$\pm(5\%$ of reading + 3 digit)
2.00 –19.99 $\Omega$	0.01 $\Omega$	$\pm 10\%$ of reading

Earth bond resistance (100 mA)

Range R	Resolution	Accuracy (after calibration)
0.00 –1.99 $\Omega$	0.01 $\Omega$	$\pm(5\%$ of reading + 3 digit)
Indication range: 2.00 –19.9 $\Omega$		

Test currents: 100 mA, 4 A, 10 A, 25 A into 100 m $\Omega$  at mains voltage of 240 V<sub>AC</sub>

Open circuit voltage: <6 V<sub>AC</sub>, (2.2 V<sub>AC</sub> at 100 mA) at U<sub>mains</sub> = 240 V<sub>AC</sub>

Limits: 0.01 - 0.09  $\Omega$ , 0.10 - 0.90  $\Omega$ , 1.00 - 9.00  $\Omega$

Timer: 2 s, 3 s, 5 s, 10 s, 30 s

Output: EARTH BOND clip, 115 V or 230 V socket

#### 3.2 Insulation test

Insulation resistance readout

Range	Resolution	Accuracy
0.000 – 0.500 M $\Omega$	0.001 M $\Omega$	$\pm(10\%$ of reading + 5 digit)
0.500 –1.999 M $\Omega$	0.001 M $\Omega$	$\pm(5\%$ of reading + 3 digit)
2.00 –19.99 M $\Omega$	0.01 M $\Omega$	
20.0 – 199.9 M $\Omega$	0.1 M $\Omega$	

Nominal voltage: 250 V<sub>DC</sub>, 500 V<sub>DC</sub> (-0 % / +10 %)

Nominal current: 1 mA @ 250 k $\Omega$  (250 V)

1 mA @ 500 k $\Omega$  (500 V)

Short circuit current: 2 mA max.

Limits: 0.50 M $\Omega$ , 1.00 M $\Omega$ , 2.00 M $\Omega$ , 4.00 M $\Omega$ , 7.00 M $\Omega$ , 10.0 M $\Omega$ , 50.0 M $\Omega$

Auto discharging after test

Timer: 2 s, 3 s, 5 s, 10 s, 30 s

Output: 115 V or 230 V socket

### 3.2 Substitute leakage test

Substitute leakage current readout

Range	Resolution	Accuracy
0.00 – 19.99 mA	0.01 mA	±(10 % of reading + 5 digit)

Short circuit current: < 30 mA

Open circuit voltage: 40 V AC

Displayed substitute current is calculated to 115 V, 230 V, depending on mains voltage

Limits: 0.25 mA, 0.50 mA, 0.75 mA, 2.50 mA, 3.50 mA, 7.00 mA, 9.90 mA, 15.00 mA

Timer: 2 s, 3 s, 5 s, 10 s, 30 s

Output: 115 V or 230 V socket

### 3.3 Flash test (MI2140 only)

Flash current readout

Range	Resolution	Accuracy
0.00 - 2.50 mA	0.01 mA	±(5 % of reading + 5 digit)

Test voltage: 1500 V<sub>AC</sub>, 3000 V<sub>AC</sub>

Output resistance: 480 kΩ@1500 V, 960 kΩ@3000 V

Limits: 1 mA, 1.5 mA, 2.0 mA, 2.25 mA

Timer: 2 s, 3 s, 5 s, 10 s, 30 s

Output: For Class I appliance 115 V or 230 V sockets

For Class II appliance 115 V or 230 V sockets and Flash terminal

### 3.4 Leakage current and Power test

Differential leakage current readout

Range	Resolution	Accuracy
0.00 – 10.00 mA	0.01 mA	±(5 % of reading + 5 digit)

Threshold limits: 0.25 mA, 0.50 mA, 0.75 mA, 1.00 mA, 1.50 mA, 2.25 mA, 2.50 mA, 3.00 mA, 3.50 mA, 9.90 mA

Timer: 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s

Output: 115 V or 230 V socket

## Power readout

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

Timer: 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s

Output: 115 V or 230 V socket

### 3.5 Touch leakage current

## Touch leakage current readout

Range	Resolution	Accuracy
0.00 – 1.99 mA	0.01 mA	±(10 % of reading + 5 digit)

Threshold values: 0.25 mA, 0.50 mA, 1.00 mA

Timer: 2 s, 3 s, 5 s, 10 s, 30 s, 60 s, 120 s, 180 s

Output: 115 V or 230 V socket

$R_{A\text{-meter}}$ : 2 k $\Omega$

### 3.6.Polarity test

Test voltage: < 50 V

Output: 230 V / 115 V socket and IEC cord

Results: PASS, L-PE short, N-PE short, L-N short, L open, N open, PE open, N -PE crossed, L-PE crossed, L-N crossed, MULTIPLE FAULT

## 4. Measurements

### 4.1. Presentation of results

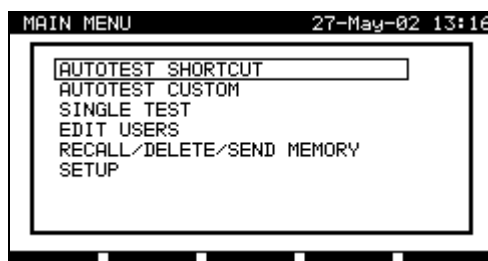
#### 4.1.1. PASS / PASS \* / FAIL result

Depending on the limit set in the selected test, the result is marked either with a PASS or FAIL message. Limits are shown in the upper right corner of the display. The message is always displayed as well as the actual measured result (except in visual test).

A conditional PASS (PASS\*) message is shown if one or more tests in the set Autotest routine are skipped or aborted. In this case all performed tests must PASS. Otherwise, FAIL is shown.

### 4.2. Manipulation

After start-up of the instrument, the MAIN MENU is displayed:



*Fig. 4.1 Main menu*

To select an option from the menu, use UP and DOWN keys. The selected option will be highlighted. The selection is confirmed with the ENTER key. To return into MAIN MENU from any sub-menu, press the ESC key.

#### 4.2.1. Help option

In all measurements a help menu is available with connection diagram and instructions on how to perform the test. Where there are two options (Class I or Class II appliance), descriptions for both are available. The last page (or two) of the help menu provides guidance on why a test may fail (e.g. connection problems). An example help menu for earth bond measurement is presented in the following figures.

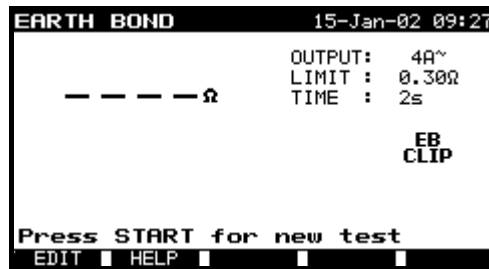


Fig. 4.2 Earth bond display example

→Press key F2 (HELP)→



Fig. 4.3 Help example for earth bond test connection

→  
Press  
PgUp →



Fig. 4.4 Help for reasons of failed earth bond test

### 4.3. Single mode

In single mode individual tests can be performed. This is suitable in cases when the appliance fails in one or more tests. After repairing the appliance it is wise to retest that particular function. In this mode it is not possible to save the result, because it is only intended to check the effectiveness of the repair. After the successful repair the complete appliance test has to be performed.

In single mode the SINGLE MODE menu is displayed:

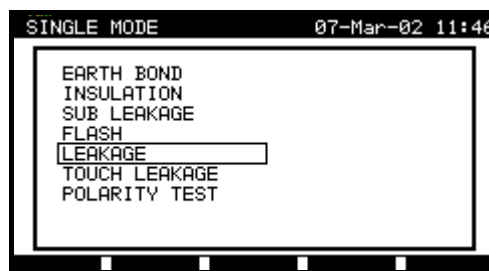


Fig. 4.5 Single mode menu

To select an option from the menu, use the UP and DOWN keys. The selected option will be highlighted. The selection is confirmed with the ENTER key. To return to the previous menu, press the ESC key.

In every test it is possible to set measurement parameters. If the limits are saved, they will be used for all future measurements in the single mode function. If they are not saved and the measurement is started with the START key, the settings are used until exit from the single mode function, then they are returned to the previous settings.

### 4.3.1. Earth bond test

The purpose of this test is to ensure that the resistance of connections between the earth wire in the mains supply plug and the grounded metal parts of an appliance is below allowed limits. The resistance limit, duration of measurement, output current and the number of measurements are selectable according to the requirements. Before testing, check that the test will not cause any damage to the appliance. Test with a maximum current of 100 mA is applied when higher current can cause damage. This is often necessary when computers or other information technology appliances are checked.

#### Earth bond test of Class I appliances

For Class I appliances the test voltage is applied between PE terminal (L and N line are of no importance) and Earth Bond clip.

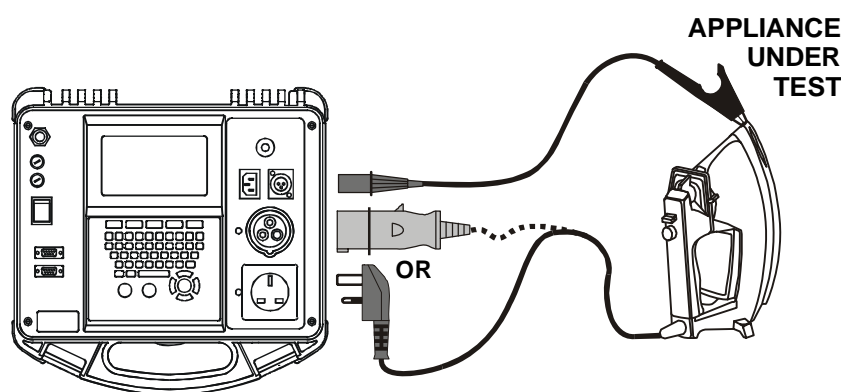


Fig. 4.6 Connection for Class I appliance

#### Earth Bond test of IEC leads

When testing IEC leads, the lead end should be connected to the IEC CORD terminal. This is convenient when performing a complete IEC CORD test (no need for reconnection during test, no need for adapters).

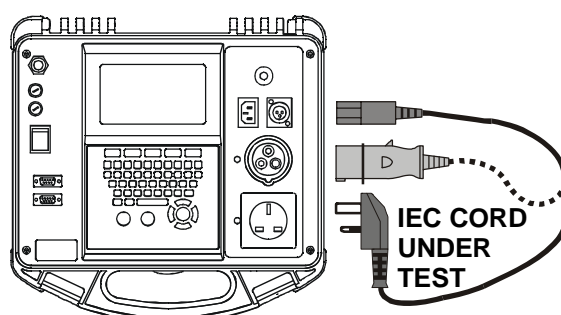
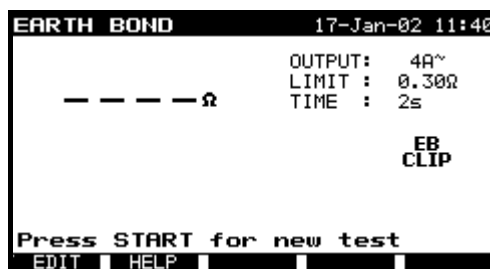


Fig. 4.7 Earth bond test of IEC cord



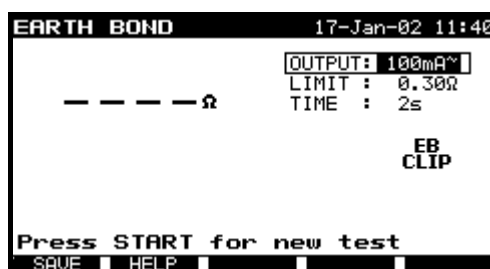
**How to carry out single Earth Bond resistance measurement:**

- STEP 1.** In the MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select EARTH BOND and confirm with the ENTER key.



*Fig. 4.8 Earth bond test initial display*

- STEP 3.** The parameters of the measurement are detailed in the upper right corner of the display. To change these parameters, first press the F1 (EDIT) key and then use cursor keys to set relevant parameters. The selected limit is changed with the UP and DOWN keys, movement between parameters is possible with the LEFT and RIGHT keys. To save new limits press the F1 (SAVE) key. The test can now be performed.



*Fig. 4.9 Selection of test current*

- STEP 4.** Press START key to perform the test.
- STEP 5.** PASS/FAIL result is shown on the display. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.

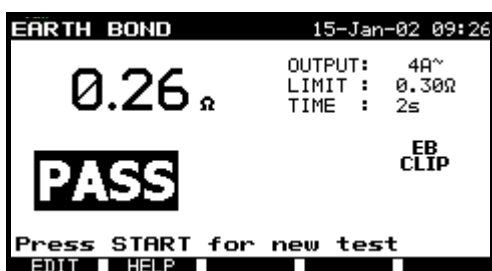


Fig. 4.10 Good result example

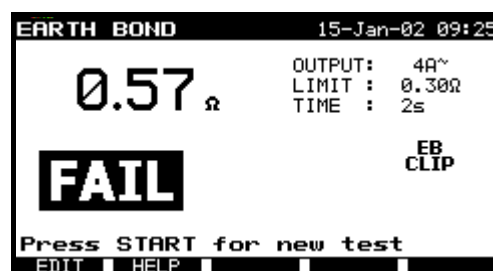


Fig. 4.11 Bad result example

The test can be aborted with the STOP key at any time, but in such case there is no PASS / FAIL decision.

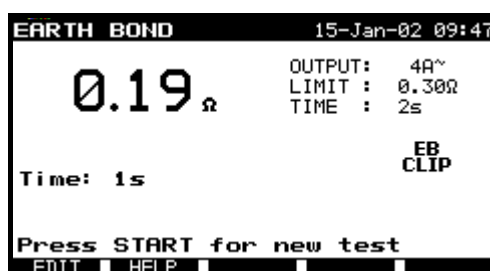


Fig. 4.12 Indication of aborted measurement

#### Note:

- Consider any warning on the display (see Chapter 2.2) before starting measurement.

### 4.3.2. Insulation test

The purpose of this test is to ensure that the insulation resistance between the live conductors and the earth or metal parts of an appliance is within allowed limits. The test voltage, resistance limit, duration of measurement and number of measurements are selectable according to requirements.

Check to ensure that the appliance under test does not contain any over voltage protection device, otherwise incorrect results could be obtained.

#### Insulation test of Class I appliances

For Class I appliances the test voltage is applied between the live pins (L and N are shorted together in the tester) and the earth pin in an appliance mains plug.

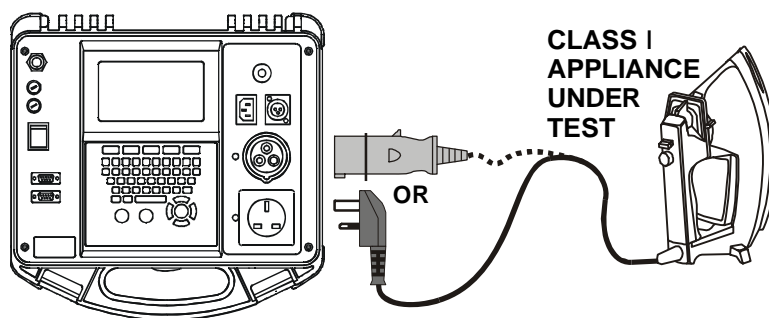


Fig. 4.13 Connection of Class I appliance

**Insulation test of Class II appliances**

For Class II appliances (and non-earthed parts of Class I appliances), the test voltage is applied between the live pins (L and N lines are shorted together in the tester) and the earth bond test clip that is attached to the metal parts of the appliance. Before testing, check that the test will not cause any damage to the appliance.

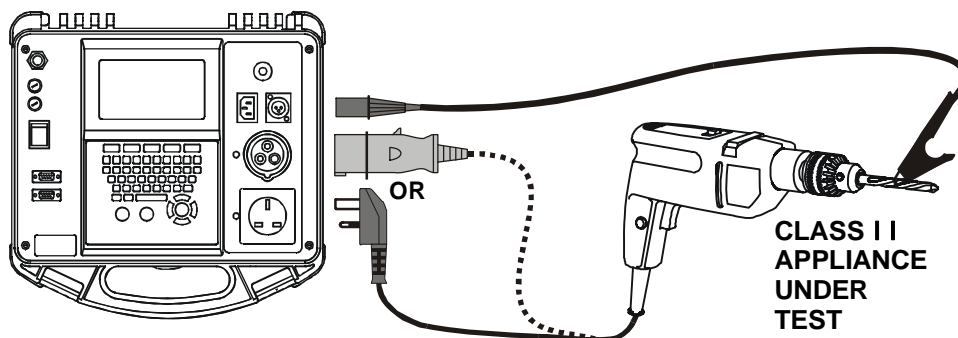


Fig. 4.14 Connection of Class II appliance

**Insulation test of IEC leads**

When testing IEC leads, the lead's end can be connected to the IEC CORD terminal. This is recommended when performing a complete IEC CORD test (no need for reconnection during test).

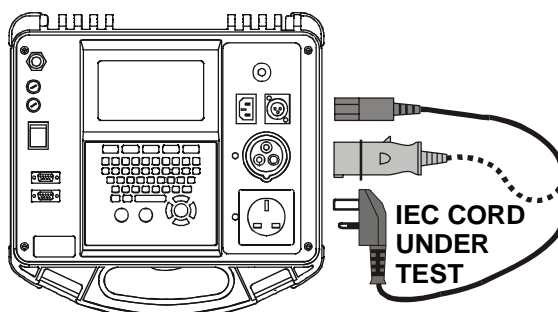


Fig. 4.15 Insulation test of IEC cord

**How to carry out single Insulation resistance measurement:**

- STEP 1.** In MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select INSULATION and confirm with the ENTER key.
- STEP 3.** The parameters of the measurement are detailed in the upper right corner of the display. To change these parameters first press the F1 (EDIT) key and then use cursor keys to set required parameters. The highlighted limit is changed with the UP and DOWN keys, movement between parameters is possible with the LEFT and RIGHT keys. To save new limits press the F1 (SAVE) key. The test can now be performed.



Fig. 4.16 Insulation test initial display

- STEP 4.** Press the START key to perform test.
- STEP 5.** PASS/FAIL result is shown on the display. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.



Fig. 4.17 Good result of insulation test



Fig. 4.18 Bad result of insulation test

The test can be aborted with the STOP key at any time, but in such case there is no PASS / FAIL decision.

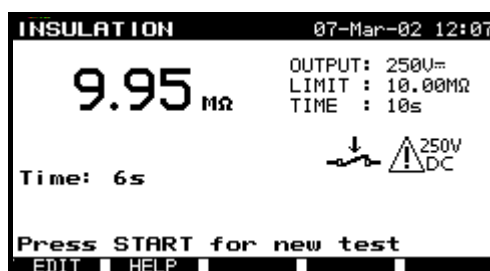


Fig. 4.19 Indication of aborted measurement

#### Notes:

- The appliance under test should be de-energized before the test.
- Consider any warning on the display (see Chapter 2.2) before starting measurement.
- Do not touch the equipment under test during the test or before it is fully discharged. The message “Discharging” is on display whilst the voltage on equipment under test is higher than 30 V.
- Do not disconnect the equipment under test from the instrument during the measurement or before it is automatically discharged.

### 4.3.3. Substitute leakage test

The purpose of this test is to predict the leakage current at nominal mains voltage and to avoid danger for both the operator and the appliance under test where there is a faulty insulation or a connection between PE and mains. Substitute leakage current is measured at a nominal voltage of 40 V<sub>AC</sub> and is scaled to a nominal mains voltage (115 V<sub>AC</sub> or 230 V<sub>AC</sub>).

In some cases, when large suppression capacitors are connected between L and PE line, substitute leakage current can differ from conventional leakage current.

#### Substitute leakage current test of Class I appliances

For Class I appliances, test voltage is applied between mains lines (L and N lines are shorted together in the tester) and ground line.

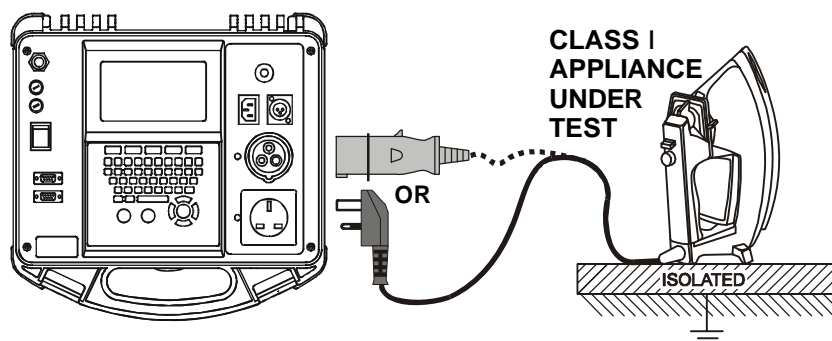


Fig. 4.20 Substitute leakage current test connection for Class I appliance

## Substitute leakage current test of Class II appliances

For Class II appliances earth bond test clip is used as a substitute for PE. Ensure that the connected metal part is not in contact with external ground connection (see picture).

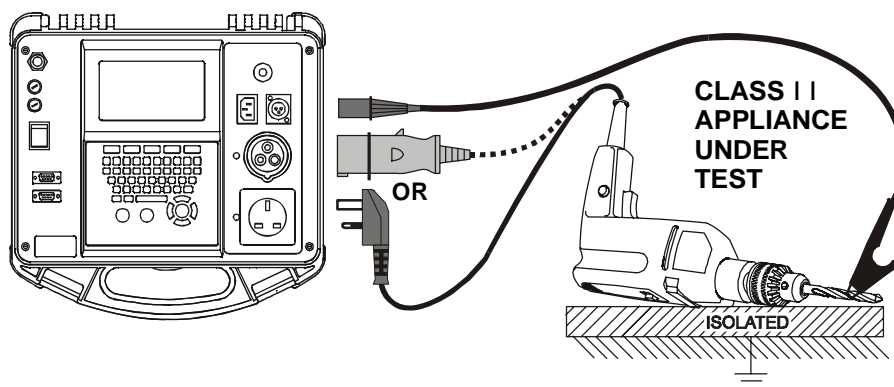


Fig. 4.21 Substitute leakage current test connection for Class II appliance

### How to carry out single Substitute leakage current measurement:

- STEP 1.** In the MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select SUB LEAKAGE and confirm with the ENTER key.
- STEP 3.** The parameters of the measurement are detailed in the upper right corner of the display. To change these parameters first press the F1 (EDIT) key and then use cursor keys to select the required parameter. The highlighted limit is changed with the UP and DOWN keys, movement between parameters is possible with the LEFT and RIGHT keys. To save new limits press the F1 (SAVE) key. The test can now be performed.

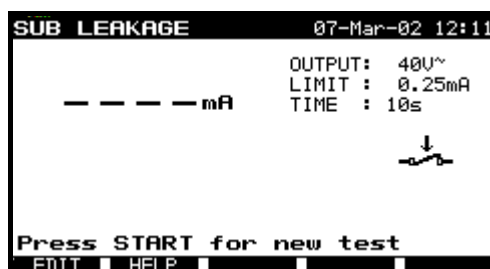


Fig. 4.22 Substitute leakage current initial display

- STEP 4.** Press the START key to perform test.
- STEP 5.** PASS / FAIL result is shown on the display. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.



Fig. 4.23 Good result of substitute leakage current test

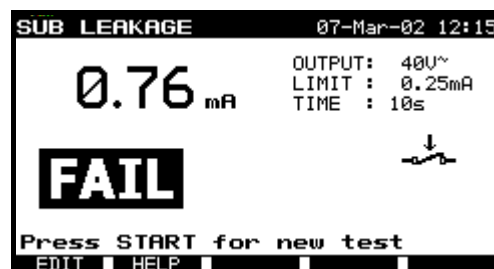


Fig. 4.24 Bad result of substitute leakage current test

The test can be aborted with the STOP key at any time, but in such case there is no PASS / FAIL decision.

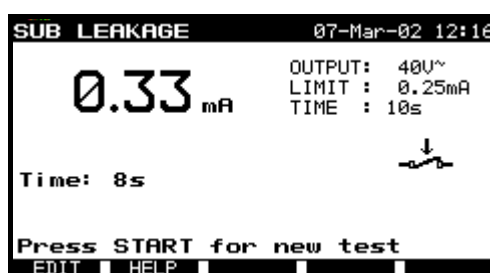


Fig. 4.25 Display of aborted substitute leakage current test

**Note:**

- Consider any warning on the display (see Chapter 2.2) before starting measurement.

#### 4.3.4. Flash test (MI2140 only)

The purpose of this test is to ensure that the insulation strength is high enough to prevent breakdown. Insulation strength becomes significant when high transient voltages are present on the mains supply.

Before applying the test, check that the components in the appliance can withstand test voltage. IT appliances are especially sensitive.

Before testing, check that the test will not cause any damage to the appliance.

#### Flash test of Class I appliances

For Class I appliances the test voltage (1.5 kV<sub>AC</sub>) is applied between the live pins (L and N are shorted together in the tester) and the PE pin in an appliance mains plug.

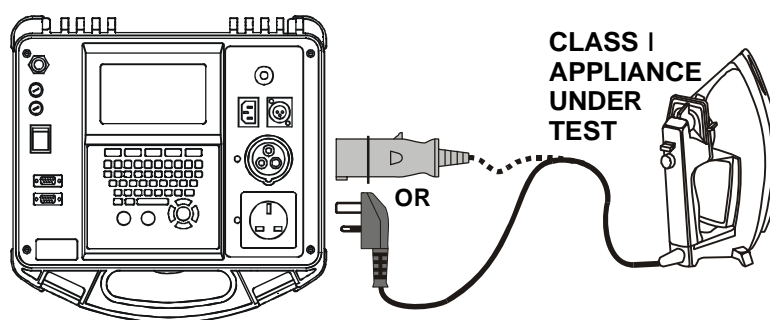


Fig. 4.26 Flash test connection for Class I appliance

### Flash test of Class II appliances

For Class II appliances the test voltage ( $3\text{ kV}_{AC}$ ) is applied between mains pins (L and N are shorted together in the tester) and the flash probe tip.

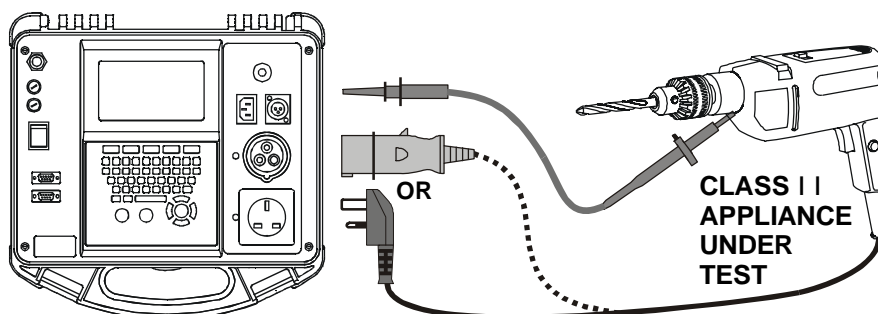


Fig. 4.27 Flash test connection for Class II appliance

### How to carry out single Flash measurement:

- STEP 1.** In the MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select FLASH and confirm with the ENTER key.
- STEP 3.** The parameters of the measurement are detailed in the upper right corner of the display. To change these parameters first press the F1 (EDIT) key and then use cursor keys to select the required parameter. The highlighted limit is changed with the UP and DOWN keys, movement between parameters is possible with the LEFT and RIGHT keys. To save new limits press the F1 (SAVE) key. The test can now be performed.





Fig. 4.28 Flash test initial display

**STEP 4.** Press the START key to perform test. A trip out occurs if the current exceeds the set limit, followed by a 3 seconds buzzer warning.

**STEP 5.** PASS / FAIL decision is shown on the display. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.



Fig. 4.29 Flash test good result example



Fig. 4.30 Flash test bad result example

The test can be aborted with the STOP key at any time, but there is no PASS / FAIL decision.

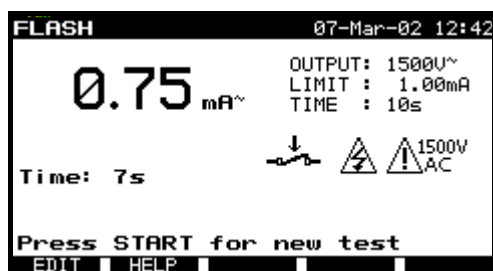


Fig. 4.31 Display of aborted flash test

#### Notes:

- Consider any warning on the display (see Chapter 2.2) before starting measurement.
- Do not touch the equipment under test or the test leads during the test – dangerous voltage is present.

### 4.3.5. Leakage current and Power test

The purpose of this test is to determine the loss of L to N current into PE. Leakage current is the difference between the current in L and N mains lines.

Regardless of whether the current leaks into the earth lead or an extra ground point, the leakage test will show the true leakage current.

Also the Power consumption of the appliance is shown.

#### Leakage current and Power test of Class I appliances

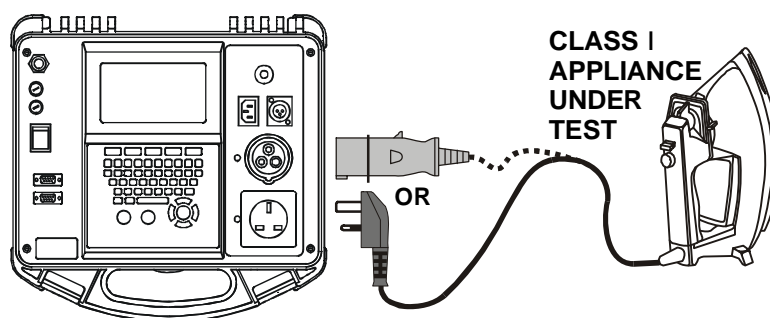


Fig. 4.32 Connection of Class I appliance for leakage current and power test

#### Leakage current and Power test of Class II appliances

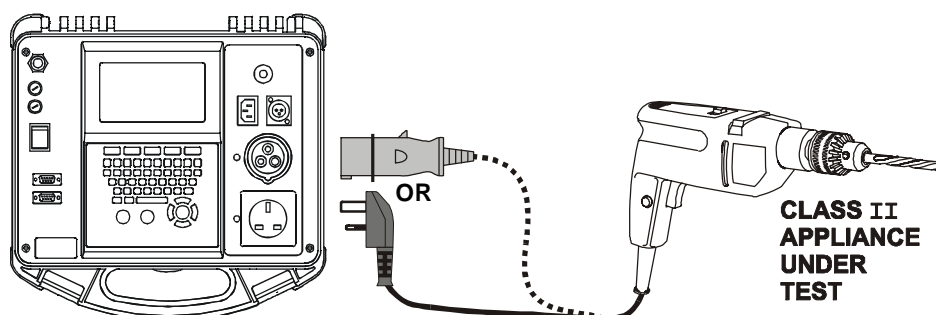


Fig. 4.33 Connection of Class II appliance for leakage current and power test

#### How to carry out single Leakage current and Power measurements:

- STEP 1.** In the MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select LEAKAGE and confirm with the ENTER key.
- STEP 3.** The parameters of the measurement are detailed in the upper right corner of the display. To change these parameters first press the F1 (EDIT) key and then use cursor keys to set the required parameter. The highlighted limit is changed with the UP and DOWN keys, movement between parameters is possible with the LEFT and RIGHT keys. To save new limits press the F1 (SAVE) key. The test can now be performed.

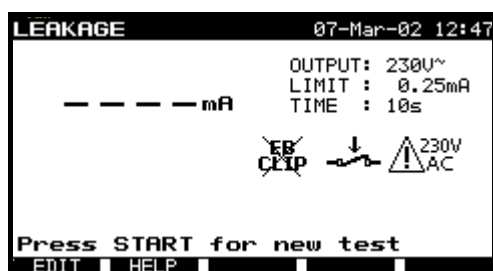


Fig. 4.34 Leakage current and power test initial display

**STEP 4.** Press the START key to perform test.

**STEP 5.** PASS/FAIL result is shown on the display. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.



Fig. 4.35 Good result example for leakage current and power test



Fig. 4.36 Bad result example for leakage current and power test

The test can be aborted with the STOP key at any time, but in such case there is no PASS / FAIL decision.



Fig. 4.37 Display of aborted leakage current and power test

#### Notes:

- The appliance is connected to mains – hazardous voltage. Make sure that if the tested appliance has any moving parts it is safely mounted or protected to prevent possible danger to operator or damage to the appliance.
- Consider any warning on the display (see Chapter 2.2) before starting measurement.
- Before performing the full test a pre-test is carried out using a low voltage to ensure that the appliance can be safely powered up. These tests check for any possible leakage current and resistance between L and N. If the potential current (into PE or between L and N) is too high, a warning sign as shown in chapter 2.2. is displayed.

### 4.3.6. Touch leakage current

The purpose of this test is to check what level of current would flow to ground if a person touches a metal part of an appliance. The human body is simulated with a 2 k $\Omega$  resistor.

The Earth Bond clip is used as the test probe.

#### Touch leakage current test of Class I appliances

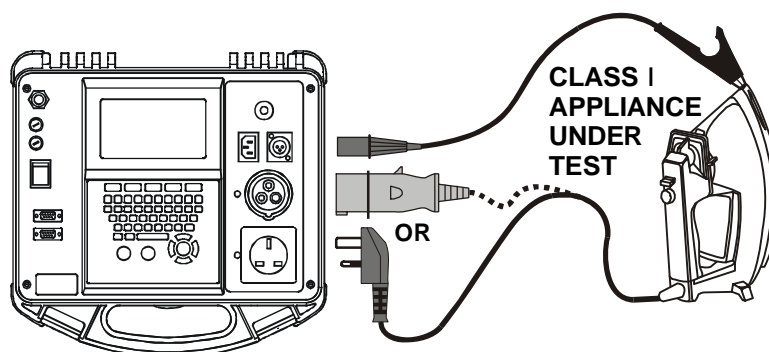


Fig. 4.38 Connection for touch leakage test of Class I appliance

#### Touch leakage current test of Class II appliances

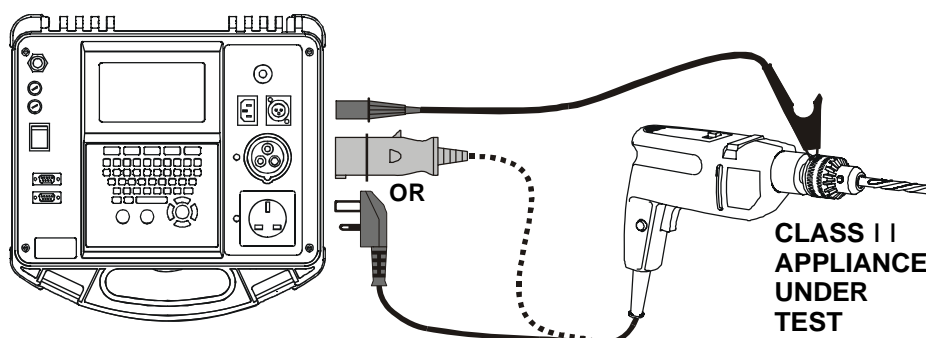


Fig. 4.39 Connection for touch leakage test of Class II appliance

#### How to carry out single Touch leakage current measurements:

- STEP 1.** In the MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select TOUCH LEAKAGE and confirm with the ENTER key.
- STEP 3.** The parameters of the measurement are detailed in the upper right corner of the display. To change these parameters first press the F1 (EDIT) key and then use cursor keys to select the required parameter. The highlighted limit is changed with UP and DOWN keys, movement between parameters is possible with LEFT and RIGHT keys. To save the new limits press the F1 (SAVE) key. The test can now be performed.

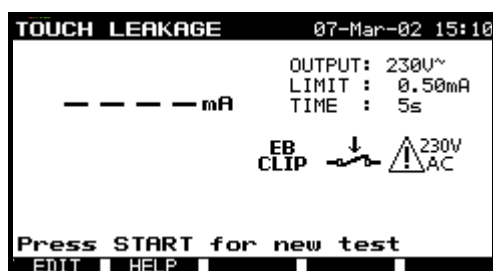


Fig. 4.40 Touch leakage test initial display

**STEP 4.** Press the START key to perform test.

**STEP 5.** PASS / FAIL result is shown on the display. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.



Fig. 4.41 Good result example of touch leakage test



Fig. 4.42 Bad result example of touch leakage test

The test can be aborted with STOP key at any time, but in such case there is no PASS / FAIL decision.

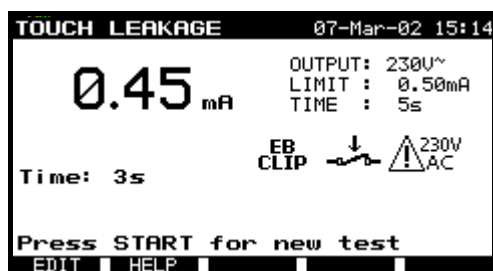


Fig. 4.43 Display of aborted touch leakage current test

**Notes:**

- The appliance is connected to mains – hazardous voltage. Make sure that if the tested appliance has any moving parts it is safely mounted or protected to prevent possible danger to operator or damage to the appliance.
- Consider any warning on the display (see Chapter 2.2) before starting measurement.
- Before performing the full test a pre-test is carried out using a low voltage to ensure that the appliance can be safely powered up. These tests check for any possible leakage current and resistance between L and N. If the potential current (into PE or between L and N) is too high, a warning sign as shown in chapter 2.2. is displayed.

### 4.3.7. Polarity test

The purpose of this test is to check the continuity and polarity of the mains supply cable. Following faults are detected: L-PE shorted, N-PE shorted, L-N shorted, L open, N open, PE open, N-PE crossed, L-PE crossed, L-N crossed, multiple fault.

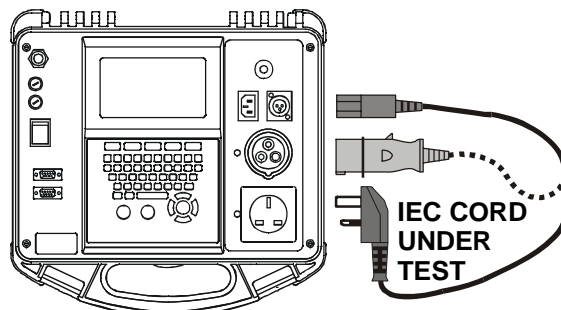


Fig. 4.44 Connection of IEC cord for polarity test

#### How to carry out Polarity test:

- STEP 1.** In the MAIN MENU window select SINGLE TEST and confirm with the ENTER key.
- STEP 2.** In the SINGLE TEST window select POLARITY and confirm with the ENTER key.



Fig. 4.45 Polarity test initial display

- STEP 3.** Press the START key to perform test.
- STEP 4.** PASS / FAIL result is shown on the display. In case of a FAIL result explanation is displayed under the decision. Repeat the test with the START key or return to SINGLE MODE main screen with the ESC key.



Fig. 4.46 Good result of polarity test



Fig. 4.47 Bad result of polarity test

**Note:**

- Consider any warning on the display (see Chapter 2.2) before starting measurement.

## 4.4. Autotest

Autotest is the fastest and easiest way to test and certify appliances. A pre-programmed sequence leads the user through the tests needed for verifying the appliance. Different pre-programmed test procedures can be selected in each of the two autotest menus.

## 4.5. Autotest - shortcut

In this menu the user can choose between over 120 types of preselected test procedures. The preprogrammed sequences covers practically all in-service tests, regardless of appliance type, class, supply cord length, fuse size, etc.

All limits and tests are in accordance with currently valid standards and regulations. In case of any changes new firmware (with new standards and limits) is available on-line at your distributor or from Metrel directly.



Fig. 4.48 Example for Autotest of appliance



Fig. 4.49 Example for Autotest of extension cord

The AUTOTEST SHORTCUT can be easily selected:

- by setting the few displayed parameters,
  - by entering the three number autotest code,
  - by using the barcode reader,
- and then started with the START key.

Two autotest shortcut examples are shown in the pictures above.

The complete list of measurements and codes can be found in Appendix 1 at the end of this manual.

For operation of a barcode reader see chapter 5.2.

#### APPLIANCE TYPE

- Portable or Handheld Appliances
- IT (Information Technology) equipment (EN60950)
- Heating and Cooking Appliances
- Other appliances
- Extension leads

Most electrical appliances belong to one of these types. The tests and limits differ slightly depending on the specific regulation.

In general the following tests have to be performed during an in service test:

Class I equipment: VISUAL CHECK, EARTH BOND TEST, INSULATION TEST, FUNCTIONAL TEST.

Class II equipment: VISUAL CHECK, INSULATION TEST, FUNCTIONAL TEST.

#### Notes:

- For portable and handheld appliances the Leakage (or Touch Leakage) limits are stricter than for other types.
- For IT equipment the Earth Bond test is performed with low current (100 mA) in order to avoid any damage to earth connections for EMC (screening) purposes.
- For cooking and heating appliances the Leakage limit is set higher because some of leakage typically occurs in the heating elements. Therefore the substitute leakage test is performed instead of insulation test.
- Only three conductor extension leads are considered and they are tested as a Class I appliance. When testing them the Functional test and the Polarity test are performed.
- The IT equipment must conform to the EN60950 regulation. Otherwise the equipment may be damaged during the insulation test!

#### APPLIANCE CLASS

- Class I
- Class II

#### SUPPLY CORD

- Short
- Middle (or low c.s.a)
- Long

#### Notes:

- The Earth Bond limit depends significantly on the supply cord length and its PE wire cross-section.
- SHORT should be set for appliances with a cord not longer than 5 m.
- MEDIUM can be used when the appliance's supply cord is longer than 5 m or the cord's wire has a small cross-section.



- LONG can be used if the appliance has a very long supply cord (for instance, for vacuum cleaners the cord is longer than 15 m).

**APPLIANCE FUSE**

3 A (750 VA), 6 A (1.5 kVA), 10 A (2.5 kVA), 13 A (3.2 kVA)

**Notes:**

- The Earth Bond test current depends on the set fuse rating of appliance. The current is always at least 1.5 times higher than the fuse rating.
- The power (in brackets) means the maximum power that can be delivered in combination with the set fuse. Some users are more familiar with the nominal power than the fuse size.
- Substitute Leakage and Leakage current limits (in Heating and cooking) are set according to the set power.

**FUNCTIONAL TEST / PROTECTIVE EARTH TEST**

YES, NO

**Notes:**

- A functional test should be performed at the end of the test sequence to assure that the appliance works properly. This test can also be performed without the measuring instrument.
- However it is a good practice to perform this test with the OmegaPAT or BetaPAT, because it makes more tests simultaneously: the functional check, the Protective Earth test and Load test.

Extension leads test only:

**LENGTH**

<5 m, 7.5 m, 10 m, 12 m, 15 m, 20 m, 30 m, 40 m, 50 m

**CROSS-SECTION AREA (c.s.a.)**

0.5 mm<sup>2</sup>, 0.75 mm<sup>2</sup>, 1.0 mm<sup>2</sup>, 1.25 mm<sup>2</sup>, 1.5 mm<sup>2</sup>, unknown

**MAXIMUM CURRENT CAPABILITY, POWER (I<sub>max</sub> / Power)**

3 A / 750 VA, 6 A / 1.5 kVA, 10 A / 2.5 kVA, 13 A / 3.2 kVA, 15 A / 3.75 kVA, unknown

**Notes:**

- If the cross-section area is unknown the most conservative (as for 1.5mm<sup>2</sup>) limit is set.
- The I<sub>max</sub> / Power is only informative. It provides the maximal current capability and power depending on the lead's c.s.a.

## CODE

Each of the possible test combinations has its own three-number code. By entering the three-digit code the appropriate test will be set.

The parameters of the selected autotest (enabled tests, limits, and duration) can be viewed by pressing the F1 (VIEW) key.

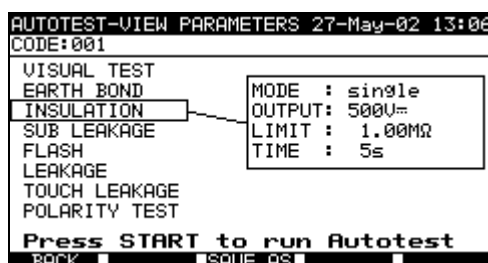


Fig. 4.50 Autotest parameter verification

By pressing the UP and DOWN keys the settings (function enabled/disabled, duration, limit) for individual functions can be seen in a frame in the right part of the display.

**Unlike in the AUTOTEST CUSTOM menu the settings cannot be saved or altered.** Refer to chapter 4.6 for more information.

When pressing the F3 (SAVE AS) key it is possible to copy the settings (parameters) in the AUTOTEST CUSTOM menu where the test data can be changed and renamed (refer to chapter 4.6 for further information).

When pressing the F1 key (BACK) the instrument returns to the main AUTOTEST SHORTCUT menu.

The autotest can be started directly from both described menus.

### Note:

- It could happen that none of the offered autotests in this menu corresponds (for instance when testing against stricter limits in end of production line testing or after repair testing, if performing flash tests etc). In this case it is recommended to use the AUTOTEST – CUSTOM menu. From this menu, any autotest combination can be set (see chapter 4.6).

## 4.6. Autotest – custom

In the autotest – custom the user can set his own test procedures, store and name them in a list.

When setting this option the AUTOTEST – CUSTOM main menu will be displayed.

If more than one procedure is stored they can be selected with the UP and DOWN keys. The selected procedure will be shown in a frame. The selection is confirmed with the ENTER key.



Fig. 4.51 Example of preparing custom test

The parameters of the selected procedure (enabled tests, limits, and duration) can be viewed by pressing the F1 (VIEW) key.

By pressing the UP and DOWN keys individual measurement settings (function enabled/disabled, duration, limit) can be seen in the right of the display.

### Viewing / changing of custom test procedures:

Pressing the F4 (EDIT) key enables changing of parameters:

#### MODE

Disabled, Single, Continuous

In Disabled is set the function will be skipped in autotest.

In Single (Enabled in Visual Test) the test will be performed once in the autotest.

If Continuous is set more than one of the selected tests can be performed. During the autotest the user will be asked whether to make a new test (of the same measurement) or proceed to the next function.

#### OUTPUT

Test voltages and currents can be set here, depending on the selected measurement.

#### LIMIT

Test limits can be set here, depending on the selected measurement.

#### TIME

Test durations can be set here, depending on the selected measurement.

New settings can be confirmed with the F1 (CONFIRM) key. If not saved the changes will stay only for one (next) autotest. Setup can be exited without any change by using the ESC key.

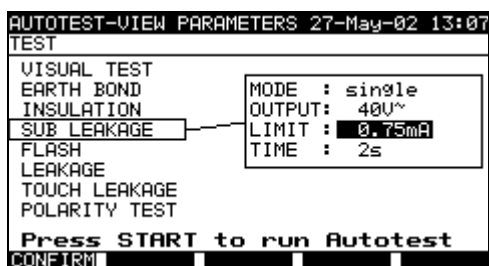


Fig. 4.52 Parameter modification example of selected autotest

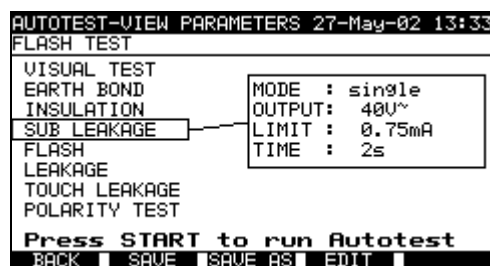


Fig. 4.53 Confirmed parameters

### Adding a new custom test procedure to the list

By pressing the F3 (SAVE AS) key it is possible to save the selected settings (parameters) and adding them to the end of the list in autotest – custom main menu. The instrument will ask for the name. The entered name is confirmed with the F1 (SAVE) key. The old name can be recalled with the F2 (UNDO) key.

### Changing / renaming of existing custom test procedures

When pressing the F2 (SAVE) key it is possible to save the selected settings (parameters). The instrument will ask for the name. The existing name can be left or changed. The entered name is confirmed with the F1 (SAVE) key. The old name can be recalled with the F2 (UNDO) key.

### Deleting of existing custom test procedures

When pressing the F3 (DELETE) key in the main autotest – custom menu the selected test procedure will be deleted. The instrument will ask for confirmation.

#### Notes:

- The test in the first line of the list cannot be deleted.
- The autotest can be started directly from both described menus (Main and Parameters-View).

## 4.7. Performing of autotests

The following actions can be taken during any measurement:

- F5 (END) key: end appliance test  
 F4 (SKIP) key: skip (do not perform) the selected test  
 START key: entering the autotest or proceed with next function\* or perform a new test  
 F3 (REPEAT) key: repeat the measurement (except in visual check)  
 STOP key: abort the measurement  
 ENTER key: proceed with next function\*\*

\*) if single mode is selected

\*\*\*) if continuous mode is selected

If the measurement is skipped (before the measurement, after aborting it or after completion) it will be internally treated as a FAIL result (to assure safety for the user). If a FAIL result is given (due to a FAIL or skipped Earth Bond/Insulation/Substitute Leakage test) the Flash/Leakage/Touch leakage measurements will be skipped to ensure safety. The Polarity test will be performed in any case.

### Visual check

The purpose of a visual check is to identify any visual damage to the case or cable of an appliance. The external casing of the appliance must be carefully checked. Check also that the mains fuse is the correct rating for the appliance.

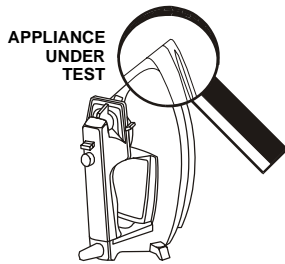


Fig. 4.54 Appliance inspection

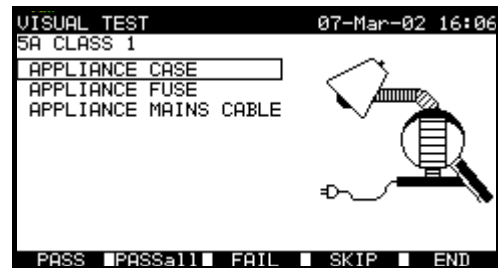


Fig. 4.55 Items of appliance inspection

Check the required points and confirm correct result with function keys F1 to F5. If everything is in good order the user can confirm all items with F2 (PASSall) key.

### Earth bond measurement

Check the connections and consider the warnings on the display (EB CLIP, appliance switched on). If testing an IEC lead connect the lead end to the IEC terminal.

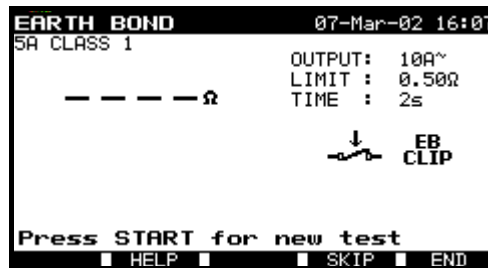


Fig. 4.56 Earth bond test waiting for right connection

After performing the measurement one of the following displays will be shown indicating the result.

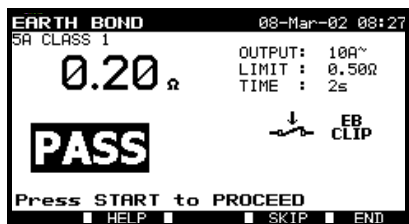


Fig. 4.57 Good result

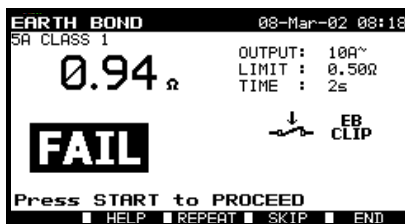


Fig. 4.58 Bad result

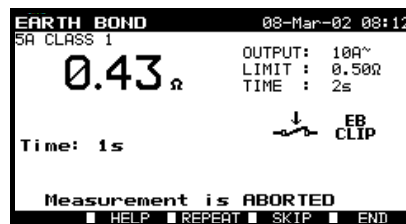


Fig. 4.59 Aborted test

If the test passes, the instrument automatically proceeds with the Insulation test or Substitute Leakage test (if applied and if in single mode).

Pressing the START key will move to the next function (single mode) or a new earth bond test (continuous mode).

Pressing the F2 (HELP) key will display the HELP menu.

Pressing the F3 (REPEAT) key will repeat the test

Pressing the F4 (SKIP) key will skip the test and move to the next test.

Pressing the F5 (END) key will end (abort) the test.

### Insulation measurement

Consider any displayed warnings (output voltage, appliance switched on). If testing a Class II appliance use the earth bond clip as the second measurement probe.

If testing an IEC lead, connect the lead end to the IEC lead terminal.

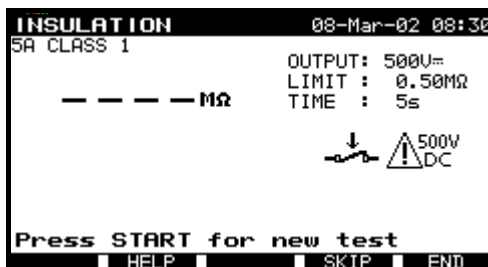


Fig. 4.60 Insulation test waiting for right connection

After performing the measurement one of the following displays will be shown indicating the result.

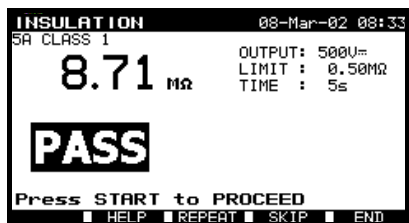


Fig. 4.61 Good result



Fig. 4.62 Bad result

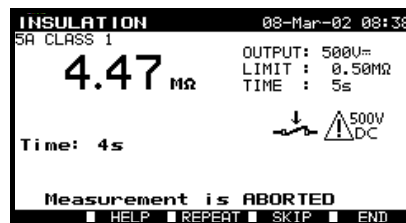


Fig. 4.63 Aborted test

If the test passes, the instrument automatically proceeds with Substitute Leakage test (if applied and if in single mode).

Pressing the START key will move to the next function (single mode) or a new insulation test (continuous mode).

Pressing the F2 key will display the HELP menu.

Pressing the F3 key will repeat the test.

Pressing the F4 key will skip the test and move to the next test.

Pressing the F5 key will end (abort) the test.

### Substitute leakage test

Consider any displayed warnings (switch appliance on). If testing a Class II appliance use the earth bond clip for the second measurement probe.

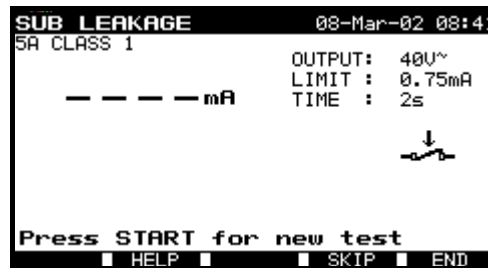


Fig. 4.64 Substitute leakage current test waiting for right connection

After performing the measurement one of the following displays will be shown indicating the result.

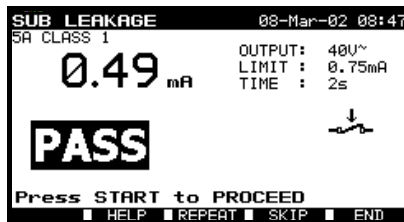


Fig. 4.65 Good result

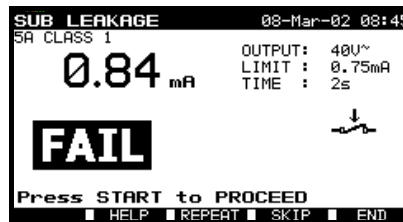


Fig. 4.66 Bad result

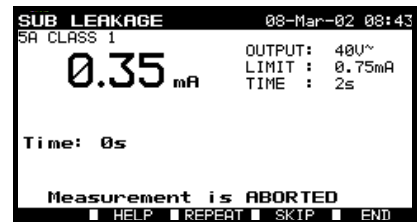


Fig. 4.67 Aborted test

Pressing the START key will move to the next function (single mode) or a new subleakage test (continuous mode).

Pressing the F2 key will display the HELP menu.

Pressing the F3 key will repeat the test.

Pressing the F4 key will skip the test and move to the next test.

Pressing the F5 key will end (abort) the test.

### Flash test (MI2140 only)

This test is only allowed if the previous measurements (Insulation / Earth Bond / Substitute Leakage) have passed. If any one of them has failed or been skipped the measurement is skipped.

Consider any displayed warnings (Dangerous - HIGH output voltage, switch appliance on).

If testing a Class II appliance use the Flash probe as the second measurement probe.



Fig. 4.68 Flash test waiting for right connection

After performing the measurement one of the following displays will be shown indicating the result.



Fig. 4.69 Good result



Fig. 4.70 Bad result

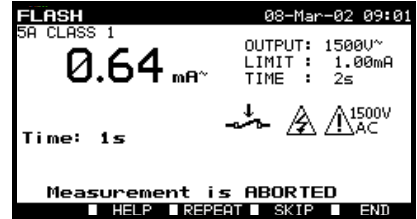


Fig. 4.71 Aborted test

The test can only proceed if the Flash test has passed. If not the appliance test is finished.

Pressing the START key will move to the next function (single mode) or a new flash test (continuous mode).

Pressing the F2 key will display the HELP menu.

Pressing the F3 key will repeat the test.

Pressing the F4 key will skip the test and move to the next test.

Pressing the F5 key will end (abort) the test.

### Leakage current and power test

This test is only allowed if previous measurements (Insulation / Earth Bond / Substitute Leakage/Flash) have passed. If any one of them has failed or been skipped the measurement is skipped.

Consider any displayed warnings (mains output voltage, switch appliance on, remove EB CLIP').

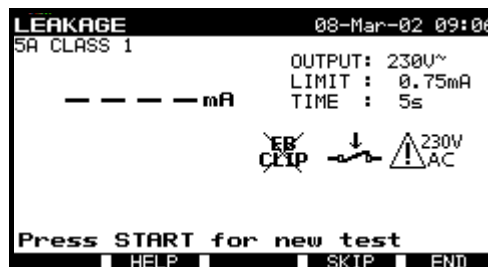


Fig. 4.72 Leakage current test waiting for right connection

After performing the measurement one of the following displays will be shown indicating the result.





Fig. 4.73 Good result



Fig. 4.74 Bad result

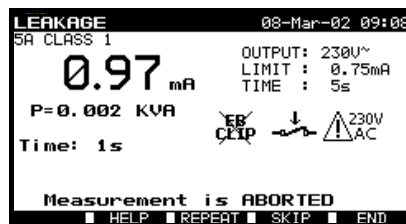


Fig. 4.75 Aborted test

The test can only proceed if the Leakage/Power test has passed. If not the appliance test is ended.

Pressing the START key will move to the next function (single mode) or a new leakage test (continuous mode).

Pressing the F2 key will display the HELP menu.

Pressing the F3 key will repeat the test.

Pressing the F4 key will skip the test and move to the next test.

Pressing the F5 key will end (abort) the test.

### Touch leakage current

The test can only proceed if the previous measurements (Insulation / Earth Bond / Substitute Leakage/Flash/Leakage) have passed. If at least one of them has failed or been skipped the measurement is skipped.

Consider any displayed warnings (mains output voltage, appliance switched on, use EB CLIP).

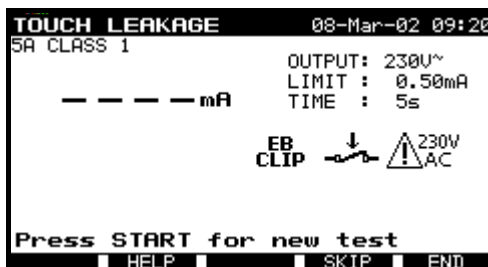


Fig. 4.76 Touch leakage current test waiting for right connection

After performing the measurement one of the following displays will be shown indicating the result.



Fig. 4.77 Good result



Fig. 4.78 Bad result

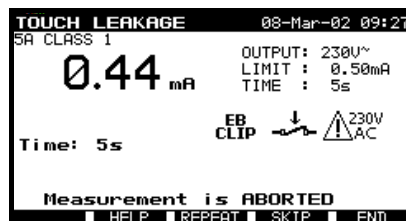


Fig. 4.79 Aborted test

Pressing the START key will move to the next function (single mode) or a new touch leakage test (continuous mode).

Pressing the F2 key will display the HELP menu.

Pressing the F3 key will repeat the test.

Pressing the F4 key will skip the test and move to the next test.

Pressing the F5 key will end (abort) the test.

Continuation is allowed only if the Touch Leakage test has passed. If not the appliance test is ended.

## Polarity



Fig. 4.80 Waiting for cord connection

After performing the measurement one of the following displays will be shown indicating the result.

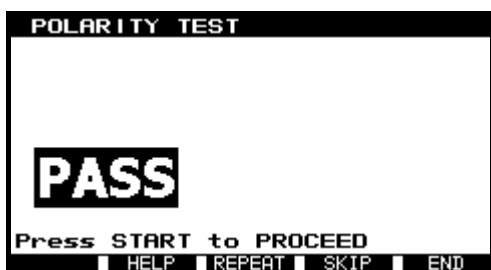


Fig. 4.81 Good result

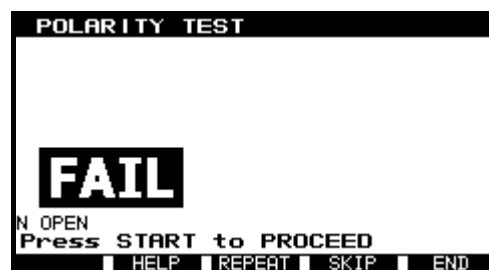


Fig. 4.82 Bad result

Pressing the START key will end the test.


Pressing the F2 key will display the HELP menu.

Pressing the F3 key will repeat the test.

Pressing the F5 key will end (abort) the test.

## 4.8. Storing autotest results

After completing the appliance test the SAVE RESULT display will appear.



```
SAVE RESULT                                09-APR-02 10:44
-----
APPLIANCE No.: 1234567
  BUILDING:  FACTORY
    ROOM:   OFFICE
    USER:  ANYNAME
-----
APPLIANCE NAME: IRON
RETEST PERIOD :
REPAIRING CODE:
COMMENTS :
-----
SAVE  UNDO  SEND  VIEW  LIST
```

*Fig. 4.83 Save result menu*

By using the keyboard the user can enter all relevant details, such as number and name of appliance, building, room, repair code and desired comments (the user is predefined in the EDIT USERS menu – see chapter 5.3). To select the required line, use the UP and DOWN keys.

Pressing the F2 (UNDO) key will return the previous content in the selected data line.

By pressing the F5 (LIST) key the user can choose a name from predefined name lists.

### APPLIANCE NUMBER

Appliance number: any alphanumeric character can be used in this field. Appliance number can be read directly with a Bar Code Reader. This data is **obligatory** for storing any appliance test.

### BUILDING

Any alphanumeric character can be used in this field.

It is possible to choose building data from a pre-set list of buildings – SELECT BUILDING menu. Up to 60 predefined names can be pre-set in this menu.

### ROOM

Any alphanumeric character can be used in this field.

It is possible to choose data from a pre-set list of rooms – SELECT ROOM menu. Up to 60 predefined names can be pre-set in this menu.

### USER

The user is predefined in EDIT USERS menu – (see chapter 5.3).

### APPLIANCE NAME

Any alphanumeric character can be set in this line.

It is possible to choose the appliance data from a pre-set list of names – SELECT APPLIANCE menu. Up to 60 predefined names can be prepared in this menu.

### RETEST PERIOD

In retest period a predefined period for retesting of appliances can be entered.

### REPAIRING CODE

Repair code is a short, predefined code used in connection with some PC SW packages.

**COMMENT**

Any desired comments can be added in this field.

Pressing the F1 (SAVE) will save the measurements into memory. After saving the results the instrument returns to the PERFORM APPLIANCE TEST display.

Pressing the F3 (SEND): the instrument goes into SEND RESULTS menu. From this menu, the appliance test results can be printed out or downloaded to PC. Refer to chapter Recall/Delete/Send memory for more information.

Pressing the F4 (VIEW) key will display all results and data in the same format, as they will be stored.

Pressing the ESC key will return to the PERFORM APPLIANCE TEST display **without** saving the results.

**How to choose a name from the pre-set building/room/appliance list:**

An example of how to use pre-set appliance names is shown below. The procedure is identical for both buildings and rooms.

Press the F5 (LIST) key and select the name. Press the F1 (EDIT) key to change the set name. The new name is confirmed with the SAVE or cancelled with the UNDO key.



Fig. 4.84 Predefined appliance names

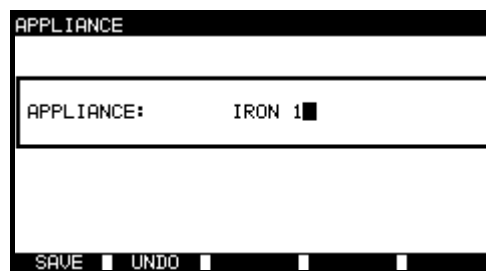


Fig. 4.85 Custom appliance name

## 5. Instrument operation

### 5.1. Setup

It is advisable to create some settings before starting to use the instrument. This is done in the SETUP function.

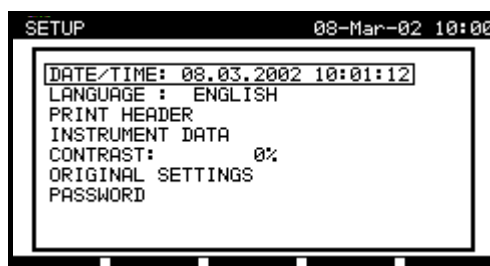


Fig. 5.1 Set-up menu

From the MAIN MENU window select SETUP and confirm with the ENTER key.

#### 5.1.1. Set date and time

Date and time are attached to the results in the memory.

Select DATE/TIME with the ENTER key. Date is highlighted and can be changed with the UP and DOWN keys, moving between the parameters is possible using the LEFT and RIGHT keys. To save the new limits, press the F1 (SAVE) key, with the F2 (UNDO) key it is possible to reset the previous value (in the case of a wrong entry) and using the ESC key leaves these settings unchanged.

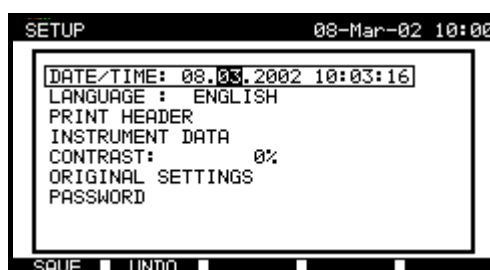


Fig. 5.2 Date / time setting

#### 5.1.2. Set language

Select LANGUAGE with the ENTER key and select the desired language with the UP and DOWN keys. To save the new language press the ENTER key, to leave these setting without any changes press the ESC key.

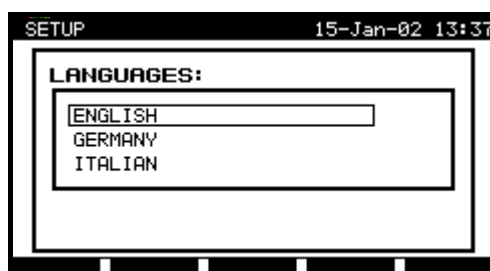


Fig. 5.3 Language selection

### 5.1.3. Set print header

Select PRINT HEADER with the ENTER key and change it by pressing the F1 (EDIT) key. Use the alphanumeric keyboard to enter all the desired data. Pressing the F1 (SAVE) key will save the data, by pressing the F2 (UNDO) key it is possible to reset the previous values and using the ESC key leaves these settings unchanged.

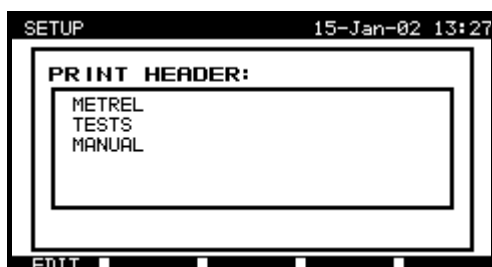


Fig. 5.4 Set-up of printing header



Fig. 5.5 Editing of printing header

### 5.1.4. Instrument data

In this menu the instrument data is shown. No changes are possible.

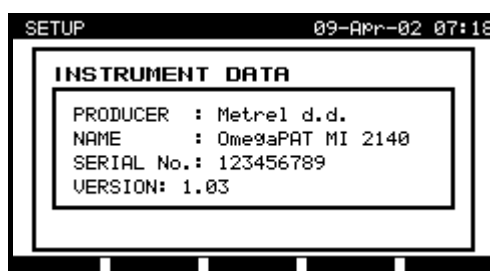


Fig. 5.6 Information of the instrument

### 5.1.5. Set Contrast

Select CONTRAST using the ENTER key. Percentage number is highlighted and by using the UP and DOWN keys the optimal contrast on the display can be set. To save new value press the F1 (SAVE) key. By pressing the F2 (UNDO) key it is possible to reset the previous value and using the ESC key leaves these settings without any changes.

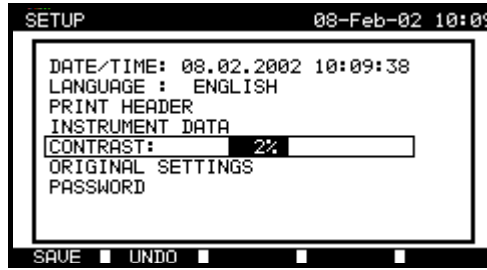


Fig. 5.7 Contrast modification

### 5.1.6. Original settings

In this menu the configuration can be reset to the values set when the tester was first purchased.  
 Select ORIGINAL SETTINGS with the ENTER key. By pressing the Y key the reset is confirmed, by pressing the N or ESC key the reset is cancelled.

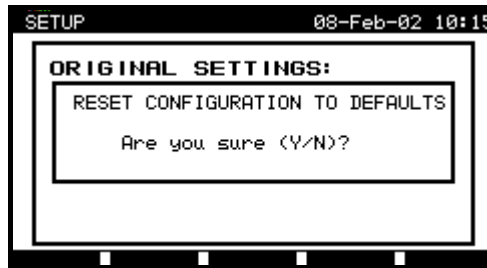


Fig. 5.8 Restoring original settings

Instrument settings and measurement parameters and limits are set to their initial values as follows:

Menu Sub-menu	Default setting(s)
<b>SINGLE TEST</b>	
Earth bond.....	Output: 25 A <sub>AC</sub> Limit: 0.30 Ω Time: 5 s
Insulation.....	Output: 250 V <sub>DC</sub> Limit: 10.00 MΩ Time: 5 s
Sub leakage.....	Limit: 0.25 mA Time: 5 s
Flash.....	Limit: 1.00 mA Time: 5 s
Leakage.....	Limit: 0.25 mA Time: 5 s
Touch leakage.....	Limit: 0.50 mA Time: 10 s
<b>AUTOTEST CUSTOM</b>	TEST1-TEST8, all measurements disabled
<b>EDIT USERS</b>	USER1-USER15

### 5.1.7. Password

In password protected actions it is necessary to insert the password before deleting or editing the protected data. The instrument requires a password and it will not allow changes unless the correct password is entered.

Select PASSWORD with the ENTER key.

The typed password is entered with the ENTER key and pressing the ESC key will leave these setting unchanged.

**Please take a note of this password and keep it in a safe place.**



Fig. 5.9 Entering a new password



Fig. 5.10 Confirmation of the new password

If there is no password protection the instrument will request that you enter a new password twice, once for confirmation.

If the instrument is already password protected, then the instrument will request the old password before entering the new one twice, once for confirmation.

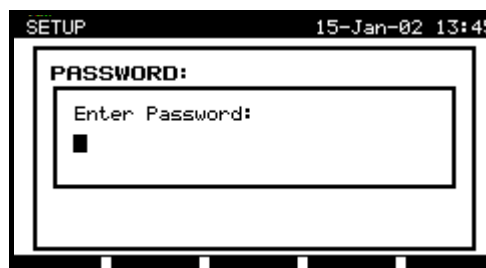


Fig. 5.11 Disabling existing password

To disable the password protection, instead of entering a new password just press the ENTER key when asked for a new password and confirmation and the password will be disabled.

If you forget the password, contact your dealer.

Password protected actions:

- Entering EDIT USER menu
- Entering EDIT MEASUREMENTS menu
- Deleting stored results
- Entering ORIGINAL SETTINGS menu



## 5.2. Autotests controlled by test code (use of barcode reader)

In the Autotest – Shortcut menu it is possible to set the testing procedure by test code. By using the keyboard or a barcode reader it is possible to set the three number test sequence for an appliance test.

To select a desired code select CODE and use the LEFT and RIGHT keys. When pressing the ENTER key the code number can be entered directly with the keyboard. In both cases the settings are displayed on-line. No confirmation is needed to adopt the setting.

It is also possible to enter the code with an approved barcode reader (connected to BARCODE / PRINTER connector).

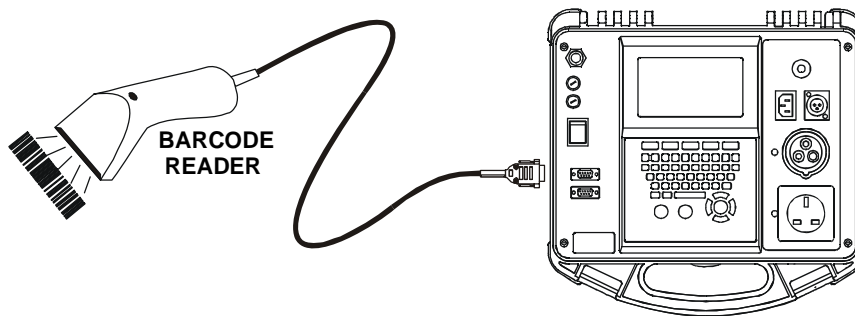


Fig. 5.12 Bar code reader connection

If the test code is accepted the instrument confirms the editing by changing the test code and emitting two short 'beeps'. If the test code is not correct the instrument does not change the test code and warns the user with a long 'beep'.

Start the measurement with the START key.

See the meaning of test code numbers in appendix 1.

## 5.3. Edit users

If more than one user uses the instrument, you can pre-set each users name to distinguish the saved records by the each users name.

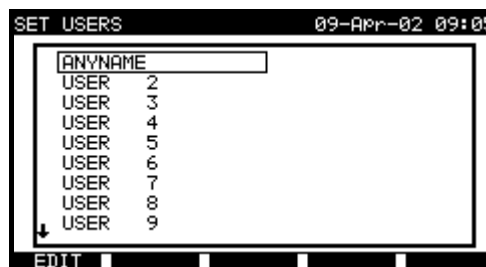


Fig. 5.13 User name selection

In the menu SET USERS it is possible to set 15 different users. By pressing the F1 (EDIT) key each user name can be set. The typed user name is confirmed by pressing the F1 (SAVE) key.

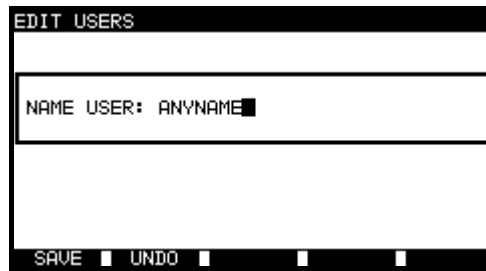


Fig. 5.14 User name modification

By pressing the F2 (UNDO) key it is possible to reset the previous values and using the ESC key leaves these settings unchanged. After saving the name(s) of the user(s), select the temporary user by highlighting the appropriate name and confirming it by the ENTER key.

## 5.4. Recall / Delete / Send memory

### Searching and recalling memory

After entering RECALL/DELETE/SEND MEMORY menu, the SEARCH MEMORY menu will be displayed.

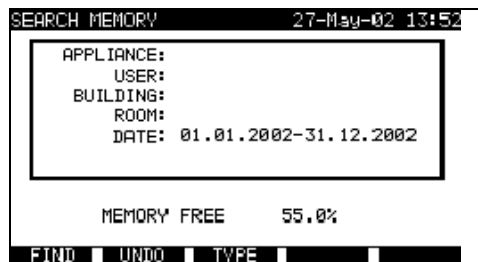


Fig. 5.15 Memory search menu

It is possible to search all saved results, some of them or just one by means of five special filters. Each of them can be set to search results according to appliance, building, room, date and user. Individual filters can be enabled or disabled.

### Operation of filters

All filters of the same type are combined together.

Example 1:

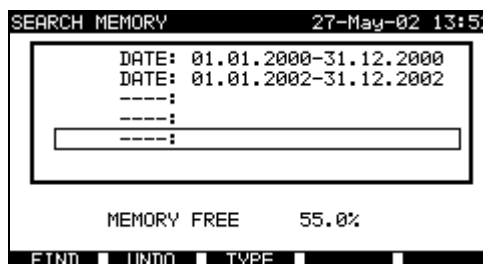
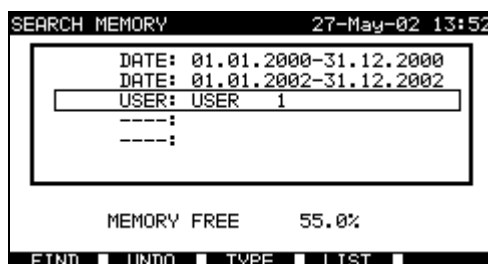


Fig. 5.16 Date filters

All results obtained in year 2001 and 2003 will be found.

All filters of different type will narrow search results.

Example 2:



*Fig. 5.17 Adding user filter*

All results of User 1, obtained in year 2001 and 2003 will be found. Other users won't be considered.

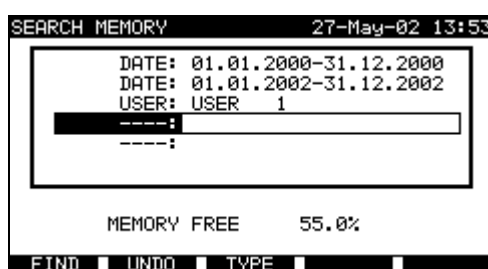
### Setting of filter type

After pressing the F3 (TYPE) key the filter type will be highlighted. It can be set or switched off with the LEFT and RIGHT keys. With the UP and DOWN keys other filters can be selected.

Filter types are:

APPLIANCE, BUILDING, ROOM, DATE, USER

The '----' sign means that the filter is disabled.



*Fig. 5.18 Example of main filters*

### Setting of filter content

By pressing the F5 (LIST) key the user can choose a name from the predefined name lists (see chapter 4.8 for more information). For inserting appropriate data, use keyboard. To find all results just enter "\*" instead of names. Start searching by pressing the F1 (FIND) key.

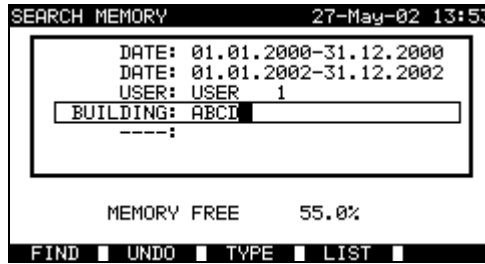


Fig. 5.19 Additional content filter

After completion of the search the RECALL MEMORY menu is shown, where it is possible to see the overall result for each measurement. To see test results for the selected appliance press the ENTER key and return back with the ESC key. For listing other results, press the UP / DOWN keys or the F1, F2 (PgUp, PgDown) keys



Fig. 5.20 Find result codes for predefined filters

After pressing the ENTER key the selected result is shown in full detail. Use the F1 (PgUp), F2 (PgDown), F5 (MORE) or F5 (RESULT) keys to see complete result data.

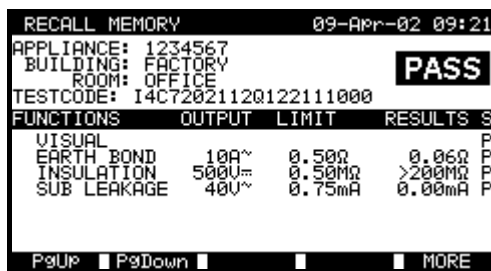


Fig. 5.21 Stored result of particular appliance code

→ F5 →

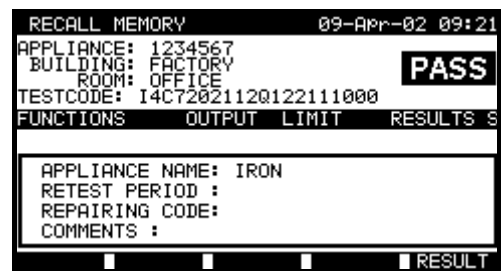


Fig. 5.22 Appliance Information with particular code

Note: 'S' means STATUS, 'P' means PASS, 'F' means FAIL

## Deleting memory

By pressing the F5 (DELETE) key in the RECALL MEMORY menu it is possible to delete a selected measurement, all selected measurements, or all saved measurements. By using the DOWN key select the desired option and press the F5 (DELETE) key again. The instrument now asks for confirmation of deleting (see picture) and a final decision can be made with the Y or N key.

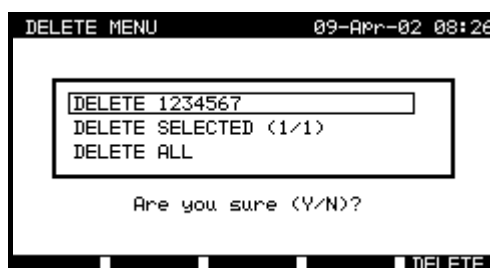


Fig. 5.23 Delete menu

If there is no result found in the instrument the display will show "No records found" and returns to the MAIN MENU.

## Downloading of results

Two options are available when downloading test results:

By pressing the F3 (SEND) key the instrument goes into SEND RESULTS menu. From this menu, the selected appliance test result can be printed out or downloaded to PC.

By pressing the F4 (SENDall) key the instrument goes into SEND RESULTS menu. From this menu, all found appliance test results could be printed out or downloaded to PC.

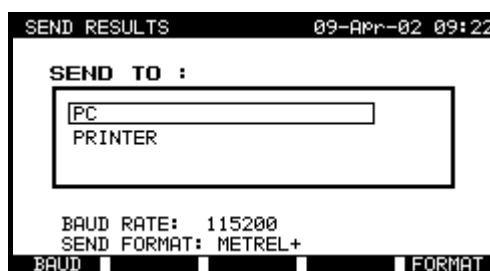


Fig. 5.24 Selection of destination for filtered results

When PC is selected the current baud rate is displayed. When pressing the F1 (BAUD) key the baud rate can be changed.

When working with a printer the baud rate is set by default to 9600.

By pressing the F5 (FORMAT) key the PC downloading format can be changed.

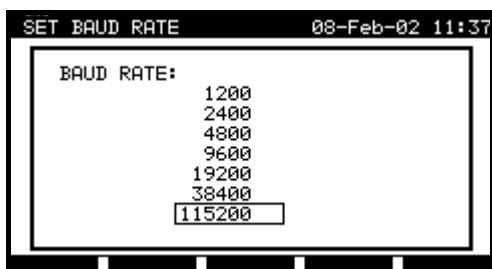


Fig. 5.25 Serial interface speed selection

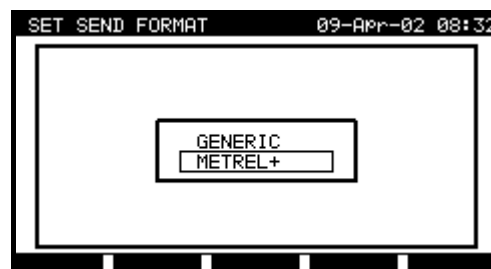


Fig. 5.26 Output format selection

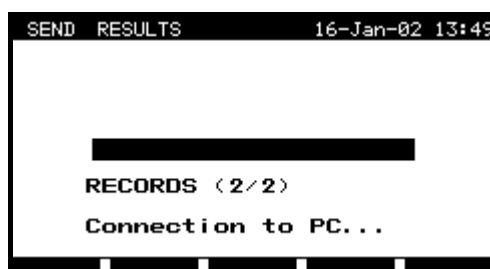


Fig. 5.27 Sending results information

Take care to use the correct RS232 port!

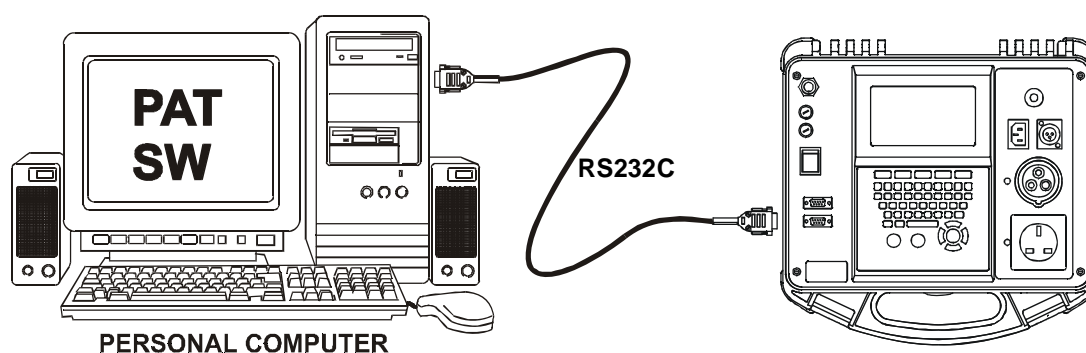


Fig. 5.28 Connection of interface cable between the instrument and PC

If the instrument fails to connect with the external device, a communication error warning is displayed.

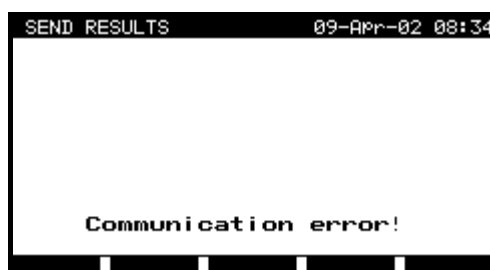


Fig. 5.29 No detected communication destination

**Note:**

- Take care to use the correct RS232 port!

## 6. Maintenance

### 6.1. Inspection

It is essential that all measuring instruments be regularly calibrated. For occasional daily use, we recommend to carry out annual calibration. When the instrument is used continuously every day, we recommend the calibration for every 6 months.

### 6.2. After sales service

Repairs under or out of guarantee: please return the products to your distributor.

### 6.3. Replacing the fuses

The instrument contains two user replaceable fuses (F1 and F2) in input section. They should be replaced with only the same type as defined:

F1, F2 fuse: 16 A T / 250 V; size: 6.3 mm x 32 mm



..... Disconnect all test cables and mains lead before changing the fuses.

If there is any instrument malfunction, send the instrument to an appropriate service center for all fuses to be checked.



..... Disconnect all test cables and mains lead before opening the instrument.



..... Hazardous voltage may be present inside the instrument.

Only properly trained and competent personnel should carry out operation.

### 6.4. Cleaning

Use a soft cloth slightly moistened with soapy water to clean the surface and leave the instrument to dry totally after cleaning.

Do not use liquids based on alcohol, petrol or hydrocarbons!

Do not spill cleaning fluid over the instrument!

## 7. General information

Mains voltage – 230 V system:.....	230 V ( $\pm 10\%$ ) / 50 or 60 Hz
Mains voltage – 115 V system:.....	115 V ( $\pm 10\%$ ) / 50 or 60 Hz
Max. power consumption.....	150 VA (without load on TEST SOCKETS)
Display.....	Graphic, 240 X 128 dots
RS232 interfaces .....	1 start bit, 8 data bits, 1 stop bit, Baud rate 115200
Memories.....	4000 memory locations
Measurement protection:	
F1 T 16 A / 250 V, 6.3 x 32 mm (test socket protection)	
F2 T 16 A / 250 V, 6.3 x 32 mm (test socket protection)	
Case .....	shock proof plastic / portable
Dimensions (mm) (w x h x d).....	335 x 160 x 335
Mass (with standard accessories):..	
OmegaPAT MI 2140.....	9.5 kg
BetaPAT MI 2141 .....	8.4 kg
Pollution degree.....	2
Degree of protection .....	IP 50 (closed and locked cover)
Overvoltage category.....	Cat II / 300 V
Protection classification .....	I
Working temp. range .....	- 10 ÷ + 50 °C
Ref. temp. range.....	5 ÷ 35 °C
Ref. humidity range.....	35 ÷ 65 % RH
Storage temp. range .....	-10 ÷ + 60 °C
Max. working humidity .....	85 % RH (0 ÷ 40 °C), non-condensing
Max. storage humidity.....	90 % RH (-10 ÷ 40 °C) 80 % RH (40 ÷ 60 °C)

### Protection tests against (before test):

External AC or DC voltage on test sockets between L and N:	yes
External AC or DC voltage between test sockets L and PE:	yes
External AC or DC voltage between PE and Earth Bond clip:	yes
Excessive Leakage between L and PE before applying mains voltage to test socket:	yes
Short circuit or too low resistance between L and N before applying mains voltage to test socket:	yes

### Connectivity (fuse) pre-test:

Appliance not switched on or too high resistance between L and N before performing Insulation, Subleakage, Flash, Leakage, Touch Leakage tests (limit is ca 30 k $\Omega$ ).	yes
--	-----



## 8. Sets and Accessories

### Standard set

Instrument OmegaPAT Tester MI 2140 or BetaPAT Tester MI 2141  
Additional bag for accessories inside carrying case  
Earth Bond / Touch Leakage Clip  
HV Flash Test Cable (MI 2140 only)  
Users Manual  
PC SW package PATLink with RS 232 cable  
Production Verification Data  
List of conformity

<b>Options</b>	<b>Order No.</b>
- Printer	<b>A 1103</b>
- 110 V / 220 V adapter	<b>A 1104</b>
- Barcode Reader	<b>A 1105</b>
- Bar code Labels, 200 pcs	<b>A 1106</b>
- PAT Link	<b>A 1117</b>
- PC SW package Simply PATs	<b>A 1118</b>

## 9. Appendix 1

### Test Codes List

#### Appliance type:

Other

Portable or Handheld

Heating and Cooking

IT equipment (EN 60950)

Extension Leads

#### Class: I, II

**Fuse:** 3 A (750 VA), 6 A (1.5 kVA), 10 A (2.5 kVA), 13 A (3.2 kVA), unknown

**Supply cord:** short, middle (or low c.s.a.), long

**Functional / Protective conductor Test:** yes, no

**Length:** ≤ 5 m, 7.5 m, 10 m, 12 m, 15 m, 20 m, 30 m, 40 m, 50 m

**Conductor Crosssection:** 0.5 mm<sup>2</sup>, 0.75 mm<sup>2</sup>, 1.0 mm<sup>2</sup>, 1.25 mm<sup>2</sup>, 1.5 mm<sup>2</sup>, unknown

**Max. current capacity:** 3 A (<750 VA), 6A (1.5 kVA), 10 A (2.5 kVA), 13 A (3.2 kVA), 15 A (3.75 kVA)

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

Type	Class	Fuse	Cord	Earth Bond Limit	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	-	-	-	0.75 mA	-	028
	I	10 A	short	0.10 Ω	25 A	-	-	-	1.00 mA	-	029
	I	13 A	short	0.10 Ω	25 A	-	-	-	1.50 mA	-	030
	I	3	short	0.10 Ω	10 A	-	-	0.75 mA	-	-	031
	I	6 A	short	0.10 Ω	10 A	-	-	0.75 mA	-	-	032
	I	10 A	short	0.10 Ω	25 A	-	-	1.00 mA	-	-	033
	I	13 A	short	0.10 Ω	25 A	-	-	1.5 mA	-	-	034
	II	-	-	-	-	2.00 MΩ	500 V	-	0.25 mA	-	035
	II	-	-	-	-	2.00 MΩ	500 V	-	-	-	036
<b>IT equipment EN 60950</b>											
	I	-	short	0.10 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	037
	I	-	midd	0.30 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	038
	I	-	long	0.50 Ω	100 mA	1.00 MΩ	500 V	3.5 mA	-	-	039
<b>IT equipment EN 60950-250V</b>											
	I	-	long	0.50 Ω	100 mA	1.00 MΩ	250 V	3.5 mA	-	-	040
<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	25A	1.00 MΩ	500 V	-	3.50 mA	-	043
	I	13 A	short	0.10 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	044
	I	3 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	-	-	045
	I	6 A	short	0.10 Ω	10 A	1.00 MΩ	500 V	-	-	-	046
	I	10 A	short	0.10 Ω	25 A	1.00 MΩ	500 V	-	-	-	047
	I	13 A	short	0.10 Ω	25 A	1.00 MΩ	500 V	-	-	-	048
	I	3 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	049
	I	6 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	050
	I	10 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	051
	I	13 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	052
	I	3 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	053
	I	6 A	midd	0.30 Ω	10 A	1.00 MΩ	500 V	-	-	-	054
	I	10 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	-	-	055
	I	13 A	midd	0.30 Ω	25 A	1.00 MΩ	500 V	-	-	-	056
	I	3 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	057
	I	6 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	3.50 mA	-	058
	I	10 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	059
	I	13 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	3.50 mA	-	060
	I	3 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	-	-	061
	I	6 A	long	0.50 Ω	10 A	1.00 MΩ	500 V	-	-	-	062
	I	10 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	-	-	063
	I	13 A	long	0.50 Ω	25 A	1.00 MΩ	500 V	-	-	-	064
	II	-	-	-	-	2.00 MΩ	500 V	-	0.25 mA	-	065
	II	-	-	-	-	2.00 MΩ	500 V	-	-	-	066

	Length	Earth Bond Limit Out		Insulation Limit Out		Polarity	Code
<b>IEC leads</b>							
<b>0.5mm<sup>2</sup> / 3A</b>							
	<=5 m	0.30 Ω	10 A	1.00 MΩ	500 V	✓	067
	7.5 m	0.40 Ω	10 A	1.00 MΩ	500 V	✓	068
	10 m	0.50 Ω	10 A	1.00 MΩ	500 V	✓	069
	12 m	0.60 Ω	10 A	1.00 MΩ	500 V	✓	070
	15 m	0.70 Ω	10 A	1.00 MΩ	500 V	✓	071
	20 m	0.80 Ω	10 A	1.00 MΩ	500 V	✓	072
	30 m	1.00 Ω	10 A	1.00 MΩ	500 V	✓	073
	40 m	2.00 Ω	10 A	1.00 MΩ	500 V	✓	074
	50 m	2.00 Ω	10 A	1.00 MΩ	500 V	✓	075
<b>0.75mm<sup>2</sup> / 6 A</b>							
	<=5 m	0.20 Ω	10 A	1.00 MΩ	500 V	✓	076
	7.5 m	0.30 Ω	10 A	1.00 MΩ	500 V	✓	077
	10 m	0.40 Ω	10 A	1.00 MΩ	500 V	✓	078
	12 m	0.40 Ω	10 A	1.00 MΩ	500 V	✓	079
	15 m	0.50 Ω	10 A	1.00 MΩ	500 V	✓	080
	20 m	0.60 Ω	10 A	1.00 MΩ	500 V	✓	081
	30 m	0.90 Ω	10 A	1.00 MΩ	500 V	✓	082
	40 m	1.00 Ω	10 A	1.00 MΩ	500 V	✓	083
	50 m	1.00 Ω	10 A	1.00 MΩ	500 V	✓	084
<b>1 mm<sup>2</sup> / 10 A</b>							
	<=5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	085
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	086
	10 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	087
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	088
	15 m	0.40 Ω	25 A	1.00 MΩ	500 V	✓	089
	20 m	0.50 Ω	25 A	1.00 MΩ	500 V	✓	090
	30 m	0.70 Ω	25 A	1.00 MΩ	500 V	✓	091
	40 m	0.90 Ω	25 A	1.00 MΩ	500 V	✓	092
	50 m	4.00 Ω	25 A	1.00 MΩ	500 V	✓	093
<b>1.25mm<sup>2</sup> / 13A</b>							
	<=5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	094
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	095
	10 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	096
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	097
	15 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	098
	20 m	0.40 Ω	25 A	1.00 MΩ	500 V	✓	099
	30 m	0.60 Ω	25 A	1.00 MΩ	500 V	✓	100
	40 m	0.80 Ω	25 A	1.00 MΩ	500 V	✓	101
	50 m	0.90 Ω	25 A	1.00 MΩ	500 V	✓	102
<b>1.5mm<sup>2</sup> / 15 A</b>							
	<=5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	103
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	104
	10 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	105
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	106
	15 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	107
	20 m	0.40 Ω	25 A	1.00 MΩ	500 V	✓	108
	30 m	0.50 Ω	25 A	1.00 MΩ	500 V	✓	109
	40 m	0.60 Ω	25 A	1.00 MΩ	500 V	✓	110
	50 m	0.80 Ω	25 A	1.00 MΩ	500 V	✓	111
<b>UNKNOWN</b>							
	<=5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	112
	7.5 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	113
	10 m	0.20 Ω	25 A	1.00 MΩ	500 V	✓	114
	12 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	115
	15 m	0.30 Ω	25 A	1.00 MΩ	500 V	✓	116
	20 m	0.40 Ω	25 A	1.00 MΩ	500 V	✓	117
	30 m	0.50 Ω	25 A	1.00 MΩ	500 V	✓	118
	40 m	0.60 Ω	25 A	1.00 MΩ	500 V	✓	119
	50 m	0.80 Ω	25 A	1.00 MΩ	500 V	✓	120