



PolarityPlus
MI 3106
Instruction manual
Version 1.7, Code No. 20 751 133

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1 Preface

Congratulations on your purchase of the PolarityPLUS instrument and its accessories from METREL. The instrument was designed on basis of rich experience, acquired through many years of dealing with electric installation test equipment.

The PolarityPLUS instrument is professional, multifunctional, hand-held test instrument intended for testing of proper connection on entry side of electrical installations in buildings. The following measurements and tests can be performed as unique auto sequence or separately:

- Voltage and frequency,
- Line impedance,
- Resistance to earth,
- Integrity of N conductor.

Large dot matrix display with backlight offers easy reading of results, indications, measurement parameters and messages. Operation is simple and clear – operator does not need any special training (except reading this instruction manual) to operate the instrument.


In order for operator to be familiar enough with measurements in general and typical applications it is advisable to read Metrel handbook *Measurements on electric installations in theory and practice*.

The instrument is equipped with all accessories necessary for comfortable testing. It is kept in a soft carrying bag together with all accessories.

2 Safety and operational considerations

2.1 Warnings and notes

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

- ❑ The symbol  on the instrument means »Read the Instruction manual with special care to safety operation«. The symbol requires an action!
- ❑ If the test equipment is used in a manner not specified in this user manual the protection provided by the equipment might be impaired!
- ❑ Read this user manual carefully, otherwise use of the instrument may be dangerous for the operator, for the instrument or for the equipment under test!
- ❑ Do not use the instrument and accessories if any damage is noticed!
- ❑ In case a fuse has blown follow the instructions in this manual to replace it!
- ❑ Consider all generally known precautions in order to avoid risk of electric shock while dealing with hazardous voltages!
- ❑ Do not use the instrument in supply systems with voltages higher than 300 V (line to earth)!
- ❑ A competent authorized person can only carry out service intervention or adjustment procedure!
- ❑ Use only standard or optional test accessories supplied by your distributor!
- ❑ Instrument contains rechargeable Ni-Cd or Ni-MH battery cells. The cells should only be replaced with the same type as defined on the battery placement label or in this manual.
- ❑ Do not use standard alkaline battery cells while power supply adapter is connected to prevent their leaking or even explosion!
- ❑ Hazardous voltages exist inside the instrument. Disconnect all test leads, remove the power supply cable and switch off the instrument before removing battery and fuse compartment cover.
- ❑ Do not connect any voltage source to clamp current input. It is intended only for connection of current clamp with current output. Maximum continuous input current is 300 mA!
- ❑ All normal safety precautions have to be taken in order to avoid risk of electric shock when working on electrical installations!


Warnings related to measurement functions

Testing PE terminal

- ❑ If phase voltage is detected on the tested PE terminal, stop all measurements immediately and take care the fault is eliminated before proceeding with any activity!

Notes related to measurement functions

General

- ❑ Indicator  means that the selected measurement cannot be performed because of irregular conditions on input terminals.
- ❑ PASS / FAIL indication is applied to each test.
- ❑ In case that only two of three wires are connected to tested electrical installation, only voltage indication between these two wires is valid.

Earth resistance

- ❑ Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement.

Line impedance

- ❑ Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement.

I neutral

- ❑ Use test clamp supplied by Metrel or other with similar characteristics (current output, 1000:1, appropriate measurement range, consider error of test clamp when evaluating measured results)!
- ❑ Specified accuracy of tested parameters is valid only if mains voltage is stable during the measurement.

Testing PE terminal

- ❑ For correct testing of PE terminal, the TEST key has to be touched for a few seconds.
- ❑ Make sure of standing on non-isolated support while carrying out the test, otherwise test result may be wrong!

2.2 Battery and charging

The instrument uses six AA size alkaline or rechargeable Ni-Cd or Ni-MH battery cells. Nominal operating time is declared for cells with nominal capacity of 2100 mAh. Battery condition is always present on the display when the instrument is turned on. In case the battery is weak, the instrument indicates this as shown in figure 2.1. This indication appears for a few seconds and then the instrument is turned off.

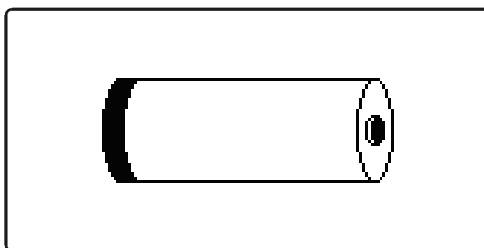


Figure 2.1: Discharged battery indication

The battery is charged whenever the power supply adapter is connected to the instrument. Internal circuit controls charging assuring maximum battery lifetime. Power supply socket polarity is shown in figure 2.2.



Figure 2.2: Power supply socket polarity

The instrument automatically recognizes connected power supply adapter and controls charging.

Symbol:

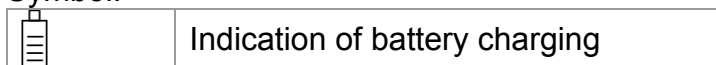



Figure 2.3: Charging indication

- ❑  Before opening battery / fuse compartment cover disconnect all measuring accessories connected to the instrument and power off the instrument.
- ❑ Insert cells correctly, otherwise the instrument will not operate and the battery could be discharged.
- ❑ Remove all battery cells from the battery compartment if the instrument is not used for longer period.
- ❑ Do not charge alkaline battery cells!
- ❑ Take into account handling, maintenance and recycling requirements that are defined by related regulations and manufacturers of alkaline or rechargeable batteries!
- ❑ Use only power supply adapter delivered from manufacturer or distributor of the test equipment to avoid possible fire or electric shock!

2.2.1 New battery cells or cells unused for a longer period

Unpredictable chemical processes can occur during charging of new battery cells or cells that were unused for a longer period (more than 3 months). Ni-MH and Ni-Cd battery cells are affected to capacity degradation (sometimes called as memory effect). As a result, the instrument operation time can be significantly reduced.

Recommended procedure for recovering battery cells:

Procedure	Notes
➤ Completely charge the battery.	<i>At least 14h with in-built charger.</i>
➤ Completely discharge the battery.	<i>Can be performed with normal work with the instrument.</i>
➤ Repeat the charge / discharge cycle for at least two times .	<i>Four cycles are recommended.</i>

Complete discharge / charge cycle is performed automatically for each cell using external intelligent battery charger.

Notes:

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

2.3 Standards applied

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

Electromagnetic compatibility (EMC)

IEC 61326	Electrical equipment for measurement, control and laboratory use – EMC requirements Class B (Hand-held equipment used in controlled EM environments)
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Safety (LVD)

IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
IEC 61010-031	Safety requirements for hand-held probe assemblies for electrical measurement and test
IEC 61010-2-032	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement

Functionality

IEC 61557	Electrical safety in low voltage distribution systems up to 1000 V _{AC} and 1500 V _{AC} – Equipment for testing, measuring or monitoring of protective measures Part 1 General requirements Part 3 Loop resistance Part 10..... Combined measuring equipment
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Other reference standards

IEC 60364-4-41	Electrical installations of buildings Part 4-41 Protection for safety – protection against electric shock
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3 Instrument description

3.1 Front panel

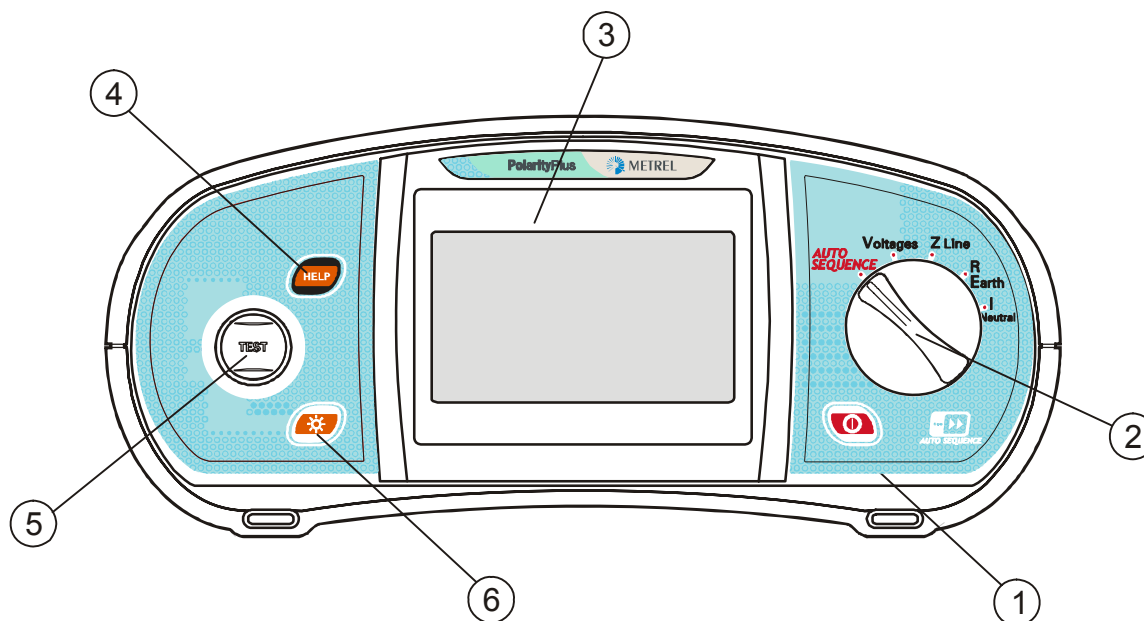


Figure 3.1: Front panel

Legend:

1	ON / OFF	Switches the instrument power on or off. <i>The instrument automatically turns off 15 minutes after the last key was pressed.</i>
2	Rotary switch	Selects test function.
3	LCD	128 x 64 dots matrix display with backlight.
4	HELP	Accesses help menus.
5	TEST	Initiates measurements. Acts also as the PE touching electrode.
6	BACKLIGHT, CONTRAST	Changes backlight level and contrast.

3.2 Connector panel

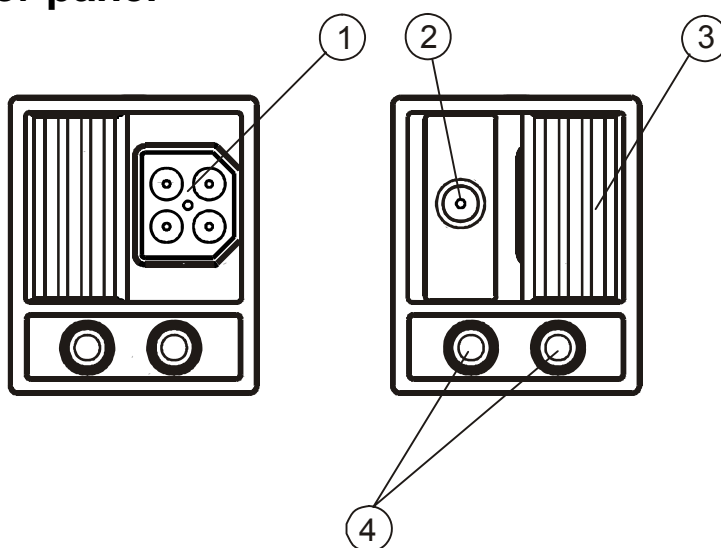


Figure 3.2: Connector panel

Legend:

1	Test connector	Measuring inputs / outputs, connection of measuring cables.
2	Charger socket	Connection of power supply adapter.
3	Protection cover	Protects from simultaneous access to test connector and power supply adapter socket plus communication connectors.
4	Clamp connector	Measuring input for current clamp.

Warnings!

- ❑ **Maximum allowed voltage between any test terminal and ground is 300 V!**
- ❑ **Maximum allowed voltage between test terminals is 500 V!**
- ❑ **Maximum short-term voltage of external power supply adapter is 14 V!**
- ❑ **Do not connect any voltage source on clamp connector sockets! It is intended for connection of current clamp with current output only.**
- ❑ **Maximum continuous current of current clamp input is 300 mA!**

3.3 Back panel

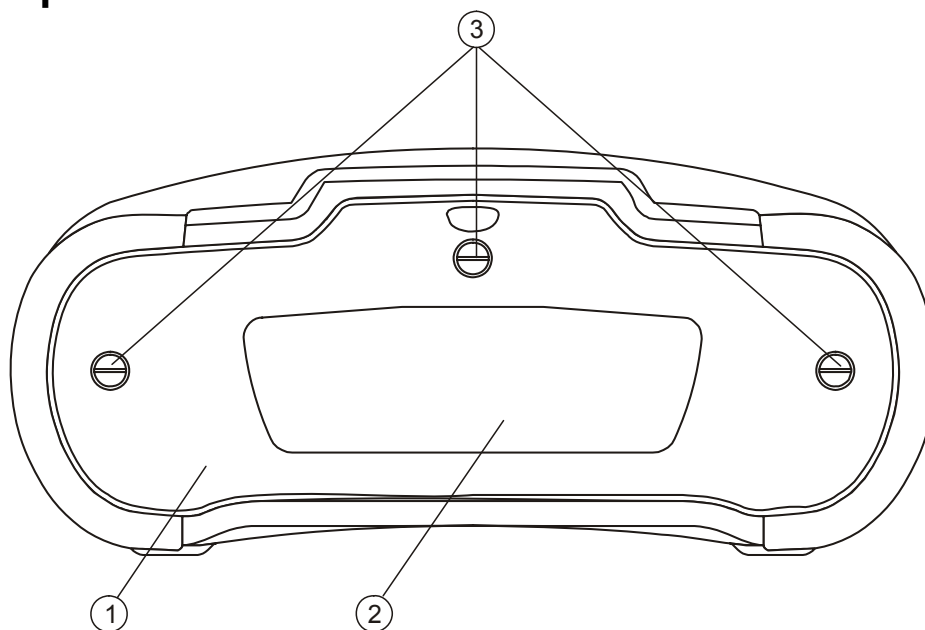


Figure 3.3: Back panel

Legend:

- | | |
|---|--|
| 1 | Battery / fuse compartment cover |
| 2 | Back panel information label |
| 3 | Fixing screws for battery / fuse compartment cover |

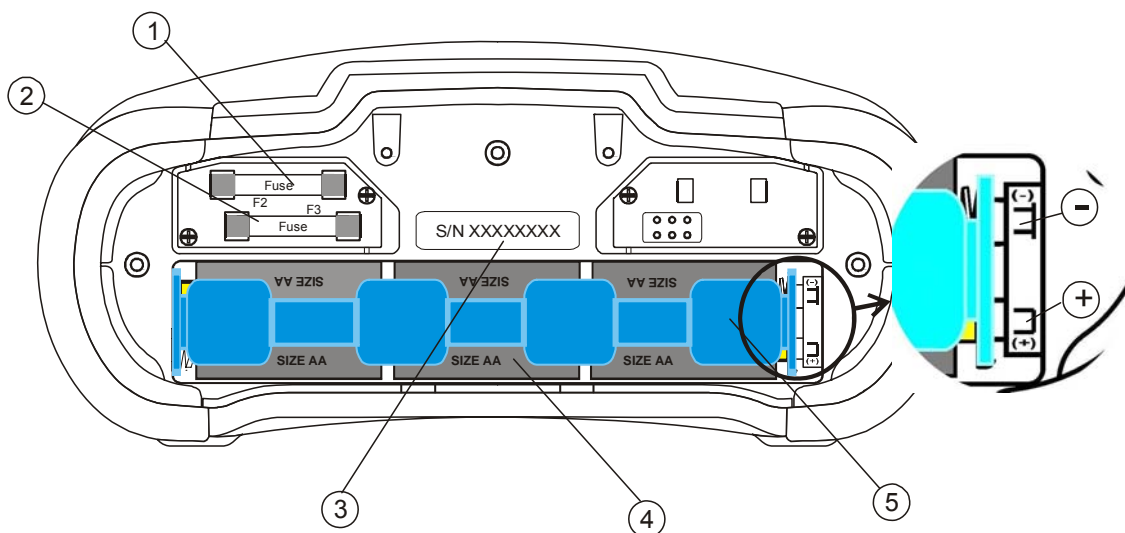


Figure 3.4.: Battery and fuse compartment

Legend:

- | | | |
|---|---------------------|---|
| 1 | Fuse F2 | T 4 A / 500 V |
| 2 | Fuse F3 | T 4 A / 500 V |
| 3 | Serial number label | |
| 4 | Battery cells | Size AA, alkaline / rechargeable NiMH or NiCd |

5 Battery holder Can be removed from the instrument

3.4 Bottom view

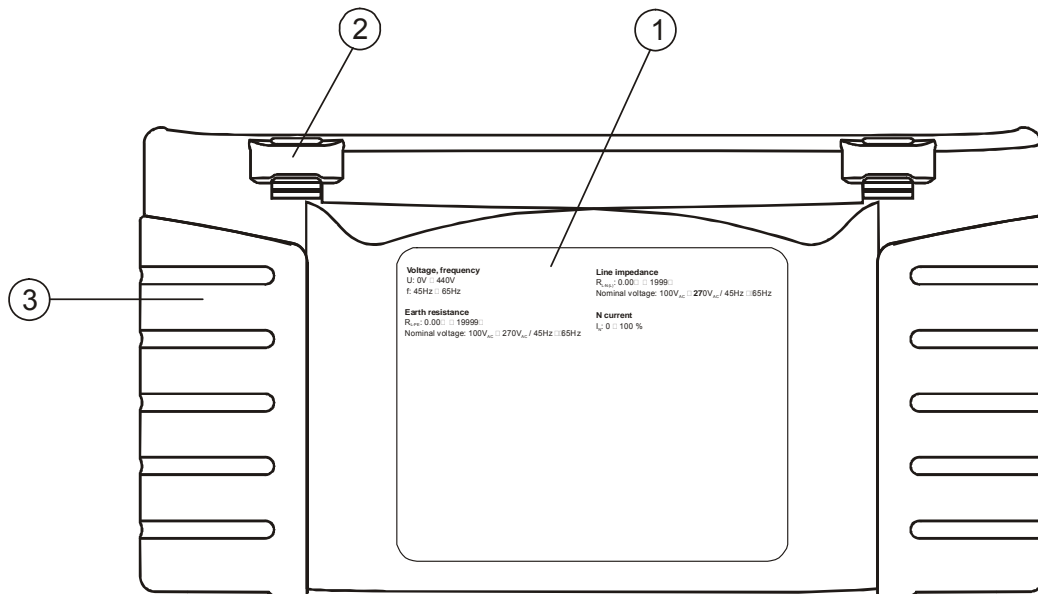


Figure 3.5: Bottom view

Legend:

- 1 Bottom information label
- 2 Neck belt openings
- 3 Handling side covers

3.5 Display organization

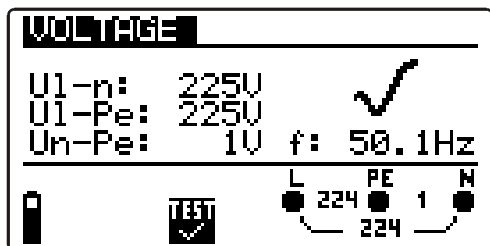


Figure 3.6: Typical single test display

VOLTAGE	Menu line
U1-n: 225V U1-Pe: 225V Un-Pe: 1V f: 50.1Hz	Result field
TEST	Message field
L 224 PE 1 N 224	Terminal voltage monitor

3.5.1 Terminal voltage monitor

The terminal voltage monitor displays current voltages present on the test terminals.

	Online voltage is displayed for right polarity of terminals.
	L and N test terminals are changed.
	L and PE are test terminals are changed. See the warning below!
	Warning! Phase voltage on the PE terminal! Stop the activity immediately and eliminate the fault / connection problem before proceeding with any activity!
	L – N polarity changed.

Notes:

- L = Active line.
- N = Neutral line.
- PE = Protective earth.

3.5.2 Menu line

In the menu line, the name of the selected function and optional limit value is displayed.

ERRH	Function name.
Lim 10.00kΩ	Limit value.

3.5.3 Message field

In the message field, different warnings and messages are displayed.

	Measurement is running; consider displayed warnings.
	Conditions on the input terminals allow starting the measurement (TEST key); consider other displayed warnings and messages.



Conditions on the input terminals do not allow starting the measurement (**TEST** key), consider displayed warnings and messages.



Instrument is overheated, the temperature inside the instrument is higher than the safety limit, and measurement is prohibited until the temperature decreases under the allowed limit.



Battery capacity indication.



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



Recharging in progress (if power supply adapter is connected).

3.5.4 Result field



Measurement result is inside limits (PASS).



Measurement result is out of limits (FAIL).



Measurement is aborted. Consider displayed warnings and messages.

3.5.5 Other messages

High wires resistance

I NEUTRAL warning: test current < 4A or line impedance > 20 Ω .

Hard Reset

Instrument settings are reset to initial (factory) values.

CAL ERROR!

Service intervention required.

3.5.6 Sound warnings

Short sound

Pressed key activated.
Measurement has been started after pressing the TEST key. Consider any displayed warnings during measurement.

Long sound

Measurement is prohibited. Consider any displayed warnings and check online voltage/terminal monitor!

Periodic sound

Warning! Dangerous voltage on the PE terminal is detected. Refer to chapter 5.8 for more information.

3.5.7 Help

Key:

HELP	Opens help screen.
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The help menu contains basic schematic / connection diagram to illustrate recommended connection of the instrument.

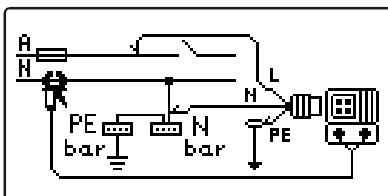


Figure 3.7: Help screen

3.5.8 Backlight and contrast adjustments

With the **BACKLIGHT** key backlight and contrast can be adjusted.

Click Toggle backlight intensity level.

Keep pressed for 3 s LCD contrast adjustment menu is displayed.

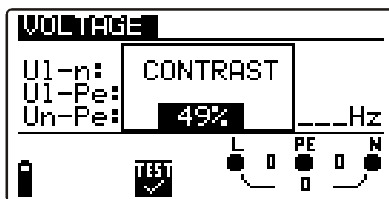


Figure 3.8: Contrast adjustment menu

Keys for contrast adjustment:

Backlight	Reduces contrast.
Help	Increases contrast.
TEST	Accepts new contrast.

Note:

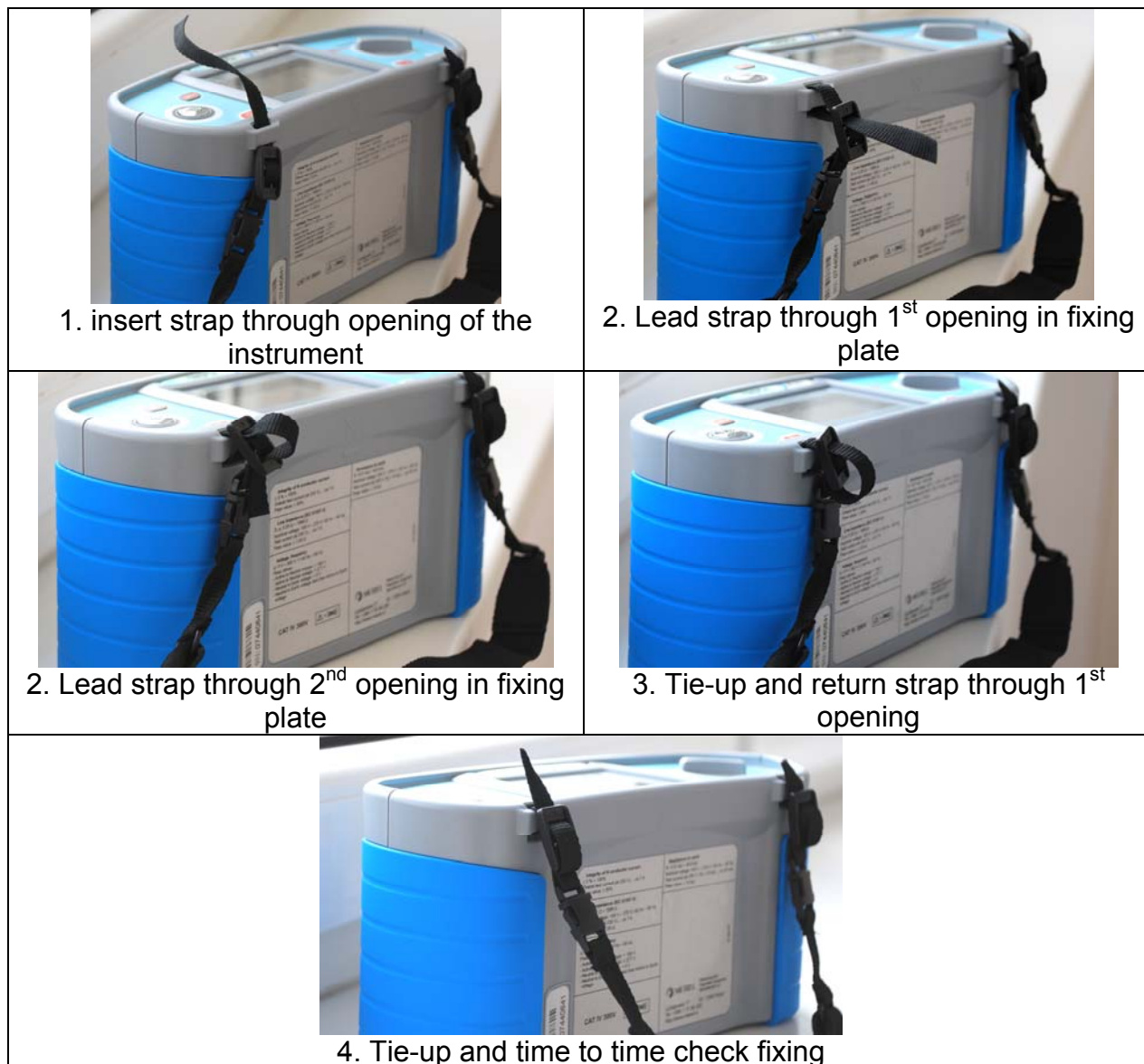
- Contrast menu can only be entered in the low intensity backlight state.

3.6 Carrying the instrument

With the neck-carrying belt supplied in standard set, various possibilities of carrying the instrument are available. Operator can choose appropriate one on basis of his / her operation. The instrument can be used even placed in soft carrying bag – test cable connected to the instrument through the front aperture.

3.6.1 Mounting of carrying straps

Carrying straps shall be mounted to the instrument properly that enables good tightening. The strap is made of materials that slides and do not secure tightening. Following figures show principle for mounting of the straps.

**Note:**

- The best fixing is application without fixing plate but with secure knots, as they are required in alpine climbing for securing of Nylon knot.

3.6.2 Instrument set and accessories

Instrument	PolarityPLUS – MI 3106 Soft carrying bag Soft carrying neck belt Soft carrying back belt
<i>Measuring accessories^{*)}</i>	Universal test cable (3 × 1.5 m) 3 alligator clips (black) Earthing probe Probe test lead 4 m Current clamp
<i>Documentation</i>	Short instruction manual Product verification data Warranty declaration Declaration of conformity
<i>Battery</i>	6 Ni-MH rechargeable cells Power supply adapter
<i>CD-ROM</i>	Instruction manual Short instruction manual Measurement on electric installations in theory and practice
<i>Optional accessories^{*)}</i>	Fast 12 cells charger (C and AA sizes) Fast 6 cells charger (AA size)

^{*)}Please, see the attached sheet to compare received set of accessories with listed one. See also the attached sheet for a list of optional accessories that are available on request from your distributor.

4 Instrument operation

4.1 Function selection

The instrument contains rotary switch intended for selection of working function.

- ❑ **Automatic test** (see 4.2),
- ❑ **Single tests** (see 4.3).

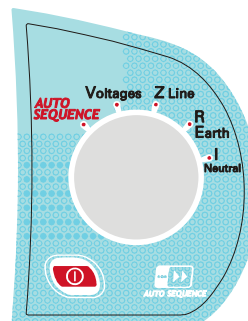


Figure 4.1: Rotary switch options

4.2 Automatic testing

The rotary switch in position **AUTO SEQUENCE** is intended for automatic executing of predefined measurement sequence.

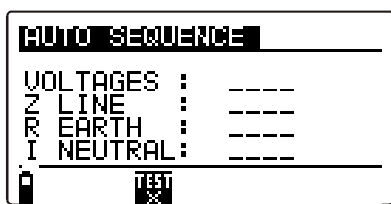




Figure 4.2: Auto sequence screen

AUTO SEQUENCE	Auto sequence indication.
VOLTAGES : ---- Z LINE : ---- R EARTH : ---- I NEUTRAL : ----	Sequence field.
 	Message field with battery condition indicator.

Running auto sequence:

- ❑ Select **AUTO SEQUENCE**.
- ❑ **Connect** the instrument to tested object as required.
- ❑ Press the **TEST** key.
- ❑ The set of measurements will be performed in sequential manner until the conditions at input terminals are valid for each individual test. If not, the instrument will stop and abort the rest of sequence.
- ❑ Results of a finished auto sequence can be viewed.

Measurements are marked with one of the following symbol after finished test.

✘ or FAIL	Measurement is finished and has failed.
✓ or PASS	Measurement is finished and has passed.
PASS	Overall PASS result is reported if all performed tests pass.
FAIL	Overall FAIL result is reported if one or more performed tests fail.

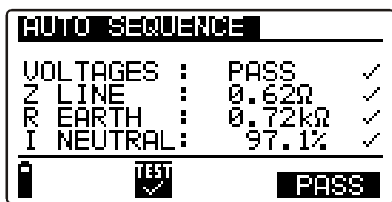


Figure 4.3: Overall PASS example

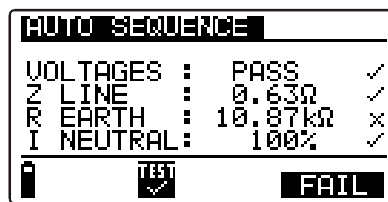


Figure 4.4: Overall FAIL example

Viewing auto sequence individual results:

- After finished auto sequence rotate rotary switch knob to see results in full details for each function in the auto sequence.
- Running any of the single test function finishes viewing of the results.

Note:

- **I NEUTRAL** function can be disabled, see, chapter 4.4 for additional information.

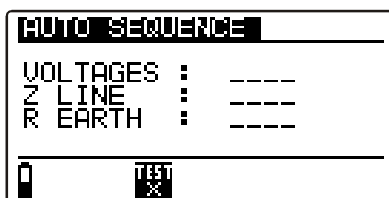


Figure 4.5: Example of auto sequence with I NEUTRAL disabled

4.3 Single tests

They are intended to run individual test / measurement functions and provide more information than the auto sequence screen. They are suitable for pre-testing, troubleshooting, etc.

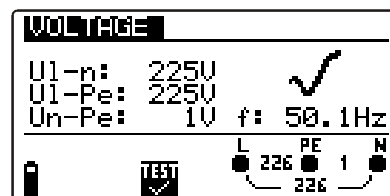


Figure 4.6: Example of typical Single test screen

Single test functions can be selected by rotary switch.

Rotary switch	Selects test / measurement function: <ul style="list-style-type: none"> □ <VOLTAGE> Voltage and frequency. □ <Z-LINE> Line impedance. □ <R EARTH> Resistance to earth. □ <I NEUTRAL> Portion of current in neutral conductor.
TEST	Runs selected test / measurement function.

Limits are fixed and intended for evaluation of measurement / test result.

See *Chapter 5* for more information about operation of the instrument in single test functions.

4.4 Instrument settings

Most settings of the instrument are fixed; operators can enable/disable **I NEUTRAL** function.

4.4.1 Setup for I NEUTRAL

The function **I NEUTRAL** can be disabled or enabled.

I NEUTRAL	
ON	Function enabled.
OFF	Function disabled.



Figure 4.6: Setup for I NEUTRAL

Opening **SETUP** menu:

BACKLIGHT key and rotary switch	They have to be activated at the same time.
--	---

Key:

TEST	Toggles between ON and OFF.
-------------	-----------------------------

Closing **SETUP** menu:

Rotary switch	Changing position, new setup is applied.
---------------	--

4.4.2 Initial settings

Initial values of instrument settings, measurement parameters and limits are as follows:

Instrument settings	Default value
Contrast	50 %

Function	Parameter: limit values
VOLTAGE	UI-n low limit: 215 V UI-n high limit: 270 V Un-pe high limit: 5 V Un-pe high limit: < UI-n
LINE	Limit: 1 Ω
RESISTANCE TO EARTH	Limit: 10 k Ω
I NEUTRAL	Limit: 50 %

5 Measurements

Main intention of the instrument is to test the integrity of distribution electricity supply connection to a consumer's installation in one step. For this purpose the connection diagram of required test set-up is as follows.

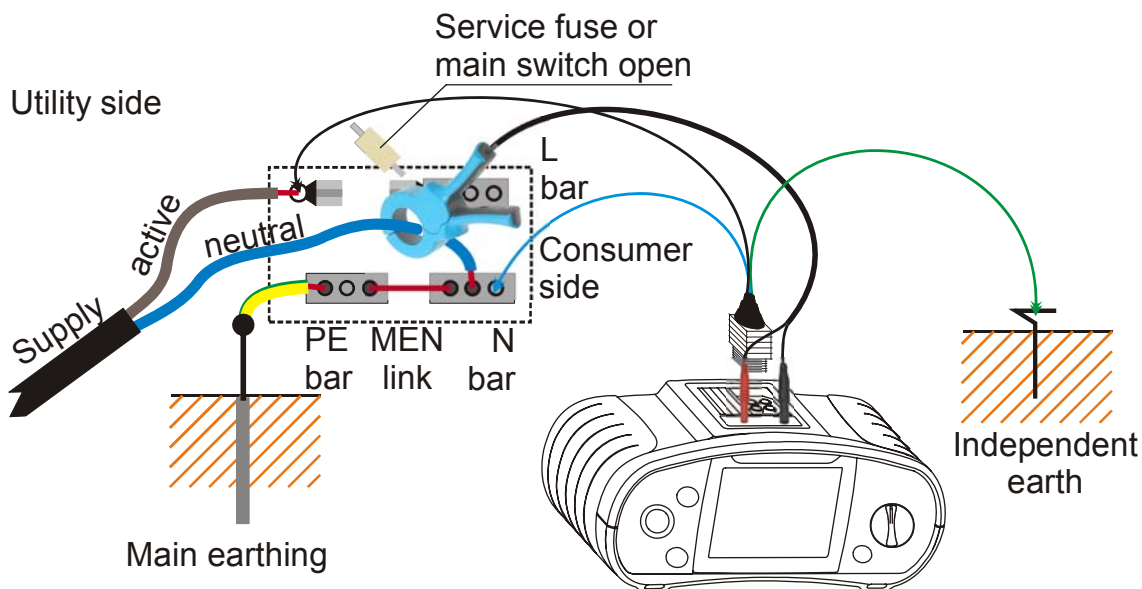


Figure 5.1: Recommended measuring circuit

Single functions are mainly intended to repeat measurements if the problem with one of tested parameters arise.

Note:

- The PASS limit values from *chapter 4.4* correspond for main purpose of the instrument, testing connections at house installation entry point. The limits and PASS/FAIL indication are void in single tests applied for other purposes.

5.1 Voltage and frequency

Voltage and frequency measurement is always active in the terminal voltage monitor. In the **Voltage** function the measured voltages and frequency are displayed. In this function, the instrument can be used as a standard 3-terminal V-meter. It automatically detects three-phase supply system.

See *4.3 Single test* for keys functionality.

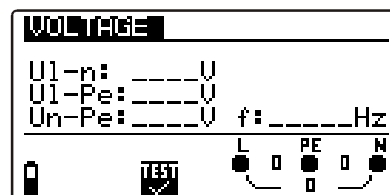


Figure 5.2: Voltage measurement

Optional connections for voltage measurement

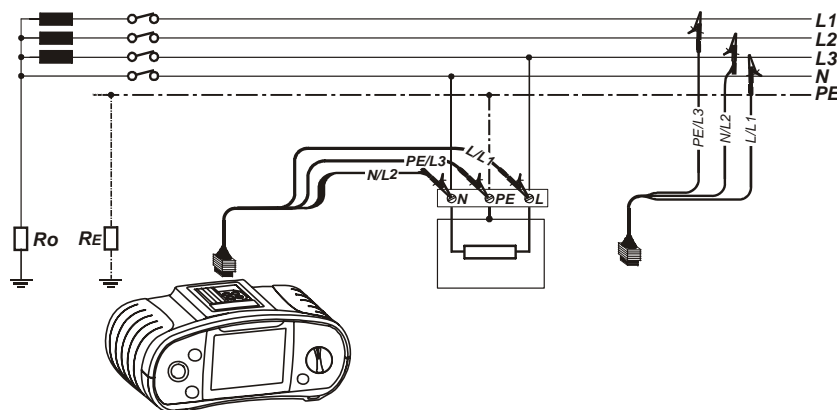


Figure 5.3: Voltage measurement

Voltage measurement procedure

- ❑ Select the **VOLTAGE** function.
- ❑ **Connect** test cable to the instrument.
- ❑ **Connect** test leads to the tested object (see figure 5.3).
- ❑ Press the **TEST** key to run measurement (optional).

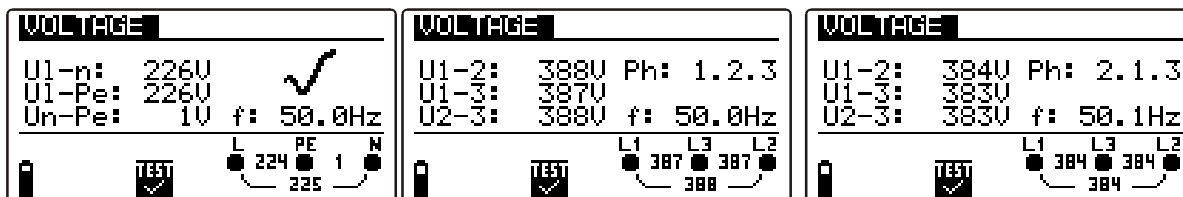


Figure 5.4: Examples of voltage measurements in single- and three-phase systems

Displayed results for **single phase** system:

- U1-n..... Voltage between phase and neutral conductors,
- U1-pe..... Voltage between phase and protective conductors,
- Un-pe Voltage between neutral and protective conductors,
- f Frequency.

Displayed results for **three-phase** system:

- U1-2 Voltage between phases L1 and L2,
- U1-3 Voltage between phases L1 and L3,
- U2-3 Voltage between phases L2 and L3,
- Ph..... Phase sequence (1.2.3 – CW rotation sequence; 2.1.3 – CCW rotation sequence),
- f Frequency.

5.2 Line impedance

Line impedance is measured in loop comprising of mains voltage source and line wiring (L and N). The measurement is performed according to the IEC 61557-3 standard. In this function the instrument can be used as standard line / loop impedance tester.

See 4.3 *Single test* for keys functionality.



Figure 5.5: Line impedance

Optional connection for measurement of line impedance

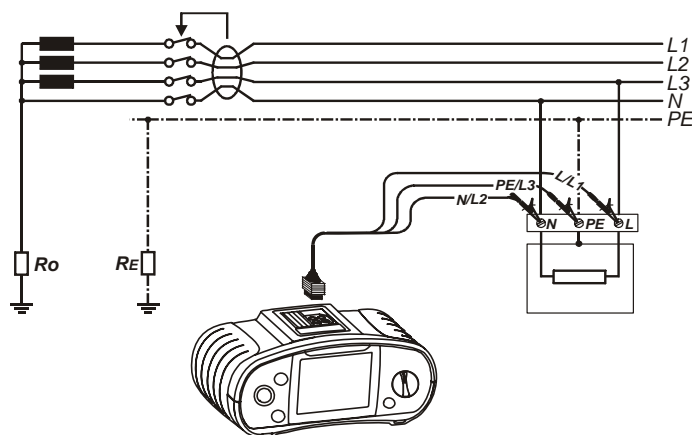


Figure 5.6: Line impedance measurement

Line impedance measurement procedure

- Select the **Z-LINE** function.
- Connect** test cable to the instrument.
- Connect** test leads to the tested object (see figure 5.6).
- Press the **TEST** key.

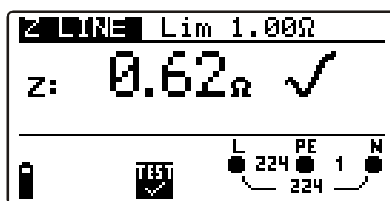


Figure 5.7: Example of line impedance measurement result

Displayed results:

Z.....Line impedance,

LimMaximum value of line impedance.

Note:

- High fluctuations of mains voltage can influence the measurement results.

5.3 Resistance to earth

The resistance to earth is measured by fault loop resistance procedure. The function can be applied on TT supply systems in the installation before protection devices.

See 4.3 *Single test* for keys functionality.

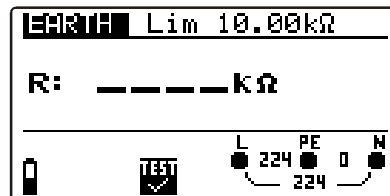


Figure 5.8: Resistance to earth

Optional connection for measurement of resistance to earth

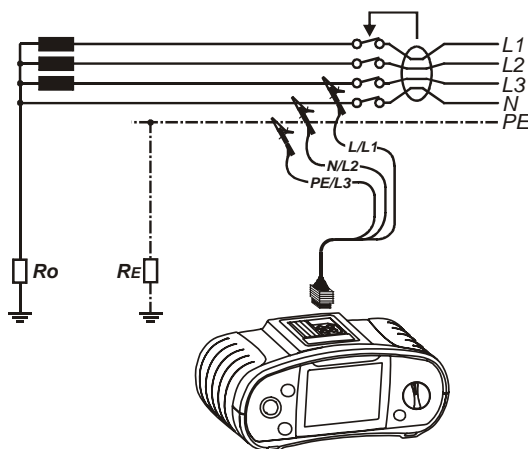


Figure 5.9: Example for resistance to earth measurement

Resistance to earth measurement procedure

- Select the **EARTH** function.
- Connect** test cable to the instrument.
- Connect** test leads to the tested object (see figure 5.9).
- Press the **TEST** key.



Figure 5.10: Example of earth resistance measurement result

Displayed result:
R.....Resistance to earth.

Notes:

- High fluctuations of mains voltage can influence the measurement results.
- Applicable in TT systems with earth resistance higher than 500 Ω.

5.4 I NEUTRAL

The function is intended to calculate the relative portion of total active (line) current that is returned into utility neutral conductor.

See 4.3 *Single test* for keys functionality.

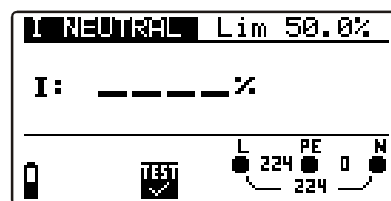
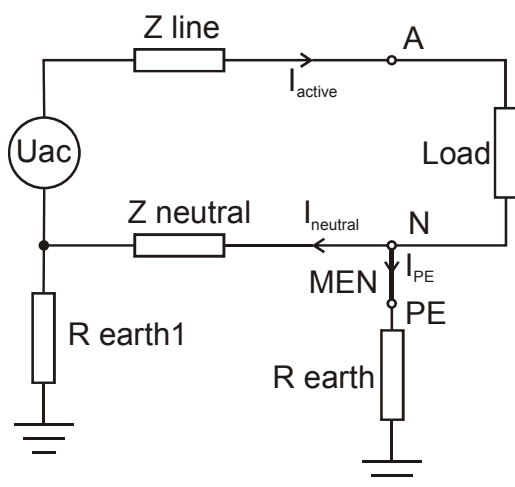


Figure 5.11: Example of line impedance measurement result

Measurement principle



Active current entering into consumers installation is split into returned neutral and PE current. The neutral current depends on impedance ratio of $Z_{neutral}/(R_{earth}+R_{earth1})$.

Figure 5.12: Neutral current measurement principle

I NEUTRAL measurement procedure

- ❑ Select the **I NEUTRAL** function.
- ❑ **Connect** test cable and clamp current transformer to the instrument.
- ❑ **Connect** test leads and clamp current transformer to the tested object (see figure 5.1).
- ❑ Press the **TEST** key.

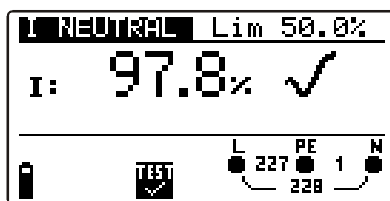


Figure 5.13: Example of N current measurement result

Displayed result:

I Part of current that is returned to N (neutral) conductor.

Notes:

- ❑ Use test clamp supplied by METREL or distributor only!
- ❑ **I NEUTRAL** function can be disabled, see, chapter 4.4 for additional information.



Figure 5.14: Disabled I NEUTRAL function

5.5 Testing PE terminal

It can happen that a dangerous voltage is applied to the PE wire or other accessible metal parts. This is a very dangerous situation since the PE wire and PE collectors are considered to be earthed. An often reason for this fault is incorrect wiring (see examples below).

The user automatically performs this test in all functions when touching the **TEST** key.

Examples for application of PE test terminal

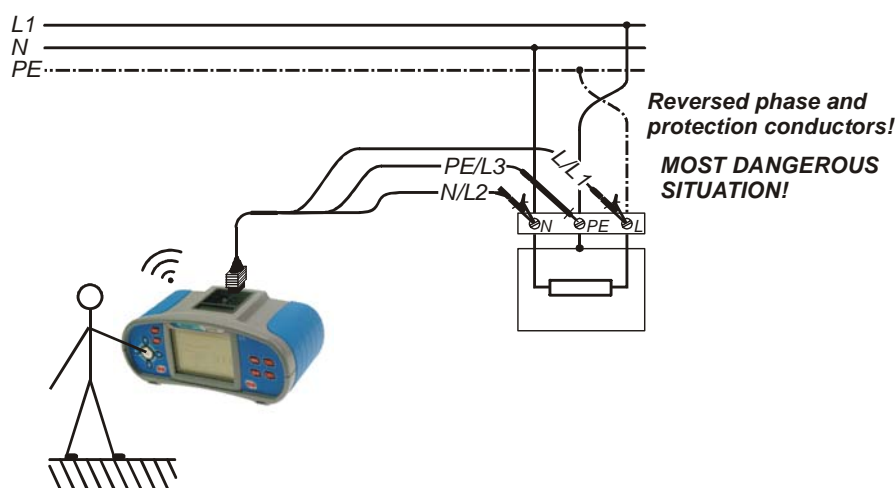


Figure 5.14: Reversed L and PE conductors

PE terminal test procedure

- ❑ **Connect** test cable to the instrument.
- ❑ **Connect** test leads to the tested object (see figures 5.14 and 5.15).
- ❑ Touch PE test probe (the **TEST** key) for at least one second.
- ❑ If PE terminal is connected to phase voltage the warning message is displayed, instrument buzzer is activated, and further measurements are disabled.

Warning:

- ❑ If line voltage is detected on the tested PE terminal, immediately stop all measurements, find and remove the fault!

Note:

- ❑ PE test terminal does not operate in case the operator's body is completely insulated from floor or walls!

In new or adapted installations it may occur that the PE conductor is reversed with the phase conductor – this is a very dangerous situation! This is why it is important to test for the presence of phase voltage at the PE protection terminal.

The test is performed before tests where mains supply voltage is applied to the instrument circuitry or before installation is used.


6 Maintenance

6.1 Replacing fuses

There are two fuses under back cover of the Polarity instrument.

- F2, F3
F 4 A / 500 V, 32×6.3 mm
General input protection fuses of test terminals L and N.

Warnings:

-  Disconnect any measuring accessory and power off the instrument before opening battery/fuse compartment cover, hazardous voltage inside!
- Replace blown fuse with original type only, otherwise the instrument may be damaged and/or operator's safety impaired!

Position of fuses can be seen in figure 3.4 in chapter 3.3 Back panel.

6.2 Cleaning

No special maintenance is required for the housing. To clean the surface of the instrument use a soft cloth slightly moistened with soapy water or alcohol. Then leave the instrument to dry totally before use.

Warnings:

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

6.3 Periodic calibration

It is essential that the test instrument is regularly calibrated in order technical specification listed in this manual can be guaranteed. We recommend an annual calibration. An authorised technical person should do the calibration only. Please contact your dealer for further information.

6.4 Service

For repairs under warranty, or at any other time, please contact your distributor. Unauthorised person is not allowed to open the instrument. There are no user replaceable components inside the instrument, except the fuses, refer to chapter 6.1 *Replacing fuses*.

7 Technical specifications

7.1 Line impedance

Measuring range according to EN61557-3 is 0.25 Ω ÷ 19.9 Ω .

Measuring range (Ω)	Resolution (Ω)	Accuracy
0.00 ÷ 19.99	0.01	$\pm(5\%$ of reading + 5 digits)

Pass value: $\leq 1.00\ \Omega$

Test current (at 230 V) ca. 7 A

Nominal voltage range 100 V ÷ 270 V (45 Hz ÷ 65 Hz)

7.2 Resistance to earth

Measuring range (k Ω)	Resolution (Ω)	Accuracy
0.50 ÷ 19.99	0.01	$\pm(5\%$ of reading + 2 digits)
20.0 ÷ 49.9	0.1	

Pass value: $\leq 10.00\ \text{k}\Omega$

Test current (at 230 V / RE = 10k Ω) ca 20mA

Nominal voltage range 100 V ÷ 270 V (45 Hz ÷ 65 Hz)

7.3 N conductor current

Measuring range (%)	Resolution (%)	Accuracy
0 ÷ 100	1	$\pm(5\%$ of reading + 3 digits)

Pass value: $\geq 50\%$

Maximum continuous input current 300 mA

(=300 A @ current clamp with ratio 1000:1)

Overall test current (at 230 V) ca. 7 A

Nominal frequency 45 Hz ÷ 65 Hz

Additional clamp error has to be considered.

7.4 Voltage and frequency

Given accuracy is valid for all displayed voltages.

Measuring range (V)	Resolution (V)	Accuracy
0 ÷ 500	1	$\pm(2\%$ of reading + 2 digits)

Nominal frequency range 0 Hz, 45 Hz ÷ 65 Hz

Measuring range (Hz)	Resolution (Hz)	Accuracy
45.0 ÷ 65.0	0.1	± 2 digits

Pass values:

- Active to Neutral voltage: > 215 V
- Active to Neutral voltage: < 270 V
- Neutral to Earth voltage < 5 V

- Neutral to Earth voltage less than Active to Earth voltage

7.5 Online voltage monitor

Measuring range (V)	Resolution (V)	Accuracy
0 ÷ 500	1	±(2 % of reading + 2 digits)

Nominal frequency range..... 0 Hz, 45 Hz ÷ 65 Hz

7.6 General data

Power supply voltage..... 9 V_{DC} (6×1.5 V battery cells, size AA)

Power supply adapter 12 V ÷ 14 V / 400 mA

Battery charging current < 250 mA (internally regulated)

Operation..... typical 50 h

Overvoltage category..... CAT IV / 300 V

Protection classification double insulation

Pollution degree..... 2

Protection degree IP 42

Display 128×64 dots matrix display with backlight

Dimensions (w × h × d)..... 23 cm × 10.3 cm × 11.5 cm

Weight (without battery)..... 1.21 kg

Reference conditions

Reference temperature range 10 °C ÷ 30 °C

Reference humidity range 40 %RH ÷ 70 %RH

Operating conditions

Working temperature range..... 0 °C ÷ 40 °C

Maximum relative humidity 95 %RH (0 °C ÷ 40 °C), non-condensing

Storage conditions

Temperature range -10 °C ÷ +70 °C

Maximum relative humidity..... 90 %RH (-10 °C ÷ +40 °C)

80 %RH (40 °C ÷ 60 °C)

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