UNITEST®

GB **Instruction Manual**
Cat. No. 9019/9020

EURO EXPERT *plus*

References marked on instrument or in instruction manual:

⚠ Warning of a potential danger, comply with instruction manual.

☞ Reference. Please use utmost attention.

⚠ Caution! Dangerous voltage. Danger of electrical shock.

⧈ Continuous double or reinforced insulation complies with Category II/IEC 60536.

⚠ Warning of potential danger caused by batteries.

CE Conformity symbol, the instrument complies with the valid directives. It complies with the EMC Directive (89/336/EEC), Standards EN 61326, EN 50081 and EN 50082-1 are fulfilled. It also complies with the Low Voltage Directive (73/23/EEC), Standard EN 61010-1 is fulfilled.

⚠ **The instruction manual contains information and references necessary for safe operation and maintenance of the instrument.** Prior to using the instrument (commissioning / assembly) the user is kindly requested to thoroughly read the instruction manual and comply with it in all sections.

⚠ Failure to read the instruction manual or to comply with the warnings and references contained herein can result in serious bodily injury or instrument damage.

1.0 Introduction

You have purchased a high quality measurement instrument of Ch. BEHA GmbH which will allow you to carry out measurement over a long period of time. The company Ch. BEHA GmbH is a member of the world-wide operating BEHA Group with its head office in Glottertal/ Schwarzwald which also houses our developement centre. The BEHA Group is a leading organisation for Test and measuring instruments.

1.1 Model and Type Designation

The type shield sticker is located on the rear of the instrument. It contains the instrument serial number and product designation. When questions arise regarding the instrument, please always quote product designation and serial number.

1.2 Produkt Description

The UNITEST EURO EXPERT plus is a portable, microprocessor-controlled test instrument for installation testing in compliance with IEC 60364, IEC 61557, IEE 16th Edition and DIN VDE 0100.
The values which may be stored in the instrument, can be assigned to any selected test object (i.e., outlet or distribution board) by the input of a number (i.e., electric circuit number and department / place number).

The UNITEST 0100-Expert plus is characterised by the following features:

- Loop Impedance Measurement- and Prospective Short Circuit Current Measurement up to 250V
- Internal Line Resistance Measurements- and Prospective Short Circuit Current Measurement up to 440V
- Phase Rotation Test up to 440V
- RCD-Analysis (Contact Voltage, trip time, Trip current, residual trip current with ramp methode)
- RCD-Analysis to test all parameters of an RCD
- Low Ohm measurement from 0...20 Ω
- Insulation resistance measurement up to 1000 V, aditional for 690-V-industrial systems
- Earth resistance 2-/3- and 4-pole
- Earth resistance in compliance with the Wenner method
- Voltage- and Frequency measurement
- Integrated socket test with contact electrode to determine incorrectly wired sockets or missing protective earth conductor
- Memory for approx. 800 measurements with assignment to distribution and current circuit in two levels
- Integrated data logger (1500 measurement values) for recording and monitoring the mains voltage
- Commander (optional) for remote control of the functions "Start Measurement" and "Save"
- Clear and easy function selection via rotary switch
- Connection figures inside instrument cover
- Standard built-in RS232-interface to transfer the measurement data to the PC
- With standard built-in printer for immediate printout of measurement data (model 9020 only)
- UNITEST software available (optional)
- Built in compliance with IEC 61010, IEC 61557, EN 61010, EN 61557, DIN VDE 0413 , DIN VDE 0411

1.3 Scope of Supply

1 pcs. UNITEST EURO EXPERT plus
1 pc Test lead with “Schuko” mains plug
1 pc 3 pole Test lead
3 pcs Croccodile clamps
3 pc Test probes
1 pc. Shoulder Strap
1 carrying holster for accessories
4 pcs. batteries 1,5 V, IEC LR 20 (Mono)
1 colour ribbon for printer (only model 9020)
10 quick reference guides
1 pc Instruction manual

1.4 Additional Options

UNITEST Software es control 0100 (Cat. No: 1251) Comfortable, software for processing measurement data.

UNITEST Protocol Printer (Cat. No: 1196) Serial printer for measurement data printout.

Interface cable (Cat. No: 1282) to connect the 0100-EURO EXPERT plus to the PC or an external printer.

Profi Accessory Package (Cat.. No..: 1103):
1 pc. Three-Phase Adaptor with selector switch L1, L2, L3
1 pc. Measurement Cable mains plug/Kupplung
1 pc. Measurement Cable 4-pole (for earth test)
1 pc. Measurement Cable 4,5 m black (for earth test)
1 pc. Measurement Cable 4,5 m green (for earth test)
1 pc. Measurement Cable 20 m blue (for earth test)
1 pc. Measurement Cable 20 m red (for earth test)
4 pc. Earth Rods (for earth test)
1 pc. Alu-Case

Three-Phase Adaptor (Cat. No.1118 E):
Three-Phase Adaptor with selector switch L1, L2, L3 for all measurements through a 16 A industrial plug/coupling *(see Profi-Set packaging Cat. No. 1103)*

UNITEST Commander 1 (Cat. No: 1218) . For measurements on Schuko sockets, equipped with remote control

UNITEST Commander 2 (Cat. No: 1223) . For insulation and low impedance measurements, equipped with remote control

UNITEST Helix Cable (Cat. No: 1137). For measurements on Schuko sockets

UNITEST Test labels 60 x 40 mm (250 pcs) (Cat. No: 1280) To prove performed measurements

UNITEST Hole punch with ◧ marking (Cat. No: 1237). To mark the test labels

UNITEST Hole punch with ⊙ marking (Cat. No: 1290). To mark the test labels

1.5 Spare Parts

Spare paper roll, Cat. No: 1068 (width 57,5 mm and max. diameter 60 mm) Ink ribbon, Cat. No: 1066.

2.0 Transport and Storage

Please keep the original packaging for later transport, e.g. for calibration. Any transport damage due to faulty packaging will be excluded from warranty claims.
In order to avoid instrument damage, we recommend that batteries are removed when not using the instrument over a certain period of time. However, should the instrument be contaminated by leaking battery cells, you are kindly requested to return it to the factory for cleaning and inspection.

Instruments must be stored in dry and clean areas. In the case of an instrument being transported in extreme temperatures, a recovery time of at least 2 hours is required prior to instrument operation.

3.0 Safety Measures

The UNITEST EURO RXPERT plus has been designed and checked in accordance with the safety regulations for Electronic test and Measurement Instruments EN 61010 and IEC 61010, and left our factory in a safe and perfect condition. The instruction manual contains information and references necessary for safe operation and maintenance of the instrument.

⚠ The respective accident prevention regulations established by the professional association for electrical systems and equipment must be strictly met at all times.

⚠ In order to avoid electrical shock, the valid safety and VDE regulations regarding excessive contact voltages must receive the utmost attention when working with voltages exceeding 120V (60V) DC or 50V (25V)rms AC. The values in brackets are valid for limited ranges (as for example medicine and agriculture).

⚠ Measurements in dangerous proximity of electrical installations are only to be executed when instructed by a responsible electrical specialist, and never alone.

⚠ Prior to usage, inspect the instrument and used test leads for external damage. Prior to any operation, ensure that connecting leads used and instruments are in perfect condition.

⚠ Only touch test leads and test probes at handle surface provided. Never directly touch test probes.

⚠ If the operator's safety is no longer guaranteed, the instrument is to be put out of service and protected against use. The safety can no longer be guaranteed if the instrument (or leads):

- shows obvious damage
- does not carry out the desired measurements
- has been stored for too long under unfavourable conditions
- has been subjected to mechanical stress duringtransport.

☞ Avoid any heating up of the instrument by direct sunlight to ensure perfect functioning and long instrument life.

3.1 Appropriate Usage

⚠ The instrument may only be used within the operating ranges as specified in the technical data section.

⚠ When modifying or changing the instrument, the operational safety is no longer guaranteed.

⚠ The opening of the instrument for fuse replacement, for example, may only be carried out by authorized professionals. Prior to opening, the instrument has to be switched off and disconnected from any voltages.

☞ Any maintenance and calibration tasks may only be carried out by our repair service staff.

4.0 Operating Elements and Display
4.1 Frontpanel

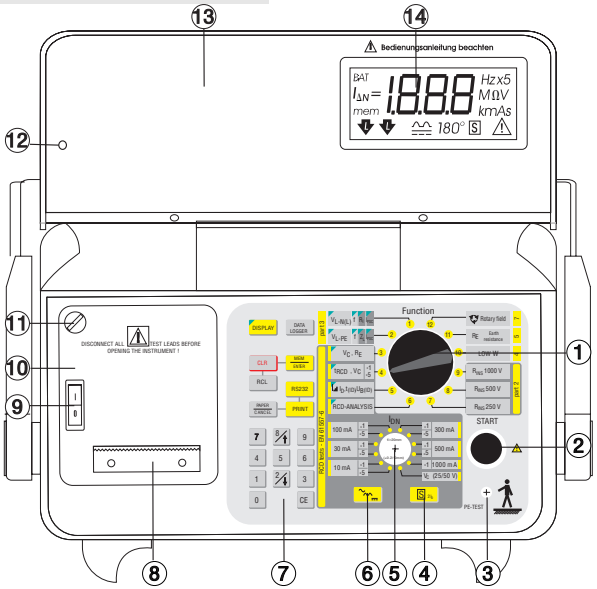


Figure 4.1 Frontpanel

Explanation of individaul operation an display elemtents:

1. Function selector switch.
2. START-pushbutton.
3. Contact-electrode PE-TEST for protective earth conductor-test. In order to check the earth connection, the contact electrode must be touched
4. Key “S” for choosing between standard and time-delayed RCD’s
5. “Rotary switch RCD nominal residual current“. With the test current selector switch you set the nominal trip current which is necessary for the RCD test. You can choose between single (x1) and fivefold (x5) nominal trip current..
6. Key ::::: for the curve shape of the RCD-Trip current.
7. Keypad for display, storing and output of the measurement data.
8. Paper tear off edge. (model 9020 only)
9. ON/OFF-switch.With this switch the instrument can be switched on or off.
10. Printer compartment with built-in matrix printer (only Model 9020).
11. Locking screw for the printer compartment. (only Model 9020). In cat. to replace paper or ribbon the printer compartment must be opened (see replacement of paper and replacement of ribbon).
12. Auto Power Off Pin, operates the OFF-switch when closing the instrument cover.
13. Instrument cover with short instructions, digital display and explanation of symbols.
14. Digital display.

4.2 Case and Connectors

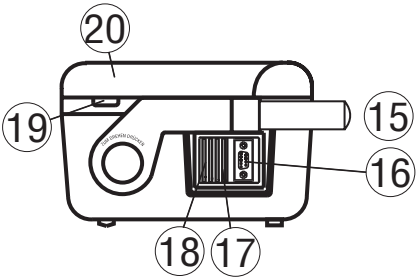


Figure 4.2 Case and Connections

15. Handle and shoulder strap.
16. Serial RS-232-interface.
    Setup
    Pin 2: TXD,
    Pin 3: RXD,
    Pin 5: GND
17. Connectors for the test leads (under moveable cover).
18. Moveable cover, protects from simultaneous using of interface
    and connectors.
19. Recess for opening of instrument lid.
20. Instrument lid.

4.3 Measurement connections

⚠ Only original test leads supplied and may be used!

⚠ The maximum admissible voltage of test connectors towards earth is 250V AC ! The maximum admissible voltage between the test connectors is 440V AC!

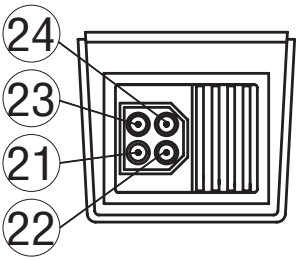


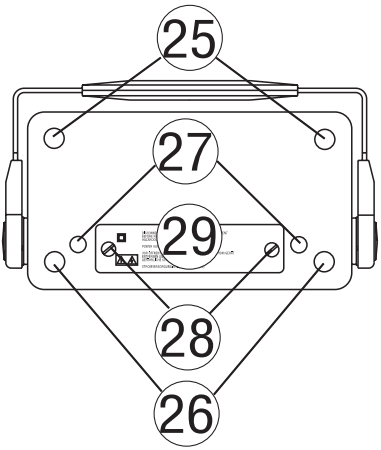
Figure 4.3 Measurement connectors (17)

Explanation of individual connectors:
21. Measurement connect for L/L1/E
22. Measurement connect for N/L2/H
23. Measurement connect for PE/L3/ES
24. Measurement connect for S

4.4 Instrument rear

Figure 4.4 Instrument rear and battery case

25. Plastic screw cover with case-screw beneath.
26. Rubber foot.
27. Plastic cover with case-screw.
28. Battery compartment screw.
29. Plastic cover.



4.5 LC-Display with Units, Symbols and Various Messages

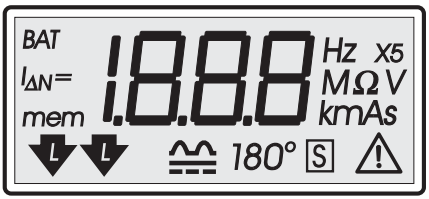


Figure 4.5 LC-Display

o.r. Overrange: Test range exceeded, test result is greater than the maximum measurable value. The respective maximum measurable value is given in the technical data.

d IS No Mains Voltage: No mains voltage exists, check connections or voltage source.

Fr Frequency out of Range: The frequency of the supply voltage is beyond the range 45 ...65 Hz.

rcd Reactivate RCD: The RCD-circuit breaker has been tripped by a test. Switch RCD on again.

P x Programme 1-8: Indication of the programme steps during RCD-analysis, see also section “Automatic RCD-analysis“.

Er x Error 1-8: Indication of a fault occurring at test step x of the RCD-analysis, see also section “Automatic RCD-analysis“.

hot Thermal Overload: The internal temperature control has reacted. The tests are inhibited until the instrument has cooled down.

CLr Memory Clear: Confirmation that the memory has been deleted.

PE Attention PE Failure: Voltage at PE or PE not connected. Do not continue testing!

rC Current Probe Resistance Exceeded: – see para 6.3 “Measurement Earth resistance

rP Potential Probe Resistances Exceeded:– see para 6.3 “Measurement Earth Resistance

mem Confirms storing or request of a stored measurement data.

BAT Low Battery: Batteries exhausted, see “Replacement of battery“ as described in section 8.2.

L Display of Phase Polarity: Automatic phase selection. The phase polarity of the socket is indicated.

L L Phase and PE reversed, Attention PE-Error!, PE under voltage.

X5 Multiplier: RCD trip current is multiplied by 5 (trip currents see in technical data).

d__ *Distribution number: Requests the input of a three-digit number (up to max 254) at storing of test data for indentification and assignment of the test data to the respective distribution.*

C__ Electric Circuit Number: Requests the input of a three-digit number (up to max 254) at storing of test data for indentification and assignment of the test data to the respective electric circuit.

no Memory locations Empty: No measurement exists under the electric distribution circuit or number given.

toP Top of Memory: Last test result stored.

bot Bottom of Memory: First test result stored.

Prt Send to internal Printer: Output on built-in printer.

SEr RS 232 Communication: Output to serial interface.

ALL All values in Memory: Query whether the complete memory content should be printed or deleted.

rS RS-232 Communication, (for service only.)

LOG Display at Data Logger function: The following test data will be displayed: the minimum value, the maximum value, number of all test data and the test interval.

FUS Fuse Blown: The built-in fuse has blown, for replacement of fuse see section “Fuse Replacement“.

 Measurement value out of limits, Attention: PE live or open !

 The time-delayed RCD-test is activated. The RCD-test will be carried out with double nominal current.

180° Start at negative polarity: Test of RCD will be started with negative half-wave.

 Shape of RCD-test current, see table RCD-trip currents in section “ RCD-analysis“.

4.6 Keypad

27. Key “PAPER/CANCEL“This key is used for paper feed or cancel during printing.

28. Key “RCL“ This key is used for the output of a stored test data to the display.

29. Key “CLR“ Double pressing deletes the complete data memory.

30. Key “DISPLAY“ During some of the tests e.g. V(L-N) / f, V(L-PE) / f, VC / RE, tRCD / VC and IDRCD, multiple data per test will be measured. With the key “Display“ the individual results can be displayed on the LC-display. The types of tests in which multiple parameters are measured, are indicated by a green triangle.

31. Key “DATA LOGGER“ This key activates the Data-logger function for the voltage between L-N or L-PE. The test-interval can be set (see also para 6.7 “Recording of voltage L-N or L-PE“).

32. Key “MEM/ENTER“ By using this key the test data on the display or the last measured data will be stored *(see also para 7.0 “Storing and processing of the test data“).*

33. Key “RS 232“ For transmitting the stored test data via the interface to a PC *(see also para 7.0 “Storing and processing of the test data“).*

34. Key “PRINT“ In order to print a test result on the built-in printer, the key “Print“ must be pressed *(see also para 7.0 “Storing and processing of the test data“).*

35. Numerical Keypad
    The keypad is used to enter the current circuit and department/place-number, when storing test data. Thus, a direct assignment of the test result to an electric circuit and place can be acheived. During the function “Data Logger“ the test interval can be entered from 1 to 99 seconds.

    The key “CE“ enables the correction of the last input number.

    The keys  and  are used to select the contact voltage limit during RCD-tests, as well as to select stored test results from the memory to the LC-display.

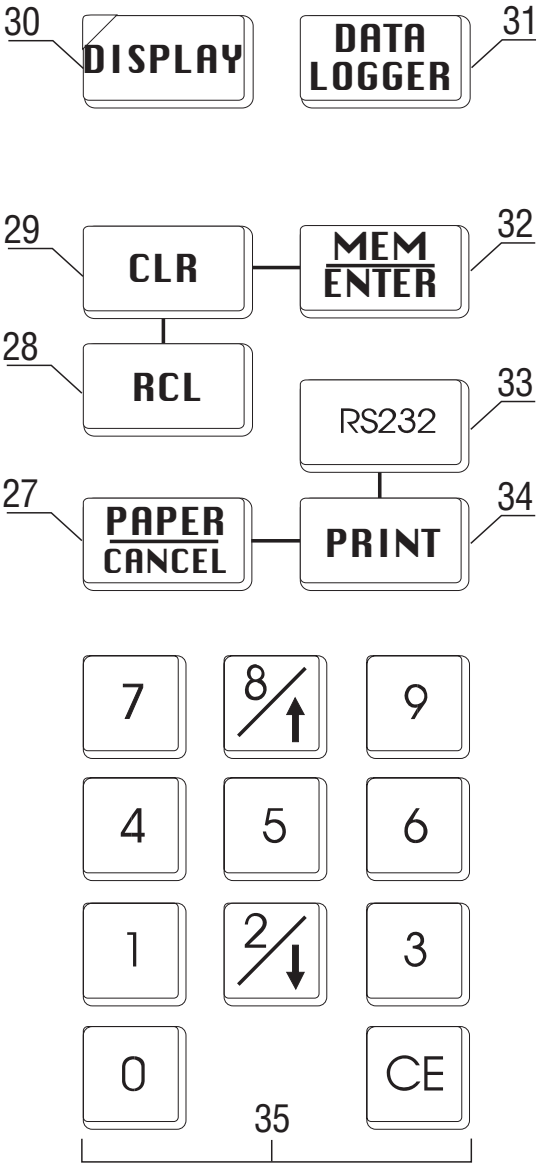


Figure 4.6 Keypad

5.0 Commissioning

5.1 Insertion of Batteries

The UNITEST EURO-EXPERT plus is supplied with four batteries. The capacity of the batteries is approx. 500 h when using alkaline-cells, type IEC LR 20.

⚠ Prior to battery replacement, switch of and disconnect the instrument from the connected measurement circuits and test leads.

⚠ The correct positioning of the batteries is shown on the battery casing bottom.

⚠ Respect battery polarity to avoid instrument destruction, explosion or fire.

⚠ Only use batteries complying with the technical data specifications! (4 pcs 1,5V Type IEC LR 20 Mono).

⚠ Never try to disassemble battery cells !The battery contains highly alkaline electrolyte. Danger of causticization ! If electrolyte gets in contact with skin or clothing, rinse immediately with water. If electrolyte gets in contact with the eyes, immediately flush by using pure water and consult a doctor.

☞ Please consider your environment when you dispose of your used batteries. They belong in a rubbish dump for hazardous waste. In most cases, the batteries can be returned to their point of sale.

⚠ Please, comply with the appropriate regulations concerning the return, recycling and disposal of used batteries.

⚠ If an instrument is not used over an extended period of time, the batteries must be removed. Should the instrument be contaminated by leaking battery cells, the instrument has to be returned for cleaning and inspection to the factory.

☞ When replacing the batteries always replace the set of 4. Only use non-leaking batteries, type IEC LR 20 (Alkaline).

For battery insertion please proceed a follows:

- Loosen the screw (28) of the battery compartment (29) and open the compartment.

.

- Insert the new batteries, type IEC LR20 (1.5 V) correctly polarized.
- Ensure that good contact is made.
- Close the battery compartment.

Now you can start with measurement.

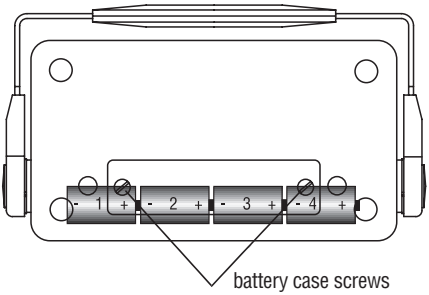


Figure 5.1 Battery case

5.2 Insertion of Printer-Ribbon (Model 9020 only)

⚠ Prior to insertion of Printer-Ribbon, switch off and disconnect the instrument from the connected measurement circuits and test leads..

- Loosen the locking screw (11) and open the printer compartment (14).
- Take the ribbon out of the packaging
- Carefully insert the new ribbon. Do not use force.
- Tighten the ribbon by turning the rippled wheel in the direction of the arrow.

5.3 Insertion of printer paper (Model 9020 only)

The printer paper is already insert in new instruments. Inserting the printer see chapter 8.4.

6.0 General Information for Carrying out Measurements

⚠ The respective accident prevention regulations established by the professional association for electrical systems and equipment must be strictly met at all times.

⚠ Measurements in dangerous proximity of electrical installations are only to be executed when instructed by a responsible electrical specialist, and never alone.

⚠ Prior to usage, inspect the instrument and test leads for external damage. Prior to any operation, ensure that connecting leads used and instruments are in perfect condition.

⚠ Only touch test leads and test probes at handle surface provided. Never directly touch test probes.

⚠ The instrument / leads may only be connected to input voltage up to 440V AC/DC to avoid instrument damage.

⚠ When measuring on earthed sockets or on equipment protected by PE, it must be checked that the PE connection is correct. Prior to measurement, briefly touch the contact electrode PE-test (3) on the instrument when test leads connected. If a signal sound is audible and the LCD indicates "Attention PE error!", the PE connection must be checked ! The testing can only be carried out once the PE connection is correct ! **During PE testing special care has to be taken that the measurement result is not influenced by insulated floor or site.**

⚠ The UNITEST EURO EXPERT plus automatically carries out the PE test, if the 'Measurement Function' rotary switch is set to one of the following functions: Ri/IPSC (1), ZL/IPSC (2), VC/RE (3), tRCD/VC (4) I(5) or RCD Analysis (6). For this, the operator must touch the contact electrode 'PE-TEST' (3) after having connected the test leads. If an error message is displayed, further performance of the measurement is disabled.

☞ The arrow in the LC-display shows the polarity of the phase at the mains plug. The red indicator at the mains plug corresponds with the black indicator of the plug symbol on the instrument cover.

☞ The UNITEST EURO EXPERT plus automatically reverses the L-N measurement connections within the required measurement functions (e.g. for RCD measurements, ZL and Ri measurements, etc.). There is no need to exchange the test leads L-N or to turn the mains plug.

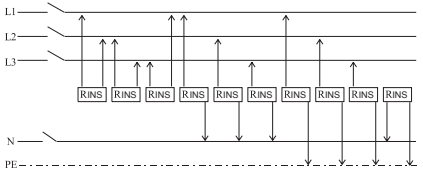
☞ When carrying out the measurement functions: loop impedance measurement, internal mains resistance measurement, and RCD measurements using large nominal trip currents, the instrument might heat up. Once the overtemperature protection has responded, the message "hot" is displayed. All further measurements will be disabled until colled down, to avoid instrument damage.

☞ Measurements have to be carried out in compliance with the respectively valid national and international standards or regulations.

6.1 Measurement of Insulation Resistance R_{INS} (Function 7,8,9)

For electrical installations the insulation measurement has to be carried out prior to final commissioning. This measurement is of basic importance as the insulation measurement is considered to be the only measurement for fire protection. If, due to an insulation error, a limited fault current flows between two conductors, this leads to a heating up or even to a fire. Only the insulation measurement procedure can detect such a fault.

Example Insulation Measurement:



According to IEC 60364 (DIN VDE 0100 Part 610) the insulation resistance measurement is carried out:

- from all phase conductors (e.g. L1, L2, L3) towards earth or to protective earth (PE)
- between protective earth (PE) and neutral (N)

Additionally, it is advised to perform the following measurements:

- between all active conductors (e.g. L1, L2, L3, N).

This measurement has to be carried out separately for each current circuit.
The measurement is performed using DC voltages from 500 V.

⚠ Prior to any insulation measurement ensure that the system parts to be tested are voltage free.

☞ If a voltage exceeding 30V AC/DC is present at test leads, the respective voltage is displayed. Further measurement is disabled.

⚠ During insulation measurement all loads must be disconnected from the mains. Furthermore, ensure that all interruptors of the system being tested are switched on.

⚠ During the measurement the UUT/ the system being tested may not be touched. Danger of electrical shock!

⚠ The insulation measurement causes the capactive UUTs to be charged by the test voltage. The instrument UNITEST EURO EXPERT plus automatically discharges the UUT after the completion of measurement. When interrupting the measurement or when removing the test leads prior to the completion of measurement, a dangerous voltage may be present at UUT. If a dangerous voltage is detected during voltage measurement, the UUT must be discharged manually, using a high-resistant load (not via short-circuit !).

6.1.1 Carrying out the Measurement

- Ensure that the test object is voltage free.
- Switch on UNITEST EURO EXPERT plus via switch "ON/OFF" (9).
- Set the measurement range needed by using the function switch (8). RINS (7,8,9), choose the test voltage 250/500/1000V).

☞ You will find a overview of the type of installation and the proper test voltage in table 6.1.1 and 6.1.2.

- Use the test leads with the 3 safety plugs and fit test probes or clamps to these plugs as required. The polarity of the black test cable (L/L1) is "+", the polarity of the blue test cable (N/L2) is "–". The green test cable is not required.
- Connect the test lead to the measurement connector (17) of the EURO-EXPERT plus.
- Connect the test cables to the test object, refer to figure 6.1

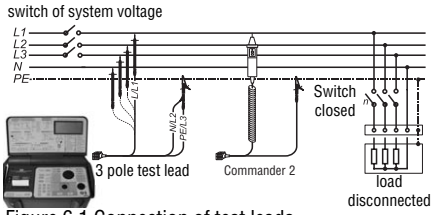


Figure 6.1 Connection of test leads

- Press the key "START" (2). The test voltage will be applied to the test object for approx. 2 seconds or is applied as long as the key is held pressed. Immediately on completion of test, the UUT is automatically discharged.
- Read the insulation resistance value on the LC-display. The measured value will be displayed until a new test is started or a different measuring function is chosen.

☞ The range which offers the highest resolution will be automatically chosen. If the measured value is higher than 200 MΩ, "o.r." appears on the display. Enter the respective test protocol ">200 M _" if this value has to be recorded.

☞ When measurements involving long lengths of cables are performed, the "START key must be kept pressed until the capacitance of the cable has fully charged, and the display has stabilised to a steady value.

Table 6.1.1: Test Voltages

System Description / Nominal Voltage	Test Voltage	Limit
Other testing, Signal systems	50 V	-
Derivation ability of flooring materials acc. to DIN 51953	100 V	1 MΩ
SELV / PELV system	250 V	0,25 MΩ
Systems up to 500V (except SELV /PELV)	500 V	0,5 MΩ
Systems above 500V to 1000V	1000 V	1 MΩ

Table 6.1.2 shows limits for the value of insulating resistance and the appropriate minimum display values allowing for the instrument's accuracy.

Requested Insulating Resistance	Minimum Display
0.100 MΩ	0.104 MΩ
0.250 MΩ	0.257 MΩ
0.500 MΩ	0.512 MΩ
1.000 MΩ	1.022 MΩ
10.00 MΩ	10.22 MΩ

☞ By using the key "MEM/ENTER" the measured value can be stored in the internal data memory.

The instrument will now request that a distribution number (e.g. a number used to denote a distribution to be tested) be entered, followed by a current/circuit number (e.g. a number to denote a room within the aforementioned circuit at which the measurement was made).

This is accomplished by using the numbered keypad. If a number is keyed in by mistake and not yet confirmed it can be deleted by using the "CE" key.

Storing and processing of the test data – see also section 7.0 "Storing and Processing of the Measurement Data".

6.1.2 Example

Table 6.1.3 shows some values of insulating resistances which are to be expected with different materials. From this table you can see that the rates measured on a faulty installation lie far below the requested standard values when the material is a bit damp or wet.

Measurement was against a metal sheet of approx. 7 cm^2 which was cast in the material against a uninsulated wire which stuck approx. 2 cm in the material (e.g. site of a nail).

Table 6.1.3: Examples of insulation resistance

Material	Insulating Resistance
NYM 3x 1,5mm2 50m	approx 300MΩ*
Concrete, dry	approx. 25 MΩ
Plaster, dry	approx. 80 MΩ
Gypsum, dry	approx. 200 MΩ
Concrete, wet	approx 10 kΩ
Plaster, wet	approx. 6 kΩ
Gypsum, wet	approx. 4 kΩ

*The insulation resistance of conductors is well above the estimated value.

6.2 Low Ohm Measurement R LOW Ω (Function 10)

This measurement is used to verify earthed conductors, earthing conductors and equipotential bonding conductors for low-resistant continuity. Furthermore, by opening the bridge between PE and N wrong wired sockets (N and PE exchanged) can be detected. In practical use the low-resistant measurement is always used when low-resistant connections between earthed conductors and equipotential bonding conductors must be verified to ensure protection against dangerous shock currents.
The measurement is carried out at a DC current of >200mA and a maximum test voltage of approx. 4-7V. During the measurement the test current polarity is reversed.

⚠ Prior to any measurement ensure that the system parts to be tested are voltage free.

⚠ The test results can be influenced if impedances of other circuits connected in parallel are not taken into account, and especially in networks where the neutral is not disconnected from the protective earth conductor.

☞ If a voltage of over 10 V AC/DC is present at the input connectors of the EURO EXPERT plus, the voltage will be displayed in a blinking mode. The LOW Ω measurement is then inhibited.

☞ The test is carried out with a DC current of more than 200 mA which automatically changed polarity. The displayed value is the average value from both measurements.

6.2.1 Carrying out measurement

☞ Before each test the resistance of the test cables must be determined and compensated for. See also chapter 6.2.2.

⚠ Prior to any measurement ensure that the system parts to be tested are voltage free.

- Switch on UNITEST EURO EXPERT plus via switch "ON/OFF" (9).

- Turn function switch (1) into position “LOW Ω (10)“.

☞ The tables 6.2.1 and 6.2.2 shows some examples of measurements and max. display values.

- Use the test leads equipped with the three safety plugs and connect test probes or alligator clamps, as requested. The black lead (L/L1) polarity is "+", the blue lead (N/L2) polarity is "–".

☞ The connector PE (green) may be connected either with N or left open !

- Connect the desired test lead to the measurement connector (17) of UNITEST EURO EXPERT plus..

- Carry out test lead compensation. If you wish to compensate test leads or measurement accessories, please refer to section 6.2.2.

- Connect the test leads to UUT in accordance with Figure 6.2.1. or 6.2.2.

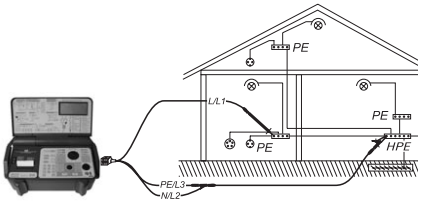


Figure 6.2.1 Connection of test leads

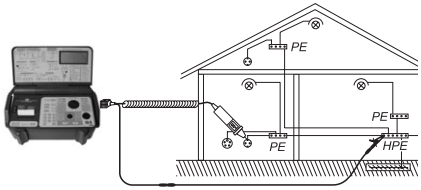


Figure 6.2.2 Connection of Commander 2

- Press the “Start“ key (2). The measurement will start.

- Read the measured value on the display. The measurement value is displayed until a new measurement procedure is started or a different measurement function is selected.

☞ If the measurement values exceed 20 Ω, "o.r." is displayed on the LCD. To protocol this value, ">20 Ω " must be entered into the respective test protocol.

The table 6.2.1 gives an overview of the plants or installations where a low ohm test is required.

Type of Installations or Plants	Test to be Carried Out
Insulated voltages	Are several appliances connected with the potential compensating conductor ?
Main potential compensation	Are all conductive pipe systems connected with PE ?
Over current protection in TN- or TT-systems	Is the PE connection ok ? Substitute for measurement of loop resistance. The loop must be measured at least once at the electrically most unfavourable location (end of cable).
RCD in TN- or TT-systems	Is the PE connection ok ? Substitute for RCD-Test. The RCD-test must be measured at least once at the electrically most unfavourable location.
IT-systems	Is the potential compensation conductor or the protective conductor ok ?

The table 6.2.2 shows some examples of measured values which have to be displayed to ensure the required value is conformed to, taking into account the instrument's accuracy.

Required Resistance	Maximum Indicated Measured Value
0.1 Ω	0.08 Ω
0.2 Ω	0.18 Ω
0.3 Ω	0.27 Ω
0.4 Ω	0.37 Ω
0.5 Ω	0.47 Ω
0.6 Ω	0.57 Ω
0.7 Ω	0,67 Ω
0.8 Ω	0.76 Ω
0.9 Ω	0.86 Ω
1.0 Ω	0.96 Ω

☞ By using the key "MEM/ENTER" the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section "Storing and Processing of the Test Data".

6.2.2 Test Lead Compensation

If the test lead resistance strongly affects the test result at Low Ohm or loop measurements, the user has the option to compensate the resistance of test leads and test accessories.

- Connect the test lead extensions, test probes, or alligator clamps required for the measurements to the EURO EXPERT plus test leads. Of course, further test leads can be plugged as extensions between the connection lead and the test probes.

- Short-circuit the end of the test leads in compliance with Figure 6.2.2. When dealing with the test lead equipped with an earthed plug, connect the contact pins L and N.

Figure 6.2.2 Test leads connection

- Turn the rotary switch 'Measurement Function' (1) from the function LOW Ω (10) to a different measurement function and then turn it back to the function LOW Ω (10).

- Press the "MEM/ENTER" key (32). Now, "k" is displayed on the LCD.

- Press the key "START" (2). The instrument determines the conductor and transition resistance, saves the value, and compensates the test leads resistance values. The LCD is reset to '.00'.

- To delete the test lead compensation, leave the test leads open for step 2, and proceed again with the above mentioned steps.

☞ The performed test lead compensation affects the measurement functions of low impedance measurement LOW Ω (10), interal mains resistance RI/IPSC (1), and loop impedance ZL/IPSC (2). The message 'CAL' is displayed on the LCD when selecting this measurement function, as reference to the activated test lead compensation.

☞ The test lead compensation is maintained even after switching the instrument off.

☞ It is possible to compensate test lead resistance values up to 5.00 Ω. Thus, even test lead extensions of lengths of approx. 290 m (for copper conductors 1 mm^2) may be used.

☞ Values exceeding 5 Ω cannot be compensated. The measurement value'.00' is displayed on the LCD instead. A test lead compensation will not be carried out.

6.3 Earth Resistance Measurement (Function 11)

The built-in earth test in the EURO-EXPERT plus is a genuine (battery-powered) earth resistance measurement in compliance with EN61557-5, DIN VDE 0413 part 5, .

General Information regarding Earth measurements:

The earth resistance is the resistance between reference earth and the connecting point of the earthing system. The earthing system is required to bring each system parts and circuits to a reference potential as close as possible to the reference earth. It is recommended to perform earth measurements in systems as lightning protection, telecommunication and tank parks.

The built-in earth measurement of the UNITEST EURO-EXPERT plus is an earth resistance measurement in accordance with the voltage/current measurement method. The power is supplied by the built-in batteries. The earth resistance is determined in accordance with the voltage/current measurement method. Earthing represents an essential part of a power supply system. Earthing is required to bring the individual system parts and current circuits to a common reference potential close to the reference earth. Earthing is also used to protect systems from overvoltage or short-circuit currents.

The earth resistance must be of sufficiently low impedance. The limit values are defined within national or international standards. Earthing or earth resistance is comprised of the earth conductor (equipotential bonding conductor or PE), the earth connector (foundation earth, rod earth, band earth...), and the earth connector spreading resistance, which is the resistance between earth connector and reference earth. A voltage funnel is formed around any earth connector depending on the earth connector shape and the surrounding soil. Assuming that the soil is uniform throughout with a uniform temperature as well as uniform humidity, the voltage funnels around the earth are of concentric shape.

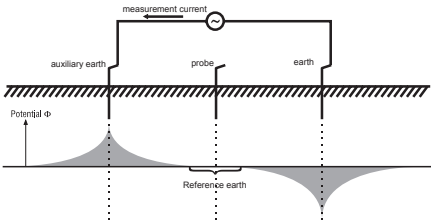


Figure 6.3.1: voltage funnel

The lower the earth resistance, the smaller the voltage funnels. When determining the earth resistance, the voltage drop is measured which is generated by a known and constant current applied to the earth electrode to be measured.

The following measurement methods can be applied with the UNITEST EURO-EXPERT plus for earth resistance determination: Earth measurement using two probes, two-, three- or four-poles. Measurement of specific earth resistance in accordance with the method 'Wenner'.

Definition of terms

Earth connector (E): The earth connector is a connector being inserted into the soil or into a foundation and is a conductive connection to the earth (e.g. foundation earth in concrete).

Earth probe (ES): Probe or earth rod being closest to the earth connector.

Reference earth: An area of the soil which is at such a distance to the respective earthing conductor that no noticeable voltages caused by the earth current occur between any points within this range.

Auxiliary Earth (H): Additional earth connector conducting the measurement current required for the measurement.

Probe (S): An additional probe, preferably an earth rod, used for measurement purposes as potential probe for the reference earth.

Spreading resistance of an earth connector: The soil resistance between earth connector and reference earth.

☞ To carry out earth measurement using a **UNITEST Profi Set Package (Cat. No. 1103)**.

⚠ The measurement instrument may only be connected to earth connectors which are voltage free.

⚠ Prior to placing the earth connectors or the earth rods the area has to be checked for possibly dangerous installed objects (pipes, cables, etc.).

☞ If a voltage exceeding 30V AC/DC is present at test leads H and E, the respective voltage is indicated. Further measurement is disabled.

☞ To avoid faulty measurements metal pipes, cables in the soil, or in open areas under earth waterways, or roots installed or located in parallel must be taken into account. Additionally, the specific earth resistance is subject to seasonal weather-related variations.

☞ If the value for auxiliary earth probe resistance is excessive (4kΩ + 100*RE) or > 50kΩ, the symbol 'rC' is displayed. Auxiliary ground resistances up to this value result in an additional error of 3 %.

☞ If the value for auxiliary earth probe resistance is excessive (4kΩ + 100*RE) or > 50kΩ, the symbol 'rP' is displayed. Auxiliary ground resistances up to this value result in an additional error of 3 %.

6.4 Measurement of Earth Resistance in accordance with the Two-Wire Method

The **two-wire method** consists of measuring the resistance between the earth being tested and a known earth. For this purpose the PEN conductor of a TN system can be used, for example. The resistance of the known earth connection has to be subtracted from the measurement result. This measurement is also feasible in a densely populated or in sealed areas where rods and auxiliary earth connections may not be installed.

With the earth resistance range, usual resistance can also be tested. Therefore connect the lines E and ES as well as H and S to the test object (as in above diagram). The test current flows between the lines E and H. The voltage will be measured between S and ES. At ES and S no additional voltage drop will be caused by the test current, thus this measurement will be very accurate.

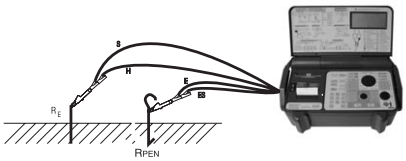


Figure 6.4.1, 2-pole Measurement

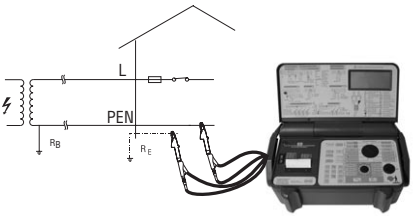


Figure 6.4.2, Earth resistance, 2- pole Measurement

Carrying out measurement:

☞ To perform this measurement the user requires the **4-pole test lead (EKM001103001)** or the **UNITEST Profi Set Package (Cat.. No. 1103)**.

- The measurement instrument may only be connected to earth connectors which are voltage free.
- Switch on UNITEST EURO-EXPERT plus via switch "ON/OFF" (9).
- Set the measuremend range needed by using the function switch (1).

☞ Tabel 6.5.1 page 26 and 6.6.1 page 28 gives an overview of earth resistance and max. diplay values.

- Connect the 4-pole test leads to instrument, measurement connectors (17).
- Connect the test leads with object see figure 6.4.1 or 6.4.2.
- Press the key “START“ (2). The test voltage will be applied to the test object for approx. 2 seconds or is applied as long as the key is held pressed. Immediately on completion of test, the UUT is automatically discharged.
- Read the insulation resistance value on the LC-display. The measured value will be displayed until a new test is started or a different measuring function is chosen.

☞ If the measurement value exceeds 2000 Ω, "o.r." iis displayed. To protocol this value enter ">2000 Ω" or "> 2 kΩ" into the test protocol.

☞ By operating the key “MEM/ENTER“ the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section “Storing and Processing of the Test Data“.

6.5 Earth Resistance Measurement in accordance with the three-wire or four-wire Method

The **three-wire method** consists of inserting two earth rods (one auxiliary earth and one probe) into the soil, at a minimum distance of 20m. This layout can also be realised by triangular shape. The test current is fed between auxiliary earth and earth. The voltage drop between earth and probe is measured. The test lead resistance from measurement instrument to earth is included in the measurement. This measurement is used to determine e.g. earth resistance of foundation earths, building site earths and lighting protection earth connections.

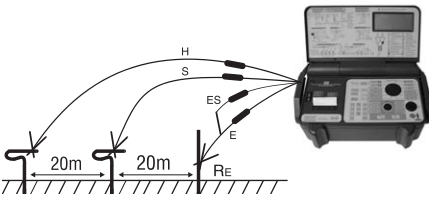


Figure 6.5.1 Three-Wire Measurement

The **four-wire measurement** is applied instead of the three-wire measurement when dealing with extremely Low Ohm earth resistance and if the resistance of test lead between instrument and earth connector interfere the measurement result.

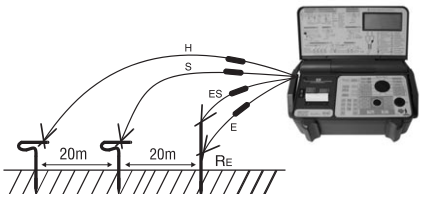


Figure 6.5.2: Four-Wire Measurement

Carrying out measurement:

☞ To perform this measurement the user requires the **UNITEST Profi Set Package (Cat.. No. 1103)**.

- The measurement instrument may only be connected to earth connectors which are voltage free.
- Switch on UNITEST EURO-EXPERT plus via switch "ON/OFF" (9).
- Set the measurement range needed by using the function switch (1).

☞ Table 6.5.1 and table 6.6.1 give an overview of earth resistance and max. displayed values..

- Connect the 4-pole test leads to instrument, measurement connectors (17).
- Arrange the earth rods for probe and auxiliary ground connection if possible in one line as shown in firgure 6.5.1. The distance between probe (S) and Earth electrode (E/ES) and similarly between probe and auxiliary ground connection (H) must be at least 20 m. Lay out the cables carefully and take care that the cables if possible do not lie alongside each other and do not cross each other in cat. to avoid capacitive coupling.
- Connect the test cables with the earth rods and the Earth electrode (see Figure 6.5.1)

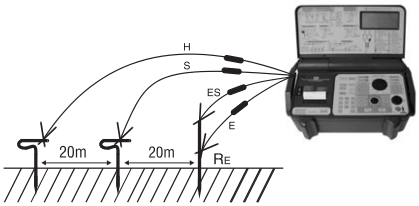


Figure 6.5.1: Connectors of leads

- Press the key “START“ (2). The test voltage will be applied to the test object for approx. 2 seconds or is applied as long as the key is held pressed. Immediately on completion of test, the UUT is automatically discharged.
- Read the insulation resistance value on the LC-display. The measured value will be displayed until a new test is started or a different measuring function is chosen.

☞ If the measurement value exceeds 2000 Ω, "o.r." is displayed. To protocol the value type ">2000 Ω" or "> 2 kΩ" into the test protocol.

Table 6.5.1 For a required earth resistance the measured value must not exceed the values in the table below taking into consideration the instrument’s accuracy.

Required max. permissible resistance	Maximum displayed test value
0,1 Ω	0,08 Ω
0,2 Ω	0,18 Ω
0,3 Ω	0,27 Ω
0,4 Ω	0,37 Ω
0,5 Ω	0,47 Ω
0,6 Ω	0,57 Ω
0,7 Ω	0,67 Ω
0,8 Ω	0,76 Ω
0,9 Ω	0,86 Ω
1,0 Ω	0,96 Ω
2,0 Ω	1,94 Ω
3,0 Ω	2,92 Ω
4,0 Ω	3,90 Ω
5,0 Ω	4,88 Ω

☞ If auxiliary grounds and probe resistance values are too high and, consequently, causing a respective error message ('rC' or 'rP'), the resistance may be reduced by taking one of the following measures: e.g. depending the soil within the earth rod range, increase the insertion depth of the earth rods, use several rods in parallel.

- To verify the measurement, exchange the connections of probe and auxiliary earth or move the earth rod for the probe approx. 1...2m towards the earth connector (or afterwards towards the auxiliary earth) and measure again. If the instrument shows similar measurement results for all measurement layouts, the probe is located in the reference earth area outside the voltage funnel generated by earth and auxiliary earth. If the measurement is not similar the probe could be located inside the voltage funnel. To avoid this there are two possibilities:

  A: increase the distance between earth and auxiliary earth

  or,

  B: position the earth rod for the probe to one point of the line outside the voltage funnel, as shown in Figure 6.5.2, and repeat the measurement.

☞ By using the key "MEM/ENTER" the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section "Storing and Pro-cessing of the Test Data".

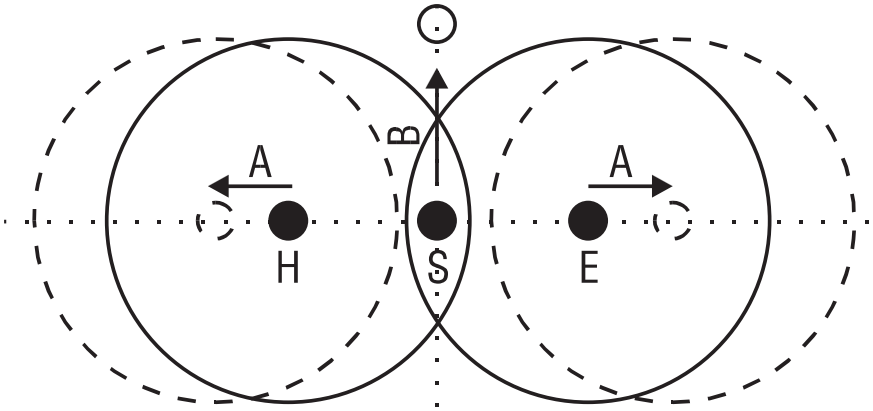


Figure 6.5.2 Voltage funnel

6.6 Measurement of the Specific Earth Resistance in accordance with the 'Wenner' method

To calculate the spreading resistance of earth connectors and earthing systems the specific earth resistance must be determined. To calculate the specific earth resistance, the measured earth resistance is used in the formula: PE =2*π*a*RE.
This measurement is performed using four earth rods inserted into the soil to be tested in one line at the same distance 'a' apart.

The earth resistance is detected up to $^1/_5$ of the depth of the distance 'a'. To avoid faulty measurements metal pipes, cables in the earth, or in open areas under earth waterways, or roots installed or located in parallel must be taken into account. Additionally, the specific earth resistance is subject to seasonal weather-related variations.

Table 6.6.1 Some guiding values for the earth resistance at different types of the ground

Type of the ground	Ωm	earth resistance bar ground connection		earth resistance flat ground connection	
		3 m deep	5 m deep	5 m long	10 m long
marshy soil/ swamp	10... ..40	10 Ω	5 Ω	12 Ω	6 Ω
arable land/ clay	20... ..100	33 Ω	17 Ω	40 Ω	20 Ω
humid sandy soil	200.. ..900	66 Ω	33 Ω	80 Ω	40 Ω
dry sandy soil	1000... ...3000	330 Ω	165 Ω	400 Ω	200 Ω
stony soil	2000... ...3000	1000 Ω	500 Ω	1200 Ω	600 Ω
concrete 1:5				160 Ω	80 Ω

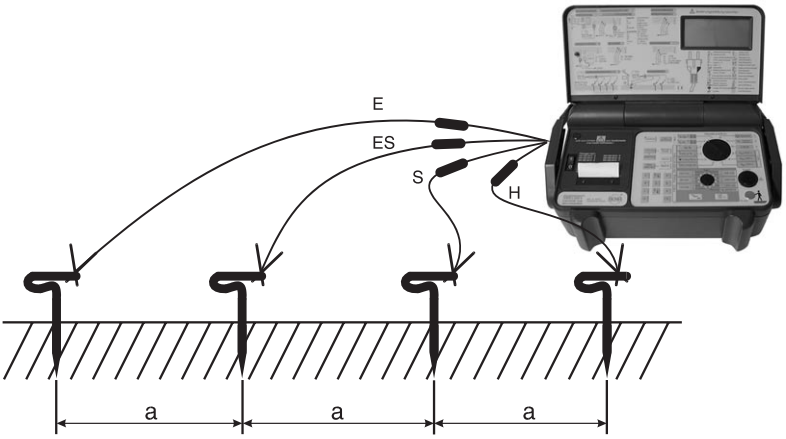


Figure 6.6.1, Measurement of Specific Earth Resistance (Wenner method)

Carrying out measurement:

☞ To perform this measurement the user requires the **UNITEST Profi Set Package (Cat. No. 1103)**.

- The measurement instrument may only be connected to earth connectors which are voltage free.
- Switch on UNITEST EURO EXPERT plus via switch"ON/OFF" (9).
- Set the measurement range needed by using the function switch (1).

☞ Tabel 6.5.1 7 and table 6.6.17 gives an overview of earth resistance and max. diplay values.

- Connect the 4-pole test leads to instrument, measurement connector (17).
- Place the four earth rods for E, ES, S, H in one line, if possible, in accordance with Figure 6.6.2. The distance between each probes must match the previously selected distance. Carefully place the test leads making sure that the test leads are not parallel to each other and do not cross to avoid coupling.
- Connect the test leads with the earth rods 6.6.2
- Press the key “START“ (2). The test voltage will be applied to the test object for approx. 2 seconds or is applied as long as the key is held pressed. Immediately on completion of test, the UUT is automatically discharged.
- Read the insulation resistance value on the LC-display. The measured value will be displayed until a new test is started or a different measuring function is chosen.

☞ If the measurement value exceeds 2000 Ω, "o.r." is displayed.

- The specific earth resistance will be calculated as follows:
  $\rho = 2 * \pi * a * RE$.

Example:

measured earth resistance RE = 48,5 Ω
distance a = 1 m
calculated specific earth resistance:
$\rho = 2 * \pi$ x 1 m x 48,5 Ω = 304,7 Ωm

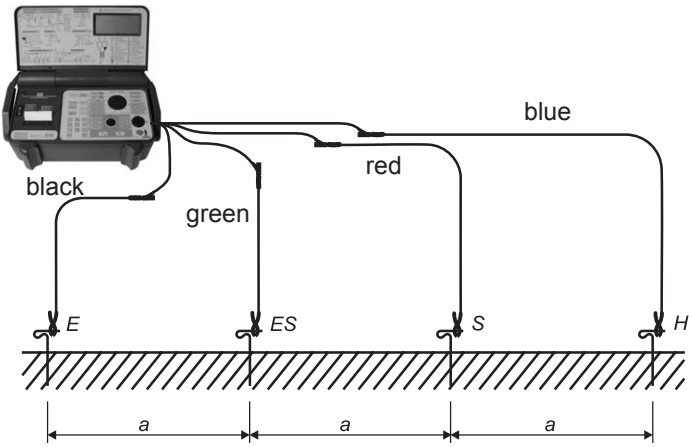


Figure 6.6.2: Connection test leads

☞ If the auxiliary earth and probe resistance values are too high, causing a respective error message (rC or rP), the resistance can be decreased by taking one of the following measures : e.g. depending the soil in the earth rod area, increase the depth of the earth rods (paying attention to the measurement distance).

- To verify the measurement modify the distance and/or the alignment of the earth rods and repeat the measurement. If the instrument shows similar measurement results for all measurement layouts, the soil is homogenous. Larger deviations may be due to disturbance factors in the soil (pebbles, rock, under earth waterways, roots, pipings, cables, earth compensation currents, etc.).

☞ By using the key “MEM/ENTER“ the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section “Storing and Processing of the Test Data“.

6.7 Voltage Measurement, Data-Logger (Function 1, 2)

The EURO EXPERT plus can measure AC voltage from 15 … 499 V/50 Hz. By switching the function switch, the voltages L-N or L-PE can be displayed. The connection to the mains can be made using the standard mains connector cable.

For recording these voltages over a period of time the instrument is provided with a data logger. After setting the time period (time interval), the voltage can be monitored and recorded over a certain period of time (max. approx. 36 hours). Measurements can be transefered and processed via RS 232 interfce
Both software packages UNITEST es control and UNITEST Expert Manager allow to present the voltage losses as graphs.
The number of measurements made, the time interval between measurements and the highest and lowest values measured during the recording period can be printed out using the internal printer. (see see chapter 6.7.2)

⚠ Never connect voltages higher than 440 V AC/DC to the input connectors.

⚠ Prior to usage the test instrument and the test leads have to be tested for correct functioning.

⚠ Test leads and test probes may only be touched at the handles provided. The user must not touch the test probes.

6.7.1 Voltage and Frequency Measurement

- Switch on UNITEST EURO EXPERT plus via switch "ON/OFF" (9).
- Set with the function switch to the desired range. You can choose between the voltages L-N and L-PE. Therefore set the function switch (1) to VL-N / RI/IPSC (1) or VL-PE / ZL/IPSC (2).
- Either use the test lead equipped with a plug, or use the test lead equipped with three safety plugs and connect the test probes or alligator clamps to the test leads, as requested.
- Connect the test leads to instrument, measurement connectors (17).
- Connect the test leads with object see figure 6.7.1 or 6.7.2.

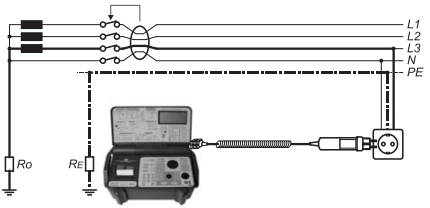


Figure 6.7.1 Connection of test leads

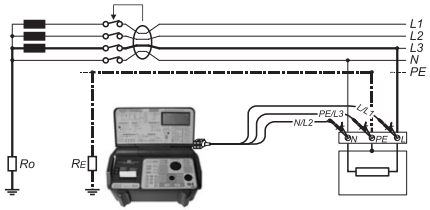


Figure 6.7.2 Connection of test leads

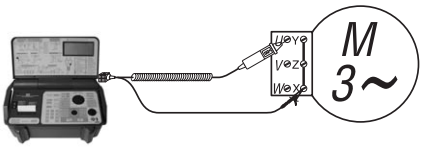


Figure 6.7.3 Connection of Commander 2

- DO NOT press the key 'START' (2), the voltage is directly displayed after connecting the test leads.
- Read the voltage value displayed on the LCD. The measurement value is displayed until a different measurement function is selected.

☞ Press the key “DISPLAY“ to display the frequency.

☞ The displayed measurement result cannot be saved

6.7.2 Recording of Voltages L-N or L-PE (Data-Logger)

For the monitoring of the voltage over a long period of time the EURO-EXPERT plus is provided with a data-logger which can store up to 1500 values of measured data.

In order. to carry out the recording proceed as follows:

- Switch on UNITEST EURO-EXPERT plus via switch "ON/OFF" (9).
- Set with the function switch (1) to the desired range. You can choose between the voltages L-N and L-PE. Therefore set the function switch (8) to VL-N / Ri/IPSC (1) or VL-PE / ZL/IPSC (2).
- Connect the test leads to instrument, measurement connectors (17).
- Connect the test leads with object see figure 6.7.1, 6.7.2 oder 6.7.3.

⚠ Before this measurement please delete the data memory. If there are still measurement values within the memory, they must be either printed prior to starting or be transferred to the PC.

- Delete the data memory by pressing twice the key “CLR“ (29).
- Press the key “Data Logger“ (31).

☞ If the user has not cleared the memory, the message 'mem' 'Clr' is now displayed. Confirm the clearing of the measurement data memory by pressing again the "CLEAR" key (29).

- Now you have to enter the time period (test interval) in seconds. 1-99 seconds are acceptable.
- To confirm press the key “MEM/ENTER“, the recording will now start.
- The “mem“ symbol will appear on the display, indicating that the recording is now active. When a value is measured, and stored into the memory the “mem“ symbol will disappear for a short time.
- The recording can be stopped by pressing the key “PAPER/CANCEL“ (16) or by turning the function switch (1) to another position. The logging is also terminated once the data memory is full. Then 'toP' is displayed on the LCD.
- The number of memorised measurement values is directly displayed after cancelling by pressing the key "Paper / Interrupt”. Otherwise, the "recall” key (28) must be pressed first.
- By repeated pressing of the key “Display“ the following will be displayed in sequence:
  the test interval
  the maximum value
  the minimum value
  and again the number of values.

☞ These test results can also be printed out with the built-in printer (only model 9020). The output of all test data takes place only via the RS-232-interface straight to the PC.

6.7.3 Data-Logger, Example

You want to record the mains voltage L-N. The measured value is supposed to be stored every 25 seconds.

- Set the function switch (1) to position VL-N (1).
- Connect the EURO-EXPERT plus with the mains connector cable to socket.
- Press the pushbutton “CLR“ twice. After the first time “mem ALL“ will appear, after the second time “mem CLR“ will appear on the display
- Press the key “Data Logger“(31).
- Enter the test interval, e.g. “25“.
- Confirm with “MEM/ENTER“; The measurement starts. Every time a value is stored, the symbol “mem“ disappears for a short time.
- The test will be stopped by operating the key “PAPER/“ CANCEL (27) or by turning the function switch (1) to another position.
- The number of values stored will be displayed. By repeated pressing of the key “Display“ the following will be displayed in sequence:
  the test interval
  the maximum value
  the minimum value
  and again the number of values.

6.8 Loop impedance measurement ZL (L-PE) and prospective short-circuit current measurement Ipsc (Function 2)

The loop impedance of a current loop is defined as the impedance sum of the current source; the phase conductor between current source to the measurement point and; the return line from the measurement point to the second pole of the current source (please also refer to Figure 6.8.1).

The loop impedance value allows the calculation of the short-circuit current, which is difficult to determine in practical applications.

The short-circuit current value must be known to ensure that installed overcurrent protection device can trip at a sufficiently high current in the event of a short-circuit.
This current is required to ensure a fast cut-out time depending on the current circuit of minimum 0.2 seconds or 5 seconds. For socket current circuits up to 35A to cut-out time is max. 0.2s, for all other circuits it is max. 5s.

The measurement is carried out by short current pulse and the measurement of the voltage drop on the built-in test resistor before and during the current pulse. Due to the test current a voltage drop occurs in the current loop to be measured resulting in a brief voltage drop at the test resistance.

If a RCD is installed, it has to be bridged for loop impedance measurement. However, depending on the national standards this measurement may not be required.

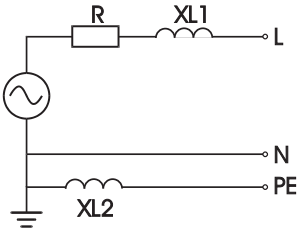


Figure 6.8.1: Impedances within the Current Circuit

⚠ The protective earth must be checked for correct wiring when carrying out measurements on earthed sockets or on equipment with protective earth connection. To perform the check, briefly touch the contact electrode 'PE-TEST (3)' on the measurement instrument after having connected the test leads. In case an acoustic signal is audible and the LCD displays the message 'Attention PE error!' the PE and the N connection must be checked ! The user may only start the tests once the protective earth has been corrected!

During the PE test it must be ensured that the measurement result is not interfered by extraneous insulation at the test location (flooring or the location in general).

⚠ Prior to any loop impedance measurement any possibly installed RCD's have to be bridged.

⚠ Connected mains loads and the influences due measurement load can cause faulty measurement results. Therefore, several measurements should be carried out and compared. To obtain precise measurement results it is recommended to switch off or disconnect all loads from the mains prior to testing.

☞ When a lot of tests (more than 70) are carried out with very short pauses between them (less than 5 s.), an internal over-temperature protection within the EURO-EXPERT plus responds.

☞ "hot" is displayed when the over-temperature protection has responded. All tests are immediately inhibited. Thus damage to the instrument is avoided.

☞ Prior to any internal mains resistance measurement, it is recommended to check the test leads resistance and perform a compensation, if required. Please proceed as described in section 6.2.2. To indicate the active test lead compensation, 'CAL' is displayed on the LCD when selecting the measurement function Ri/IPSC.

☞ The specified accuracy is only valid if the mains voltage remains constant throughout the measurement process!

Carrying out measurement:

- Switch on UNITEST EURO-EXPERT plus via switch "ON/OFF" (9).
- Set the measurement range switch (1) to function 'VL-PE / ZL/IPSC' (2).

☞ Tables 6.8.1 through 6.8.5 supply an overview on the loop impedance values and the requested display values.

- Either use the test leads equipped with an Schuko plug or the test lead equipped with three individual safety plugs and connect test probes or alligator clamps to the test leads, as requested.
- Connect the est leads to instrument, measurement connector (17).
- Connect the teast leads with object see figure 6.8.2 or 6.8.3.

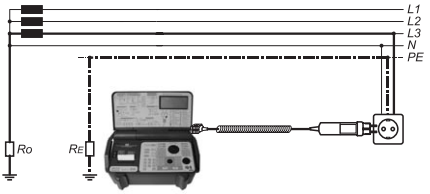


Figure 6.8.2 Connection of test leads

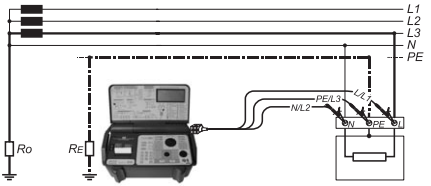


Figure 6.8.3 Connection of test leads

- Press the key “Start“, the measurement is started
- The measured value will be shown on the display. The measurement value is displayed until a new measurement procedure is started or a different measurement function is selected.
- With the key “Display“ you can switch between the display of the Low impedance and the display of the loop short-circuit current.

☞ The short-circuit current is calculated as follows, using the nominal mains voltage or the momentary voltage present: IPSC=Unom / ZL.

The following voltage values are valid for the calculation:

- Nominal voltage 115 V for mains voltage range of 103...126 V (115 V ± 10%)
- Nominal voltage 230 V for mains voltage range of 207...250 V (230 V ± 10%)
- The momentary voltage present for all other ranges between 100 and 440V.

☞ If the measurement value exceeds 2000 Ω, "o.r." is displayed. To protocol the value enter ">2000 Ω" or "> 2 kΩ" into the test protocol.

Table 6.8.1 Limit values for loop impedance and pertaining maximum display values considering the accuracy of the EURO-EXPERT plus.

Loop resistance/Internal line resistance	
Limiting value in Ω	max. display
0,1	0,08
0,2	0,18
0,4	0,37
0,5	0,47
0,75	0,72
1,0	0,96
2,0	1,94
5,0	4,88
10,0	9,78
12,0	11,7
15,0	14,68
20,0	19,58

Table 6.8.2 Limit values for the short-circuit current and the pertaining minimum display values considering the accuracy of the EURO-EXPERT plus

Prospective short circuit current IPSC	
Limit value in A	max. display
2300	2875
1150	1278
575	622
460	489
307	319
230	240
115,0	118,6
46,0	47,13
23,00	23,52
19,17	19,59
15,33	15,67
11,50	11,75

Tables containing the values to assess excess current protection devices with trip current and loop impedances (extract of table 3 contained within DIN VDE 0100 Part 610)

Table 6.8.3

Low voltage fuse		
according DIN VDE 0641, Characteristic gL		
nom. Current	Short circuit curr.	loop resistance
6 A	28 A	8,21 Ω
10 A	47 A	4,89 Ω
16 A	72 A	3,19 Ω
25 A	120 A	1,92 Ω
35 A	173 A	1,33 Ω
63 A	351 A	0,66 Ω

Table 6.8.4

LS-Switch according DIN VDE 0641, Characteristic B		
nom. Current	Short circuit curr.	loop resistance
6 A	30 A	7,66 Ω
10 A	50 A	4,6 Ω
16 A	80 A	2,88 Ω
25 A	125 A	1,84 Ω
35 A	175 A	1,31 Ω
63 A	315 A	0,73 Ω

Table 6.8.5

LS-Swich according DIN VDE 0641, Characteristic C		
nom. Current	Short circuit curr.	loop resistance
6 A	60 A	3,83 Ω
10 A	100 A	2,3 Ω
16 A	160 A	1,44 Ω
25 A	250 A	0,92 Ω
35 A	350 A	0,66 Ω
63 A	630 A	0,37 Ω

☞ By operating the key “MEM/ENTER“ the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section “Storing and Processing of the Test Data“.

6.9 Line resistance measurement Zi (L-N/L) and prospective short-circuit current measurement Ipsc (Function 1)

As described in section 6.8 Loop Impedance, the line resistance measurement is performed in accordance with the same measurement principle. However, here, the current loop L-N is measured. According to some national or international standards, this measurement may not be required. In practical applications, however, this measurement is very important and useful for the evaluation of the electrical system as well as for trouble-shooting.

☞ This measurement can be used in systems (TN-Systems) equipped with RCD's to detect wrong wiring of protective earth (PE) and neutral (N) without disconnection of the N in the distribution board. In case of wrong wiring, the RCD trips during line resistance measurement.

☞ Furthermore, this measurement can also be used to profe low resistance of neutral conductor (N).

⚠ The protective earth must be checked for correct wiring when carrying out measurements on earthed sockets or on equipment with protective earth connection. To perform the check, briefly touch the contact electrode 'PE-TEST (3)' on the measurement instrument after having connected the test leads. In case an acoustic signal is audible and the LCD displays the message ‘Attention PE error!’ the PE and the N connection must be checked ! The user may only start the tests once the protective earth has been corrected!

During the PE test it must be ensured that the measurement result is not interfered by extraneous insulation at the test location (flooring or the location in general).

⚠ Connected mains loads and the influences due measurement load can cause faulty measurement results. Therefore, several measurements should be carried out and compared. To obtain precise measurement results it is recommended to switch off or disconnect all loads from the mains prior to testing.

☞ When a lot of tests (more than 70) are carried out with very short pauses between them (less than 5 s.), an internal over-temperature protection within the EURO-EXPERT plus responds.

☞ "hot" is displayed when the over-temperature protection has responded. All tests are immediately inhibited. Thus damage to the instrument is avoided.

☞ Prior to any internal mains resistance measurement, it is recommended to check the test leads resistance and perform a compensation, if required. Please proceed as described in section 6.2.2. To indicate the active test lead compensation, 'CAL' is displayed on the LCD when selecting the measurement function Ri/IPSC.

☞ The specified accuracy is only valid if the mains voltage remains constant throughout the measurement process!

Carrying out measurement:

- Switch on UNITEST 0100-EURO EXPERT plus via key "ON/OFF" (9).
- Set the measuremend range switch (1) to function 'VL-PE / Ri/IPSC' (1).
- Either use the test leads equipped with Schuko plug or the test lead equipped with three individual safety plugs and connect test probes or alligator clamps to the test leads, as requested.
- Connect the test leads to instrument, measurement connection (17).
- Connect the test leads with object see Figure 6.8.2 oder 6.8.3.
- Briefly press the key 'START', the measurement is started.
- Read resistance vaule in the display. The measurement value is displayed until a new measurement procedure is started or a different measurement function is selected.
- The "DISPLAY" key (30) is used to alternate between the internal mains resistance (Ri L-PE) or the prospective short-circuit current (IPSC).

☞ The short-circuit current IPSC is caculated as follows, using the nominal mains voltage or the momentary voltage present: IPSC=Unom/Ri.

The following voltage values are valid for the calculation:

- Nominal voltage 115 V for mains voltage range of 103...126 V (115 V ± 10%)
- Nominal voltage 230 V for mains voltage range of 207...250 V (230 V ± 10%)
- Nominal voltage 400 V for mains voltage range of 360...440 V (400 V ± 10%)
- The momentary voltage present for all other ranges between 100 and 440V.

☞ If the measurement value exceeds 2000 Ω, "o.r." is displayed. To protocol the value enter ">2000 Ω" or "> 2 kΩ" into the test protocol.

☞ By operating the key "MEM/ENTER" the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section "Storing and Processing of the Test Data".

6.10 General regarding the testing of RCD's

In order to assess the perfect functioning of a residual current device (RCD), the contact voltage VC, generated during RCD tripping, and the tripping time t, required by the RCD to disconnect the subsequent current circuit from the mains are important measurements.

Therefore, IEC 60364 (DIN VDE 0100) prescribes as follows:

a) the maximum admissible value of the contact voltage (25V / 50V) during tripping at nominal residual current within a system may not be exceeded,
b) the RCD must trip within 300ms.

The RCD must switch off the system within 300ms after occurance of an error prior to the contact voltage reaching the admissible limit value of 25V / 50V.

The system testing should be started with a visual inspection, in particular of the protective earth connections.:

1. In TT systems, the PE must not be connected to the PEN but with the local protective earth.

2. In TN systems, the PE must be connected to the PEN before the RCD.

3. An insulation measurement in accordance with Section 6.1 must be performed. In particular it must be ensured that there is no connection between N and PE after the RCD.

4. The low impedance connection of equipotential bonding conductors must be profed according to section 6.2.

⚠ To avoid an electrical shock the valid national and international safety standards regarding dangerous contact voltages must be met when working with voltages exceeding 120V (60V) DC or 50V (25V)rms AC. The values in brackets are valid for special areas (e.g. medical and agricultural applications).

⚠ Test and measurement procedures in systems protected by RCD's should only be carried out in agreement with the operator of the system (IT-systems, processing technology, motors, etc.).

⚠ The protective earth must be checked for correct connection when carrying out measurements on earthed sockets or on equipment with protective earth connection. To perform the check briefly touch the contact electrode 'PE-TEST' (2) on the measurement instrument after having connected the test leads. If an acoustic signal is audible and the LCD displays the message 'Attention PE error!', the PE and the N connection must be checked ! The user may only start the tests when the protective earth has been corrected!

During PE test is must be ensured that the measurement result is not interfered by extraneous insulation at the test location (flooring/wooden conductor).

☞ It is recommended to switch off all loads prior to testing as they could cause erroneous measurement results.

☞ The protective earth must be voltage free to perform the measurement. If an external voltage is present, the instrument only displays the voltages having been generated by the measurement itself. However, the measurement will be interrupted if the contact voltage is exceeded by the actually present voltage between protective earth (PE) and neutral (N).

☞ Correct contact voltage measurement requires the installation of a measurement probe as the voltage caused by an insulation error have to be measured from instrument connector (PE) towards the local earth. The measurement probe has to be placed within the area of the reference earth. In built-up areas it is almost impossible to install measurement probe. Therefore, the practical measurements are mostly performed without measurement probes. This measurement is faster and easier to carry out as no installation of the measurement probe and of the test lead is required. The measurement without probe can be carried out by using the neutral conductor (N) as measurement probe.

☞ Leakage currents within the current circuit following the RCD may impair the test. The same is valid for a voltage present between the protective conductor or neutral and ground.

☞ Equipment such as capacitors or rotating machines, connected after the RCD can cause an essential extension of the determined trip time.

☞ Contact voltage measurements can be influenced by potential fields, generated by other grounding devices.

☞ Time delayed trip within 130...500 ms for nominal residual current and within 60...200 ms for double nominal current. These are the type of RCDs used as main residual current protection devices (please refer to IEC 61008-1). They are marked with S.

Type	I_n	$I_{\Delta n}$	Directives values of switch of time (s) and not trip time (s) at fault currents (IΔ) are:				
	A	A	$I_{\Delta n}$	2 $I_{\Delta n}$	5 $I_{\Delta n}$*)	500 A**)	
general	each value	each value	0,3	0,15	0,04	0,04	maximum switch of time
S	≥ 25	> 0,030	0,5	0,2	0,15	0,15	maximum switch of time
			0,13	0,06	0,05	0,04	lowest not trip time

Table 6.10.1 Trip times of residual current circuit breakers (RCD)

(Source IEC 610008-1/EN 61008-1)

6.11 Measurement of contact voltage VC and earth resistance Re without RCD Tripping

The instrument UNITEST EURO EXPERT plus test measures in the function 'VC/RE' the contact voltage at a test current of 1/3 IΔN (33%) to avoid RCD tripping. The contact voltage present at the protective earth (PE) is measured towards the neutral conductor (N).
The contact voltage measured is either calculated to nominal residual current (for standard RCD) or to double nominal residual current (for time delayed RCD) and then displayed.

Simultaneously, resistance Re of loop L-PE is calculated by dividing the contact voltage displayed by the nominal residual current (Re=VC/IΔN).

☞ If the contact voltage value is above the previously selected limit value 25V or 50V, the test is interrupted and an error message will be displayed.

Carrying out the Measurement:

- Switch on UNITEST 0100-EURO EXPERT plus via switch "ON/OFF" (9).
- Set the measuremend range switch (1) to function 'VC/RE' (3).
- For the display of the preset value of the contact voltage set the rotery switch “RCD nominal residual current” (5) on “VC(25/50 V)“. The contact voltage, limit will be shown on the display.
  In order to change the contact voltage limit use the keys 8/4 or 2/4.
- Select the nominal fault current of the RCD (depending on the RCD to be tested) using the rotary switch “RCD nominal residual current” (5). It is of no importance, whether the rotary switch is in (x1) or (x5) position.
- Either use the test leads equipped with Schuko plug or the test lead equipped with three individual safety plugs and connect test probes or alligator clamps to the test leads, as requested.
- Select the type of the RCD to be tested using the "S" key (4). Selection can be made between standard RCDs or time delayed RCDs. After having chosen 'selective RCD', 'S' is displayed on the LCD.
- Connect the test leads to instrument, measurement connectors (17).
- Connect the test leads with object see figure 6.11.1 or 6.11.2.

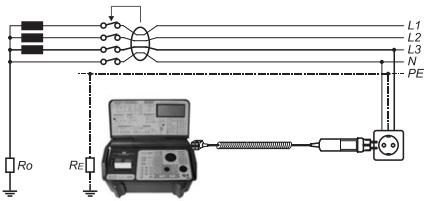


figure 6.11.1 Connection test lead

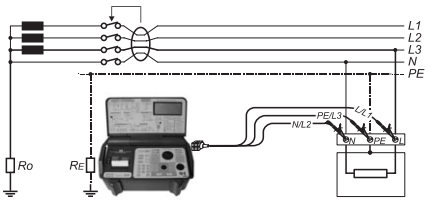


figure 6.11.2 Connection test lead

- Press the key “START“ (2). The measurement will be started.

- The contact voltage will be shown on the display. The measurement value is shown in the LCD until a new measurement is started or the range will changed.

- In order to get the earth resistance displayed, press the key “Display“ (30). You can choose between the display of VC and RE.

☞ The earthing resistance displayed is calculated as follows: RE=UB / IΔN

☞ If the measurement value exceeds 100 V, "o.r." is displayed on the screen. If the operator wishes to log this value, ">100 V" must be entered into the respective test protocol.

☞ If the RCD trips during this measurement and the measurement instrument displays the message 'rcd', either the RCD is faulty, or the setting of the nominal fault current has been incorrect (too high), or a leakage current is already present within the system, causing the RCD to trip when cumulating.

☞ By operating the key “MEM/ENTER“ (32) the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section “Storing and Processing of the Test Data“.

6.12 Measurement of the RCD trip time t and contact voltage VC with RCD Tripping (Function 4)

Within the function 'tRCD, VC' the UNITEST EURO-EXPERT plus determines the RCD trip time at a test current of either 1*IΔN (100%) or 5*IΔN (500%), therefore the RCD will be tripped. Hereby, the contact voltage present at the protective earth (PE) is measured towards the neutral conductor (N).

☞ For safety reasons, the contact voltage measurement is always carried out prior to the trip time measurement. This is performed at a preliminary test current of 1/3 x IDN (33 %) (please refer to section 6.11). Furthermore, the contact voltage is continuously monitored during trip current test.

If the contact voltage value is above the selected limit value 25V or 50V, the test is interrupted and an error message appears.

☞ For time delayed RCDs it is necessary to respect a waiting time of 30 s after the contact voltage measurement prior performing the actual trip time measurement as these RCDs work by means of fault current integration. This waiting time is displayed on the screen as countdown from 30 to 0. The measurement can be interrupted by turning the "Measurement Function" rotary switch (1) to a different measurement function.

Carrying out measurement:

- Switch on UNITEST EURO-EXPERT plus via switch "ON/OFF" (9).
- Set the measurement range switch (1) to function 'tRCD, VC' (4).
- For the display of the preset value of the contact voltage set the rotary switch "RCD nominal residual current" (5) on "VC(25/50 V)". The contact voltage will be shown on the display. In order to change the contact voltage limit use the keys ½ or 2/1.
- Set the nominal RCD fault current (depending on the RCD to be tested) using the rotary switch ""RCD nominal residual current"" (5). Selection should also be made of the trip current factor (x1) or (x5) by positioning the rotary switch to e.g. 30mA x5.
- Either use the test lead equipped with the Schuko plug, or use the test lead equipped with three individual safety plugs. As requested, connect the test probes or alligator clamps to the test leads.
- Select the type of the RCD to be tested using the "S" key (4). Selection can be made between standard RCDs or time delayed RCDs. After having chosen 'time delayed RCD', "S" is displayed on the LCD.
- Connect the test leads to instrument, measurement connectors (17).
- Connect the teast leads with object see figure 6.11.1 or 6.11.2, page 40.
- Briefly press the key 'START' (2), the measurement will start.
- Read trip time in the display.
- The "DISPLAY" key (30) is used to alternate between the trip time (tRCD) display and the contact voltage (Vc).
- If desired, repeat the test at negative half-wave. The phase position of the test current can be chosen by pressing the "START" key (2) twice. "180°" is displayed on the screen.
- If the RCD trips during this measurement and the measurement instrument displays the message 'rCd', either the RCD is faulty, or the setting of the nominal fault current is incorrect (too high), or a leakage current is already present within the system, causing the RCD tripping when cumulating with the test current.

☞ If the RCD does not trip, or if the trip time is outside the permitted range, "o.r." is displayed on the LCD, together with the symbol ⚠

This can be caused by the following: either the RCD is faulty, the RCD S type or the nominal fault current are incorrect (too low), or a connection existsbetween the protective earth (PE) and the neutral conductor (N), following the RCD.

☞ Please refer to table 6.10.1 for an overview on trip times and test currents for various residual current circuit breakers.

☞ By operating the key "MEM/ENTER" (32) the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section "Storing and Processing of the Test Data".

6.13 Measurement of RCD Trip Current IΔ, of trip time t and contact voltage V_C at rising residual current (Ramp Method) (Function 5)

Within the function 'I▟' the UNITEST EURO-EXPERT plus measures the RCD trip current and trip time using a rising test current of the nominal residual current of 40% to 140% (in steps of 10%) by tripping the RCD. Hereby, the contact voltage present for the trip current is measured at the protective earth (PE) towards the neutral conductor (N).

The rising residual current method is not required, however, for accordance it is an efficient method for trouble shooting within an installation and sometimes required for certain installations. A RCD trip current may be within a range of 50% to 100% of nominal residual current, the trip time must be below 300ms.

☞ If the contact voltage value is above the selected limit value 25V or 50V, the test is interrupted and an error message is displayed.

☞ Selective RCDs cannot be tested whilst applying rising trip current.

Carrying out measurement:

- Switch on UNITEST EURO-EXPERT plus via key "ON/OFF" (9).
- Set the measurement range switch (1) to function 'I▟' (5).
- For the display of the preset value of the contact voltage set the rotary switch “RCD nominal residual current” (5) on “VC(25/50 V)“. The contact voltage will be shown on the display. In order to change the contact voltage limit use the keys ⅛ or ¼.
- Select the nominal fault current of the RCD (depending on the RCD to be tested) using the rotary switch “RCD nominal residual current” (5). It is of no importance, whether the rotary switch is in (x1) or (x5) position.
- Either use the test lead equipped with the Schuko plug, or use the test lead equipped with three individual safety plugs. As requested, connect the test probes or alligator clamps to the test leads.
- Connect the test leads to instrument, measurement connectors (17).
- Connect the teast leads with object see figure 6.11.1 or 6.11.2, page40.
- Press the "START" key (2) the measurement is started. The test current is displayed on the LCD and is steadily increased until RCD trips.
- Read the trip current displayed on the LCD. The measurement value is displayed until the start of a new measurement procedure or the selection of a different measurement function.
- The "DISPLAY" key (30) is used to alternate between the display of the trip current (IΔ), the trip time (t(IΔ), and the contact voltage (Vc(IΔ).
- If desired, repeat the test at negative half-wave. The phase position of the test current can be chosen by pressing the "START" key (2) twice. "180°" is displayed on the LCD.

☞ If the RCD trips during this measurement and the measurement instrument displays the message 'rCd', either the RCD is faulty, or the setting of the nominal fault current has been incorrect (too high), or a leakage current is already present within the system, generating the RCD tripping when cumulating with the test current.

☞ If the RCD does not trip, or if the trip time exceeds the limit value of 300 ms, "o.r." is displayed on the screen, together with the symbol " ⚠ "

This can be caused by the following: either the RCD is faulty, the nominal fault current is incorrect (too low), or a connection between the protective earth (PE) exists and the neutral conductor (N), following the RCD.

☞ Please refer to table 6.10.1, page 39 for an overview on trip times and test currents for various residual current circuit breakes.

☞ By operating the key "MEM/ENTER" (32) the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section "Storing and Processing of the Test Data".

6.14 Automatic RCD Analysis, (Function 6)

A special feature is the built-in RCD-analysis. This analysis makes it possible to carry out a complete test of the RCD automatically.
The user has only to switch on the RCD circuit breaker after tripping between each test during the teststep.
The RCD analysis can be interrupted by turning the "Measurement Function" (1) rotary switch to a different measurement function.

If all test results are correct, the EURO EXPERT plus shows "PAS " on the display. If one test does not meet the requirements, the instrument stops the and displays the test step with the error.

☞ Select the nominal fault current of the RCD (depending on the RCD to be tested) using the "rotary switch "RCD nominal residual current" (5). It is of no importance, whether the rotary switch is in (x1) or (x5) position.

☞ The contact voltage is continuously monitored during each test and is displayed after completion of the last test.If the contact voltage value is above the pre-selected limit 25V or 50V the test is interrupted and an error message is displayed.

The RCD analysis can be cancelled by turning the rotary dial "Measurement Function" (1) to a different measurement function.

Tabelle 6.14.1. Test steps for RCD-Analysis:

Test step	Test Current	Phaseangle	trip time min.	trip time max.
1.	0,5xIΔN (50%)	0°	may not trip!	
2	0,5xIΔN (50%)	180°	may not trip!	
3	1xIΔN (100%),	0°	(S at 130ms)	300 ms (S at 500ms)
4	1xIΔN (100%),	180°	(S at 130ms)	300 ms (S at 500ms)
5	2xIΔN (200%),	0°	(S at 60ms)	150ms (S at 200ms)
6	2xIΔN (200%),	180°	(S at 60ms)	150ms (S at 200ms)
7	5xIΔN (500%),	0°	(S at 50ms)	40ms (S at 150ms)
8	5xIΔN (500%),	180°	(S at 50ms)	40ms (S at 150ms)

Carrying out measurement:

- Switch on UNITEST EURO-EXPERT plus via switch "ON/OFF" (9).
- Set the measurement range-switch (1) to function 'RCD-ANALYSIS' (6).
- For the display of the preset value of the contact voltage set the rotary switch "RCD nominal residual current (5) on "VC(25/50 V)". The contact voltage will be shown on the display.
  In order to change the contact voltage limit use the keys ⅋ or ⅋.
- Turn the rotary dial to "Nominal trip current" (5) to set the nominal trip current of the RCD (depending on the RCD to be tested). It is of no importance whether the dial is set to position (x1) or (x5)..
- Either use the test lead equipped with the shockproof plug or the test lead equipped with three individual safety plugs. Plug test probes or test clamps onto the test leads, if required,.
- Connect the test leads to instrument, measurement connectors (17).
- Connect the test leads with object see figure 6.11.1 oder 6.11.2.
- Briefly press the key 'START'. The first test step is started whereby the RCD must not trip.
- After successful performance of the first test step , the second test step is automatically started (test current 0.5xIΔN, phase position 180°), then followed by the third test step (test current 1xIΔN, phase position 0°),
- To continue further tests in compliance with the 'rCd' message, the RCD must be switched on again after every single tripping. All further test step are automatically performed.
- After the successful RCD analysis, the measurement instrument indicates the message 'PAS', confirming that all test steps have been sucessfully passed.
- The "DISPLAY" key (30) is used to alternate between the previous test steps number, the trip time, and the contact voltage.

☞ If the RCD already trips during test step 1 and the measurement instrument displays the message 'rCd', this indicates that either the RCD is faulty, or the setting of the nominal fault current has been incorrect (too high), or a leakage current is already present within the system, generating the RCD tripping when cumulating with the test current.

☞ The RCD analysis is automatically stored to the last memory location for distribution (d255), and the result for each RCD can be either printed or transferred to a PC after the test. There is no need for manual entry as required for the other measurement functions. This memory location is reserved for RCD analysis and cannot be assigned for other purposes.

Example, printout of the RCD analysis:

Press the "PRINT" key, the message "mem ALL" is displayed on the screen.
Press the "MEM/ENTER" key, "d" is briefly displayed.
Then, the operator must enter the distribution number (255) using the keys "0 … 9".
The output is started by pressing the "Print" key.

For saving and further processing of the measurement data, please also refer to section "Saving and Further Measurement Data Processing".

6.15 Test of DC sensitive RCD (type B)

In Industrial electrical installations which use electronic circuits in three phase networks (e.g. rectifiers), in the case of a fault, DC currents with a low ripple can occur.

RCD circuit breakers that can react to such fault currents are DC sensitive RCD (type B).

The EURO-EXPERT plus can be used to test DC current sensitive RCDs. For this, press the (6) key prior to the trip time test (refer to section 6.12), the trip current test I (refer to section 6.13), or the RCD analysis (refer to section 6.14).

Standard RCD circuit breakers are checked by a sinusoidal fault current. The EURO-EXPERT plus can test the RCD with two more curve types:

1. With a current which contains only the positive half-sine-wave ⏠
2. With a DC current ⎓

With the key..... (6) the various current types can be selected. The curve type is shown on the display as a symbol. Standard-setting is sinusoidal (no display).

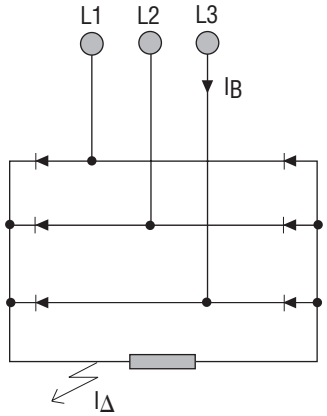


figure 6.15.1 Three-phase rectifier circuit diagram,

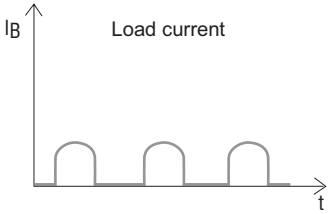


Figure 6.15.2 Three-phase rectifier circuit diagram, load current

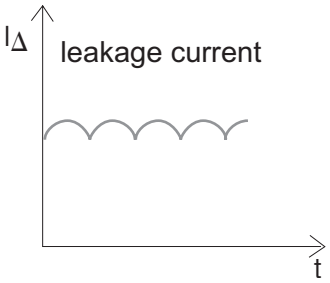


Figure 6.15.3.Three-phase rectifier circuit diagram leakage current

6.16 Rotary Field Measurement (Function 5)

The UNITEST EURO Expert plus allows the measurement of the rotary field at mains voltages of 100...440V.

The external conductor voltages can be measured by means of the voltage measurement function (please refer to section 6.7).

⚠ The measurement connectors may not be connected to external voltages exceeding 440 V AC or DC to avoid any instrument damage.

⚠ Prior to any usage, inspect the instrument and the test leads for perfect functioning.

⚠ Test leads and test probes may only be touched at handles provided. Direct contact with the test probe must be avoided.

Carrying out the Measurement

- Switch on the UNITEST EURO EXPERT plus using the switch 'ON/OFF' (9).
- Set the measurement range switch (1) to function 'Rotary field' (12)
- Use the test lead equipped with the three individual safety plugs and connect test probes or alligator clamps to the test leads, as requested.
- Connect the test leads to instrument, measurement connector (17).
- Connect the test leads with object see figure 6.16.1 oder 6.16.2. Important: the test leads L1, L2 and L3 must be correctly connected

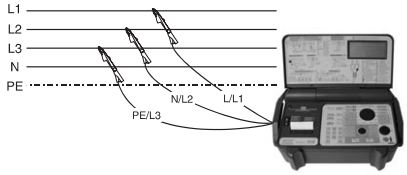


Figure 6.16.1 Connection of instrument

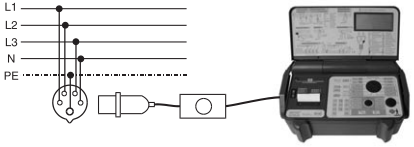


Figure 6.16.2 Connection of three phase adaptor (Cat. No. 1118)

- It is NOT necessarily requested to press the 'START' key (2), the rotary field is directly displayed as follows.

1. 2. 3	rotary field RIGHT, according to connection of test leads L1, L2, and L3
2. 1. 3	rotary field LEFT, according to connection of test leads L1, L2, and L3
0.0.0	no three-phase system present (one or two phases missing or connected to N or PE)
diS	no mains voltage present

☞ By operating the key “MEM/ENTER“ the measured value can be stored in the internal data memory.

Storing and processing of the test data – see also section “Storing and Processing of the Test Data“.

6.17 Measurements by using the Three Phase Adaptor (option) (Cat. No.: 1118)

For direct measuring at a 16 A industrial-socket, there is a three-phase adaptor with selector switch in the Profi-Set package (Cat. No. 1103) available. Thus, the rotary switch allows the connection of all 5 connectors of the three-phase socket to the EURO- EXPERT plus measurement input.

⚠ To avoid any instrument damage, the measurement connectors may not be connected to external voltage exceeding 440 V AC or DC.

⚠ Prior to usage, inspect the instrument and used test leads for external damage. Prior to any operation, ensure that connecting leads used and instruments are in perfect condition.

⚠ Only touch test leads and test probes at handle surface provided. Never directly touch test probes.

The table 6.15.1 shows what measurements using the industrial-socket can be carried out with each switch position of the EURO-EXPERT plus and the three-phase adaptor.

The table 6.15.1 switch position at the phase adaptor.

Measurements to be carried out		0100-Expert plus function	Three Phase Adaptor switch position
RI	L1-N		L1-N / PE
	L2-N	RI, IPSC (1)	L2-N / PE
	L3-N		L3-N / PE
RI	L1-L2		L1-L2
	L2-L3	RI, IPSC (1)	L2-L3
	L3-L1		L3-L1
ZL	L1-PE		L1-N / PE
	L2-PE	ZL, IK (2)	L2-N / PE
	L3-PE		L3-N / PE
RINS	L1-PE		L1-N / PE
	L2-PE	RINS 250, 500,	L2-N / PE
	L3-PE	1000 V (7,8,9)	L3-N / PE
RINS	L1-L2		L1-L2
	L2-L3	RINS 250, 500,	L2-L3
	L3-L1	1000 V (7,8,9)	L3-L1
RCD-	L1-PE	VC, RE (3)	
mea-	L2-PE	t RCD, VC (4)	L1-N / PE
sure-	L3-PE	I ▟ (5),RCD	L2-N / PE
ment		Analysis (6)	L3-N / PE
Rotary fiel- measurement		Rotary field (12)	↻

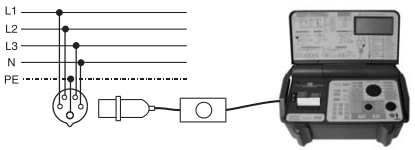


Figure 6.17.1 Connection of the Three-Phase Adaptor

7.0 Storing and Processing of the Measurement Data

The EURO EXPERT plus can store up to approx. 800 measuring results.
The absolute number of storeable measurements depends on the type of the stored measured values. With the recording function (Data-Logger) up to approx. 1500 measured values can be stored

The test data are allocated a position in memory by giving the distribution and circuit number as a three-digit number.

With the EURO-EXPERT plus with built-in printer (Cat. No. 9020) the stored test data can be read out via printer or via the interface.

Also, by recalling one memory position by entering its distribution and circuit number it is possible to print one single measured value.

☞ **Under certain unfavourable conditions, any electronic memory may lose or modify data. CH. BEHA can not be held liable for financial or other losses resulting from a data loss, wrong handling, or any other reason.**

We highly recommend transferring the measurement data to a PC for filing. Because of unforeseeable external influence, (drop, electromagnetic interference) loss of the measurement data might occur.

☞ The data remain in the memory even when the instrument is switched off or when proceeding with the battery replacement.

☞ Prior to the measurement ensure that the data memory is cleared to ensure that already existing measurement results will not be wrongly assigned or recorded.

Clear the data memory only once you are sure that the measurement data are no longer used, or that they have already been transferred to the PC and further processing!

☞ If an incorrect number is entered as a current circuit or distribution-number, it can be deleted by using the “CE“ key.

General References:

- The distribution number 255 is reserved for the values of the automatic RCD analysis and cannot be assigned for other purposes.
- Prior to starting the "Data Logger" function, the voltage VL-N(L) or VL-PE, the total measurement data memory must be cleared.
- If you do not enter distribution or current circuit number, the measurements are memorised under d = 001 and C = 001.

7.1 Examples:

You want to test the loop impedance and the internal line resistance and store the measured result.

CLR

In order to delete already existing data, the key “CLR“ must be pressed. The display shows “CLR ALL“, the key “CLR“ must be pressed once more. The data memory is now completely deleted.

The loop impedance e.g. is supposed to be stored under cdistribution number 17 and current circuit-number 10.

MEM ENTER

After the measurement is carried out, press the key “MEM/ENTER“. On the display a “d“ for distribution-number appears for a short time.

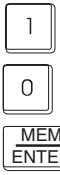
1

7

Now a three-digit distribution-number can be entered (here “1“ and “7“) by using the numerical keys.

MEM ENTER

The input of the distribution-number will be confirmed with the key “MEM/ENTER“.



Afterwards a “C“ for current circuit-number appears briefly on the display. You can type in a maximum three-digit current circuit-number (here “1“ and “0“) by using the numerical key. The input of the current circuit-number will be confirmed with key “MEM/ENTER“.

The measured value is now stored.

The line resistance e.g. is supposed to be stored under distribution-number 20 and place-number 30.

After the measurement is carried out, press the key “MEM/ENTER“.

The display shows briefly a “d“ for distribution-number. Then a three-digit distribution-number can be entered (here “2“ and “0“) by using the numerical keys.

The input of distribution-number will be confirmed with the key “MEM/ENTER“.

The display shows briefly a “C“ for current circuit-number. You can type in a maximum three-digit current circuit-number (here “3“ and “0“) by using the numerical keys.

The input of the current circuit-number will be confirmed with the key “MEM/ENTER“.

For analysis, the measured values can be printed out on the built-in printer (Model 9020 only).

If you wish to store several values of data together, the distribution-number as well as the current circuit-number at the single storing-processes must be the same. Thus several test objects can be tested one after the other and be stored, and the data can be printed out separately via the built-in printer or transferred to the PC.

7.2 Measurement function and saved, recalled measurement values

With some of the test functions there are multiple values stored depending on the measurement function. The following table shows the different measurement functions and the respective allocated test data.

Table 7.2.1 Measurement function and saved, recalled measurement values

Display after measuring key »Display«		Display after pressing of the key "Display"	
RI	Internal line resistance	IPSC	Prospective short-circuit current
ZL	Loop impedance	IPSC	Prospective short-circuit current
VC	Contact voltage	RE IΔN	Earth resistance Nominal residual current
tRCD	Trip time	VC IΔN x5 S 180°	Contact voltage at nominal residual current Nominal residualcurrent Multiplier of the nominal residual current (if not 1) Curve shape of the residual current (if not sinusoidal) Type of the RCD circuit breaker (if time-delayed type) Phase angle of the trip current at start (0° or 180°)
I Trip current		t(IΔ) VC(IΔ) IDN 180°	Trip time at trip current Contact voltage at trip current Nominal residual current Curve shape of the trip current Phase angle of the trip current at start (0°or180°)
RCD-Analysis tRCD/0.5 IΔN, 0° tRCD/0.5 IΔN, 180° tRCD/IΔN, 0° tRCD/IΔN, 180° tRCD/2 IΔN, 0° tRCD/2 IΔN, 180° tRCD/5 IΔN, 0° tRCD/5 IΔN, 180°		VC S	Contact voltage at nominal residual current Curve shape of the residual current Type of RCD circuit breaker (if time-delayed type)
RINS 250 V Insulating resistance RINS 500 V Insulating resistance RINS 1000 V Insulating resistance LOW Ω (Low ohm measuring) RE Earth resistance			
VL-N(L) Display of the voltage VL-N(L)		N Vmax Vmin int.	Number of the stored test data Maximum value of the stored test data in Volt Minimum value of the stored test data in Volt Test interval in seconds
VL-PE Display of the voltage VL-PE		N Vmax Vmin int.	Number of the stored test data Maximum value of the stored test data in Volt Minimum value of the stored test data in Volt Test interval in seconds

7.3 Recall of the Test Data

Each measured value which was stored under a distribution or current circuit-number can be displayed by entering these numbers. For each test function, the measured value will be shown together with the function identification-number (1-12) which is displayed before the measured values.

7.3.1 Examples

All measured values which were stored under a distribution circuit number (as shown in 6.1) should be displayed.

RCL

1

7

Press the key “RCL“. For a moment “d“ will be displayed. Then you can enter the requested distribution-number by using the keys 0 … 9.

RCL

The key “RCL“ confirms the requested distribution-number and displays the measured value.

By using the keys 2/↓ and 8/↑ all further test datas which were stored under this distribution-number will be displayed.

7.3.2 Example

All measured values which were stored under a certain distribution-number and a current circuit-number should be displayed.

RCL

2/↓

0

MEM ENTER

Press the key “RCL“. For a moment “d“ will be displayed. Then you can enter the requested distribution-number by using the keys “0 … 9“.

The key ”MEM/ENTER“ confirms the distribution-number. For a moment “C“ will be displayed.

3

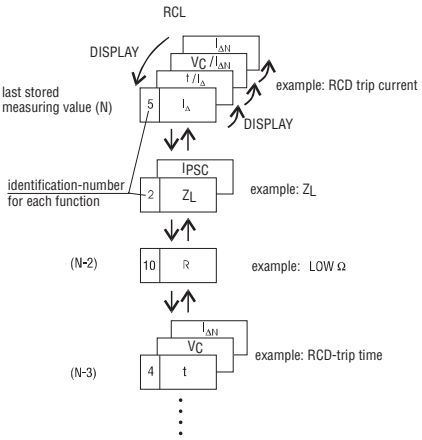
0

Then you can enter the requested current circuit-number by using the keys “0 … 9“.

RCL

The key “RCL“ confirms the current circuit-number and reads out the measured value on the display.

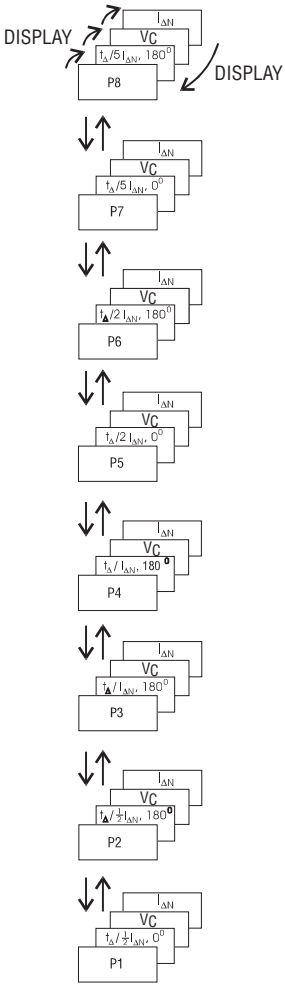
By using the keys 2/↓ and 8/↑ all further test data which where stored under this current circuit-number will be displayed.



☞ Note:

- The key “PAPER/CANCEL“ (27) stops the output of the measured values.
- A distribution or current circuit-number entered by error can be deleted by using the key “CE“.
- Before recalling the voltages which were stored with the data-logger, “LOG“ will appear on the display.
- In order to request the RCD-analysis, the distribution-number 255 must be entered.

Memory organization during the automatic RCD-analysis:



7.4 Print-out of the measurement Data by using the Built-in Printer (model 9020 only)

Using the built-in printer all test data can be printed out, or, by choice only test data which are stored under a certain distribution-number, or only the test data which is stored under a certain distribuption- and current circuit-number.

7.4.1 All measurement data are suposed to be printed out.

PRINT

Press the key “Print“, on the display appears the message “mem All“ i.e. that the whole memory content, hence all data, will be printed.

PRINT

If this is what is required, press the key “Print“ once more. The printing process will commence.

7.4.2 Printing out of measurement data which is stored under a certain distribution-number.

PRINT

Press the key “Print“, on the display appears the message “mem ALL“.

MEM ENTER

1

7

Press the key “MEM/ENTER“. For a moment “d“ will be displayed. Then the relevant distribution number can be entered by using the keys “0 … 9".

PRINT

With the key “Print“ the output will be started.

7.4.3 Printing out of measurement data which is stored under a certain distribution and current circuit-number.

PRINT — Press the key “Print“, on the display appears the message “mem ALL“.

MEM ENTER — Press the key “MEM/ENTER“. For a moment “d“ will be displayed.

1 7 — Then the relevant distribution-number can be entered by using the keys “0 … 9“.

MEM ENTER — Confirm the input with key “MEM/ENTER“.

1 0 — For a moment “C“ will be displayed. Now you enter relevant current circuit-number by using the keys “0 … 9“.

PRINT — With the key “Print“ the output will be started.

☞ Notes:

- The printing process can be stopped by switching the function switch (1) at any time.
- If you press the key “PAPER/CANCEL“ (27) for approx. 2 seconds, the printing will also be stopped.
- An incorrect entry for the distribution or current circuit number can be corrected with the key “CE“.
- Test data of the function “Data logger“ will be printed out directly by pressing key “Print“ (34).

7.5 Output of the measurement data via the RS-232-interface

Both EURO-EXPERT plus models, 9019 (without printer) and 9020 (with printer) are equipped with an RS-232-interface as standard. Because of the structure of the instruments the interface can be utilised only if the EURO EXPERT plus is disconnected from mains voltage. Thus a safe operating of the interface and PC is ensured.

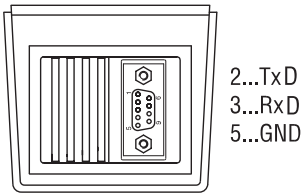


Figure 7.5.1 interface setting

For the transfer of the measurement data to the PC following options are available.

UNITEST Software es control 0100 (Cat. No: 1251) – Comfortable, extendible software to log measurement data in compliance with IEC 60364, DIN VDE 0100

UNITEST Protocol Printer (Cat. No: 1196)
Serial printer for printing measurement data

Interface Cable (Cat. No:1282)
To connect the 0100 EURO EXPERT plus to the PC or to an external printer

☞ **Before the data transfer from the EURO-EURO-EXPERT plus can be started the software in the PC must be set to data receiving mode.**

7.5.1 All measurement data are intended to be transfered.

RS232

Press the key “RS 232“. On the display the message “mem ALL“ appears which means that the entire memory content i.e. all measurements will be transfered.

RS232

If this what is required, press key “RS 232“ once more. The transmission will start.

7.5.2 Transfer of measurement data which is stored under a dsitribution circuit-number.

RS232

Press the key “RS 232“, on the display the message “mem ALL“ appears.

MEM ENTER

1

7

Press the key “MEM/ENTER“. For a moment “d“ will be displayed.
Then the relevant distribution number can be entered by using the keys “0 … 9“.

RS232

By using the key “RS 232“ the transfer will be started.

7.5.3 Transfer of measurement data which was stored under a distribution and current circuit-number

RS232

Press the key “RS 232“, on the display the message “mem ALL“ appears.

MEM ENTER

Press the key “MEM/ENTER“. For a moment “d“ will be displayed. Then the relevant distribution number can be entered by using the keys “0 … 9“.

1

7

Confirm the input by using the key “MEM/ENTER“. “C“ will be displayed for a moment.

RS232

1

0

Now you can enter the relevant current circuit-number by using the keys “0 … 9“.

RS232

By using the key “RS 232“ the transfer will be started.

☞ Notes:

- The transfer can be stopped by switching the function switch (1) at any time.
- If you press the key “PAPER/CANCEL“ (27) for approx. 2 seconds, the transfer can also be stopped.
- An incorrect entry for the distribution or current circuit-number can be corrected with the key “CE“.
- Test data from the function “DATA LOGGER“ will be transmitted directly by pressing the key “RS 232“.

7.6 Deleting of the Stored Measurement Data

In order to avoid confusion with already stored test data it is recommended to delete the data memory completely before storing new “measurements“.
If only certain test data of a distribution or current circuit-number are to be deleted the following procedure must be observed.

7.6.1 All measurement data are intended to be deleted:

CLR — Press the key “CLR“, on the display the message “mem ALL“ appears which means that the entire memory content, i.e. all test data, will be deleted.

CLR — If this is what is required, press the key “CLR“ once more. All the test data will be deleted.

7.6.2 Measurement data which is stored under a certain distribution-number is intendend to be deleted:

CLR — Press the key “CLR“, on the display the message “mem ALL“ appears.

MEM ENTER — Press the key “MEM/ENTER“. For a moment “d“ will be displayed.

1, 0 — Then the relevant distribution-number can be entered by using the keys “0 … 9“.

CLR — By using the key “CLR“ the relevant test data will be deleted.

7.6.3 Measurement data which is stored under a certain distribution and current circuit-number is intended to be deleted.

CLR — Press the key “CLR“, on the display the message “mem ALL“ appears.

MEM ENTER — Press the key “MEM/ENTER“. For a moment “d“ will be displayd.

1, 7 — Then the relevant distribution-number can be entered by using the keys “0 … 9“.

MEM ENTER — Confirm the input by pressing the key “MEM/ENTER“. For a moment “C“ will be displayed.

1, 0 — Now the relevant current circuit-number can entered by using the keys “0 … 9“.

CLR — By using the key “CLR“ the relevant test data will be deleted.

☞ Note:

- Any distribution or current circuit-number entered by error can be corrected by using the key “CE“.

7.7 Processor-Reset (instrument Values)

Should an error happen due to external interference, a reset can be carried out and all settings will be reset to the default values.

☞ When doing this all stored measurement data in the instrument is lost.

- Switch off the EURO EXPERT plus with switch “ON/OFF” (9).

- Press the key “CLR“ (29) and keep it pressed while you switch on the EURO-EXPERT plus with switch “ON/OFF” (9), release key “CLR” (29).“mem CLR“ will be displayed for a moment. The memory is deleted and all values are set as shown in the table below.

Table 7.7.1 Default settings of instrument

Measurement function	Parameter	default values
R LOW Ω (Function 10)	Compensation	deleted
RCD Measurements (Functions 3,4,5,6)	VC limiting value	50V
RCD Measurements (Functions 3,4,5,6)	RCD type	standard
RCD Measurements (Functions 3,4,5,6)	type of RCD-trip current	sinusodial
MEM function	Data memory	all data deleted
MEM function	distribution and current circuit number	d=001 c=001

8.0 Maintenance

When using the instrument in compliance with the instruction manual, no special maintenance is required.

8.1 Cleaning

If the instrument is dirty after daily usage, it is advised to clean it by using a damp cloth and a mild household detergent.

⚠ Prior to cleaning, ensure that instrument is switched off and disconnected from external voltage supplies and any other circuits connected.

⚠ Never use acid detergents or dissolvants for cleaning.

8.2 Battery Replacement

The EURO-EXPERT plus is supplied by four batteries. The battery capacity is sufficient for approx. 500 h operating time when using alkaline, type IEC LR 20.

⚠ Prior to battery replacement switch off the instrument and disconnect from all measurement circuits and test leads.

⚠ The correct positioning of the batteries is shown on the battery casing bottom.

⚠ Respect battery polarity to avoid instrument destruction, explosion or fire.

⚠ Only use batteries complying with the technical data specifications! (4 pcs, 1.5V Typ IEC LR 20 Mono).

⚠ Never try to disassemble battery cells !The battery contains highly alkaline electrolyte. Danger of causticization ! If electrolyte gets in contact with skin or clothing, rinse immediately with water.

☞ Please consider your environment when you dispose of batteries. They belong in a rubbish dump for hazardous waste. In most cases, the batteries can be returned to their point of sale.

⚠ Please, comply with the respective valid regulation regarding the return, recycling and disposal of used batteries.

⚠ If an instrument is not used over an extended time period, the or batteries must be removed. Should the instrument be contaminated by leaking battery cells, the instrument has to be returned for cleaning and inspection to the factory.

☞ Always replace all 4 batteries. Use only leakfree batteries, type IEC LR20 (alkaline).

- Loosen the battery compartment screws (28) and open the battery compartment.
- Take out the exhausted batteries.
- Insert the new batteries, type IEC LR20, correctly polarized.
- Pay attention to good contact.
- Close the battery compartment.

Now you can continue measuring.

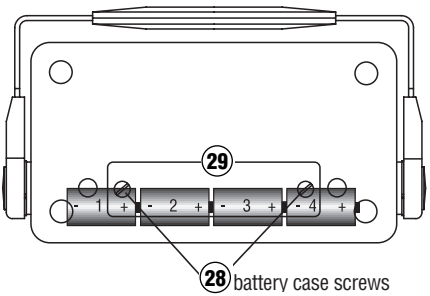


Figure 8.2.1 battery replacement

8.3 Ribbon Replacement (only model 9020)

The printer ribbon is available as a replacement under Cat. No. 1066 via your wholesaler or directly from BEHA.

⚠ Disconnect the EURO EXPERT plus from all test cables and switch off the instrument, before replacing printer ribbon.

- Loosen the locking screw and open the printer compartment (4).
- Lift the ribbon carefully at the spot marked with “Pull“, Do not use force.
- Take out the used ribbon and carefully insert the new ribbon, do not use force.
- Tighten the ribbon by turning the rippled wheel in the direction of the arrow.

8.4 Insertion of a new paper roll (model 9020 only)

The matrix printer operates with standard paper as it is used in cash registers. Replacement paper rolls with a width of 57.5 mm and a diameter of max. 60 mm are available in most stationer’s shops or under Cat. No 1068 via your wholesaler or directly from the factory.
The ribbon cassette is available as a replacement under Cat. No. 1066 via your wholesaler or directly from BEHA.

⚠ Disconnect the EURO EXPERT plus from all test cables and switch off the instrument, before replacing printer ribbon.

- Loosen the locking screw and open the printer compartment (4).
- Take out the empty paper roll.
- Set in the new paper roll so that it can roll off from the bottom.
- Cut off the start of the paper roll so that the leading edge is square and push the paper in the lower slit of the printer.
- Switch on the instrument and press the key “PAPER/CANCEL“ (27) until the paper is in its correct position.
- Make sure that the ribbon is tight. If necessary turn the wheel of the ribbon cassette in the direction of the arrow until the ribbon is tight.

8.5 Built in Fuses

If a fuse blows through overload the message “FUS“ will be appear on the display. To replace the fuse proceed as follows:

⚠ Only use fuses with the specified ratings of current, voltage, switch-off characteristics and switch-off capacities.

⚠ The use of temporary fuses, especially the short-circuitting of the fuse, is inadmissible and can lead to the destruction of the test instrument and to serious injuries to the user.

⚠ Disconnect the EURO-EXPERT plus from all test cables and circuits switch off the instrument.

8.5.1 Description of used fuses

Fuse F1 and F2 (at measurement connectors):
Type T 4 A/500 V, 10 x 38 mm, switch-off capacity more than 10 kA/500V, type FLQ 4A (littlefuse)

Fuse F1 (on PCB):
Type M 0.315 A/250 V, (medium time-lag),
5 x 20 mm

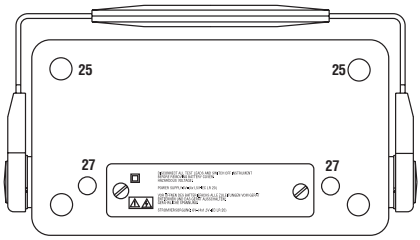
To protect the measurement function R LOW Ω if voltage is present. .

8.5.2 Fuse replacement

For fuse replacement proceed as follow.

- Disconnect the EURO-EXPERT plus from all test circutis and switch off the instrument.
- Remove the test cables and shut the cover of the EURO-EXPERT plus.
- Turn the unit upside down and remove the 4 plastic covers (25 and 27), see figure 8.5.1.

Figure 8.5.1 Case upside



- Loosen the 4 case screws. Turn the EURO EXPERT plus right side up, the top part of the case cover can now be taken off.
- Check the fuses on the PCB and on the connector board. If necessary, replace the fuses. Pay attention to the correct fitting of the fuses.
- Put the top part of the case cover to the bottom correctly, use the case screws and the screw covers to fit the case together.

9.0 Calibration interval

We suggest a calibration interval of one year. If the instrument is used very often or if it is used under rough conditions we recommend shorter intervals. If the instrument is used few times only the calibration interval can be extended on to 3 years.

10.0 Technical Data

Insulation Resistance acc. EN 61557-2

Range .....0.008...1.999 / 19.99 / 199.9 MΩ
Resolution .....0.001 / 0.01 / 0.1 MΩ
.....(Auto Range)
Accuracy.....±(2 % Rdg. + 2 Digit)
Test Voltage .....250, 500, 1000 V DC (+ 6 %/-0 % at nominal load 1 mA)
Max. open voltage.....VN +50%
Test Current .....≥ 1 mA
Short circuit Current .....< 1.4 mA
Over range display .....»o.r.«, for ≥ 200 MΩ
Number of measurements with one battery set >10 000 (at 1000V, 1 MΩ)
UUT will be discharged automatically after measurement.

LOW Ohm measurement (LOW Ω) acc. EN 61557-4

Range .....0.08...19.99 Ω
Resolution .....0.01 Ω
Accuracy.....± (2 % Rdg. + 2 Digit)*
Test Voltage .....4...7 V DC
Test Current .....>200 mA
Compensation of test leads.....up to approx. 5 Ω
Over range display .....»o.r.«, for ≥ 20 Ω
Number of measurements with one battery set >50 000

The test current polarity will be reversed automatically. The displayed value is the mean value of both measurements

* with compensated test leads as described in the manual in chapter 6.2.2 " Compensation of test leads".

Earth resistance acc. EN 61557-5

Measurement principle .....two, three and four pole with probes
.....specific Earth resistance acc. Wenner method
.....manual calculation: r = 2paRe
Range .....0.08...19.99 / 199.9 / 1999 Ω
Resolution .....0.01 / 0.1 / 1 Ω
.....(Auto Range)
Accuracy.....± (2 % Rdg. + 2 Digits)
Test Voltage .....<40 V Sinus
Test Current .....<10 mA eff
Frequency.....125 Hz (± 1 Hz)
Automatic monitoring of auxiliary earth and probe resistances

External voltages up to max. 20 Vpp/50 Hz have an influence to the measurement result of maximum ± 0.15 Ω.

Earth resistances and auxiliary earth resistances or probe resistances will give an additional error of maximum 3 %, if following equation will be fulfilled:

RHmax = (4 kΩ + 100*RE) or < 50 kΩ
RHmax = RH + RE (at four pole measurement)
RSmax = (4 kΩ + 100*RE) or < 50 kΩ
RSmax = RS1 + RS2 (at four pole measurement)
(see also figure 10.1)

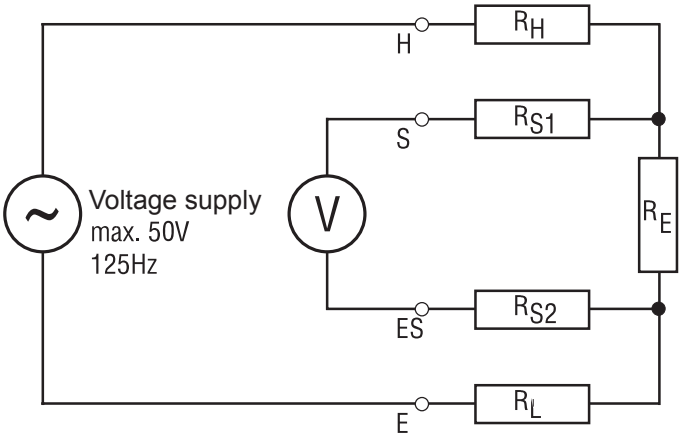


Fig. 10.1 Earth measurement principle

Voltage measurement

Range .....0...440 V
Resolution .....1 V
Accuracy.....± (2 % Rdg. + 2 Digits)
Frequency range .....15.3...499 Hz

Frequency measurement

Range .....15.3 … 99.9 / 499 Hz
Resolution .....0.1 / 1 Hz
Accuracy.....± (0.1 % Rdg. + 1 Digit)
Voltage range .....10...440 V

Loop impedance ZL (L-PE) / Prospective short circuit current Ipsc

Range .....0.08...19.99 / 199.9 / 1999 Ω
Resolution .....0.01 / 0.1 / 1Ω
.....(Auto Range)
Accuracy.....± (2 % Rdg. + 2 Digits)*
Nominal voltage / frequency .....100...250 V / 45...65 Hz
Test current .....approx. 23 A (at 230 V)

Prospective short circuit current (calculated)
Display range Ipsc .....0.11 A …2.875 kA (at 230 V)
.....0.06 A …1.437 kA (at 115 V)
Accuracy .....depending on Loop impedance measurement
Calculation .....for line voltages of 230 V ± 10%: Ipsc = 230 V/ZL
.....for line voltages of 115 V ± 10%: Ipsc = 115 V/ZL
.....for other voltages: Ipsc = V/ZL

* with compensated test leads as described in the manual in chapter 6.2.2 " Compensation of test leads".

Line resistance RI (L-N) / Prospective short circuit current Ipsc

Range .....0.08...19.99 / 199.9 / 1999 Ω
Resolution .....0.01 / 0.1 / 1Ω
.....(Auto Range)
Accuracy.....± (2 % Rdg. + 2 Digits)*
Nominal voltage / frequency .....100...440 V / 45...65 Hz
Test current .....approx. 23A (at 230V)

Prospective short circuit current (calculated)
Display range Ipsc .....0.2...5.0 kA (at 400 V)
.....0.11 A …2.875 kA (at 230 V)
.....0.06 A …1.437 kA (at 115 V)
Accuracy .....depending on Line resistance measurement
Calculation .....for line voltages of 400 V ± 10%: Ipsc = 400 V/RI
.....for line voltages of 230 V ± 10%: Ipsc = 230 V/RI
.....for line voltages of 115 V ± 10%: Ipsc = 115 V/RI
.....for other voltages: Ipsc = V/RI

* with compensated test leads as described in the manual in chapter 6.2.2 " Compensation of test leads".

RCD Test

Nominal residual currents.....10, 30, 100, 300, 500, 1000 mA,
.....standard or time delayed
Test current type.....sinus, pulse, DC, Phase polarity 0° or 180°
Test current factor .....x 1, x 5 (for IΔN=1000 mA only x 1)
Accuracy of trip of residual currents (-0 / +10)%
Nominal voltage / frequency .....100...250 V / 45...65 Hz

Contact voltage (function 3)

The contact voltage VC is measured at 1/3 IΔN and is calculated to the nominal residual current IΔN or the double nominal residual current 2 IΔN at time delayed RCDs.
Range .....10.0... 50.0 V (at limit 25 V)
.....10.0...100.0V (at limit 50 V)
Resolution .....0.1 V
Accuracy.....(-0 / +10)%
Test Current .....approx. 1/3*IΔN (~)
Limits .....25 / 50 V
Earth resistance RE, display range ..0.00...19.99 / 199.9 / 1999 Ω
Calculation .....RE=VC/ IΔN
Resolution .....0.01 / 0.1 / 1Ω
Accuracy .....depending on contact voltage measurement

Trip time (function 4)

Range (standard RCD) .....0...500 ms (at IΔN)
.....0...50 ms (at 5*IΔN)
Range (time delayed RCD) .....0...200 ms (at 2*IΔN)
.....0...150 ms (at 5*IΔN)
Resolution .....1 ms
Accuracy.....± (2 % Rdg. + 2 ms)

RCD Trip current (function 5)

Measurement principle .....rising current (ramp method)
Range .....(40.....140%) IΔN ΔI=10% IΔN
Accuracy of trip current .....±10% of IΔN
Range trip time .....0 …500 ms
Resolution .....1 ms
Accuracy.....± (2% Rdg. + 2 ms)

RCD-Analysis (function 7)

Nominal residual currents.....10, 30, 100, 300, 500 mA
.....standard or time delayed
Measurement principle .....8 test steps with 50%, 100%, 200% and 500%
.....at 0° and 180° of nominal residual current
Trip time range
at standard RCD .....0...500 ms (at 1/2 IΔN, IΔN)
.....0...150 ms (at 2 IΔN)
.....0...50 ms (at 5xIΔN)
at time delayed RCD .....0...500 ms (at 1/2 IΔN, IΔN)
.....0...200 ms (at 2xIΔN)
.....0...150 ms (at 5xIΔN)
Resolution .....1 ms
Accuracy.....± (2 % Rdg. + 2 ms)

Available nominal trip currents (RMS value) in mA

IΔN	1/3 IΔN (*1)			1/2 IΔN (*2)			IΔN (*3)			2IΔN(*4)			5IΔN (*5)		
	~	⩘	⎓	~	⩘	⎓	~	⩘	⎓	~	⩘	⎓	~	⩘	⎓
10	3,33	-	-	5	3,5	5	10	20	10	20	28,3	20	250	353,6	250
30	10	-	-	15	10,5	15	30	42,5	30	60	84,9	60	250	353,6	250
100	33,3	-	-	50	35	50	100	141,4	100	200	283	200	500	707,1	500
300	100	-	-	105	150	300	300	424,3	300	600	849	600	1500	2121	-
500	167	-	-	250	175	250	500	707,1	500	1000	1414	-	2500	3535	-
1000	333	-	-	500	354	500	1000	1414	-	-	-	-	-	-	-

*1 Test current for contact voltage measurement in function 3 (VC/RE) and pre-test current for contact voltage measurement in the functions 4, 5, 6

*2 Test current for test steps 1 and 2 in function 6 (RCD-Analysis)

*3 Test current for trip time measurement at Idn x 1 in function 4 (tRCD) and test current for test steps 3 and 4 in function 6 (RCD-Analysis)

*4 Test current for test steps 5 and 6 in function 6 (RCD-Analysis)

*5 Test current for trip time measurement at Idn x 5 in function 4 (tRCD)and test current for test steps 7 and 8 in function 6 (RCD-Analysis)

Rotary field test acc. EN 61557-7

Nominal voltage .....100 … 440 V
Frequency.....45 … 65 Hz
Display .....
1.2.3 .....for rotary field RIGHT
2.1.3 .....for rotary field LEFT
0.0.0 .....No three phase system
.....(one or two phases missing or connected to N or PE)
diS .....no line voltage present

Technical Data

Built in printer (only model 9020)

Type .....Matrix printer 5 x 8 dots, 24 columns,
Print speed .....1 line per second
Paper .....Standard paper, 57.5 mm wide, max. 60 mm diameter
Replacement paper .....Cat. No. 1068
Print ribbon .....Citizen IR-91B
Replacement ribbon .....Cat. No. 1066

General technical data

Display .....$3^1/_2$ digit LC display, 1999 Digits
Memory capacity .....approx. 800 values
.....1500 values (for Data Logger)
Interface .....RS 232
.....2400 baud, 1 start bit, 8 Data bit, 1 stop bit
Safety complying with.....IEC 61010/EN 61010/DIN VDE 0411
.....IEC 61557/EN 61557/DIN VDE 0413
Protection class .....II (double insulated)
Overvoltage category .....CAT III/300 V CAT II/440 V
Pollution degree 2
Protection degree .....IP 40, (IP 53 with closed lid)
Power supply .....Battery 4 x 1.5V IEC LR 20 (Mono)
Battery voltage .....approx. 4.5...6.4 V
Battery time life.....approx. 500 h
Internal buffer accumulator: .....4.8 V, 120 mAh, NC (type Emmerich NC-M120-4,8 V)
Internal fuses:.....Fuse F1 and F2 (at measurement connectors):
.....Type T 4 A/500 V, 10 x 38 mm, switch-off capacity more than 10 kA/500V, type FLQ 4A (littlefuse)
.....Fuse F1 (on PCB):
.....Type M 0.315 A/250 V, (medium time-lag), 5 x 20 mm

Ambient condition

Height abbove sea level.....up to 2000m
Reference temperature range .....+17...+27°C, 40...60% R. H.
Operating temperature range .....0...+40°C, max. 85% R. H.
Storage temperature range .....-32...+70°C max. 85% R. H.

Dimensions (W*H*D).....350 x 125 x 265 mm
Weight .....approx. 3.8 kg (w. batteries w/o accessories)

Qualitätszertifikat • Certificate of Quality
Certificat de Qualité • Certificado de calidad

D

Die BEHA-Gruppe bestätigt hiermit, dass das erworbene Produkt gemäß den festgelegten Beha-Prüfanweisungen während des Fertigungsprozesses kalibriert wurde. Alle innerhalb der Beha-Gruppe durchgeführten, qualitätsrelevanten Tätigkeiten und Prozesse werden permanent durch ein Qualitätsmanagement-System nach ISO 9000 überwacht.

Die BEHA-Gruppe bestätigt weiterhin, dass die während der Kalibrierung verwendeten Prüfeinrichtungen und Instrumente einer permanenten Prüfmittelüberwachung unterliegen. Die Prüfmittel und Instrumente werden in festgelegten Abständen mit Normalen kalibriert, deren Kalibrierung auf nationale und internationale Standards rückführbar ist.

GB

The BEHA Group confirms herein that the unit you have purchased has been calibrated, during the manufacturing process, in compliance with the test procedures defined by BEHA. All BEHA procedures and quality controls are monitored on a permanent basis in compliance with the ISO 9000 Quality Management Standards.

In addition, the BEHA Group confirms that all test equipment and instruments used during the calibration process are subject to constant control. All test equipment and instruments used are calibrated at determined intervals, using reference equipment which has also been calibrated in compliance with (and traceable to) the calibration standards of national and international laboratories.

F

Le groupe BEHA déclare que l´appareil auquel ce document fait référence a été calibré au cours de sa fabrication selon les procédures de contrôle définies par BEHA. Toutes ces procédures et contrôles de qualité sont régis par le système de gestion ISO 9000.

Le groupe BEHA déclare par ailleurs que les équipements de contrôle et les instruments utilisés au cours du processus de calibrage sont eux-mêmes soumis à un contrôle technique permanent.

Ces mêmes équipements de contrôle sont calibrés régulièrement à l´aide d´appareils de référence calibrés selon les directives et normes en vigueur dans les laboratoires de recherche nationaux et internationaux.

E

El grupo BEHA declara que el producto adquirido ha sido calibrado durante la producción de acuerdo a las instrucciones de test BEHA. Todos los procesos y actividades llevados a cabo dentro del grupo BEHA en relación con la calidad del producto son supervisados permanentemente por el sistema ISO 9000 de control de calidad.

Adicionalmente, el grupo BEHA constata que los equipos e instrumentos de prueba utilizados para la calibración también son sometidos a un permanente control. Estos equipos e instrumentos de prueba son a su vez calibrados en intervalos regulares valiéndose de equipos de referencia calibrados de acuerdo a directivas de laboratorios nacionales e internacionales.

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Reg. No. 3335
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I.S./ISO 9002/EN 29002
Quality Management System

IQ NET

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24 month Warranty

UNITEST instruments are subject to strict quality control. However, should the instrument function improperly during daily use, your are protected by our 24 months warranty (valid only with invoice).

We will repair free of charge any defects in workmanship or material, provided the instrument is returned unopened and untampered with, i.e. with undamaged warranty label.

Any damage due to dropping or incorrect handling are not covered by the warranty.

If the instrument shows failure following expiration of warranty, our service department can offer you a quick and economical repair.

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