GOSSEN METRAWATT
GMC-INSTRUMENTS GROUP

OPERATING INSTRUCTIONS

1/3.25
3-447-232-03

PROFITEST PRIME
PROFITEST PRIME AC

TEST INSTRUMENTS FOR STANDARDS-COMPLIANT TESTING OF THE EFFECTIVENESS OF PROTECTIVE MEASURES PER:

- VDE 0100-600 / DIN VDE 0100-600 / IEC 60364-6
- VDE 0105-100 / DIN VDE 0105-100 / EN 50110-1
- OVE E 8101
- NIV SN 411000
- VDE 0113-1 / DIN EN 60204-1 / IEC 60204-1
- VDE 0126-23-1 / DIN EN 62446-1 / IEC 62446-1
- VDE 0122-1 / DIN EN 61851-1 / IEC 61851-1
- VDE 0100-710 / DIN VDE 0100-710 / IEC 60364-7-710
- VDE 0660-600-1 / DIN EN IEC 61439-1 *
- VDE 0432-1 / DIN EN 60060-1 / IEC 60060-1 *
- VDE 0472 / DIN VDE 0472 *

* PROFITEST PRIME AC only

TABLE OF CONTENTS

1 SAFETY INSTRUCTIONS

	Read and follow these instructions carefully and completely in order to ensure safe and proper use. The instructions must be made available to all persons who use the instrument. Keep for future reference.

General

- Tests/measurements may only be performed in commercial settings by a qualified electrician, or under the supervision and direction of a qualified electrician.
  The instrument is not intended for private end users.
  The user must be instructed by a qualified electrician concerning performance and evaluation of tests and/or measurements.
- Observe the five safety rules in accordance with DIN VDE 0105-100, Operation of electrical installations – Part 100: General requirements.
  (1: Shut down entirely. 2: Secure against restart. 3: Assure absence of voltage at all poles. 4: Ground and short circuit. 5: Cover neighboring live components, or make them inaccessible.)
- Observe and comply with all safety regulations which are applicable for your work environment.
- Wear suitable and appropriate personal protective equipment (PPE) whenever working with the instrument.
- The functioning of active medical devices (for example pacemakers, defibrillators) and passive medical devices may be affected by voltages, currents and electromagnetic fields generated by the instrument and the health of their users may be impaired. Implement corresponding protective measures in consultation with the manufacturer of the medical device and your physician. If any potential risk cannot be ruled out, do not use the instrument.

Accessories

- Use only the specified accessories (included in the scope of delivery or listed as optional accessories) with the instrument.
- Carefully and completely read and adhere to the product documentation for optional accessories. Retain these documents for future reference.

Handling

- Use the instrument in undamaged condition only.
  Inspect the device before use. Pay particular attention to damage, interrupted insulation or kinked cables.
  Damaged components must be replaced immediately.
- Use the accessories and all cables in undamaged condition only.
  Inspect accessories and all cables before use. Pay particular attention to damage, interrupted insulation or kinked cables.
- If the instrument or its accessories don’t function flawlessly, permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- If the instrument or accessories are damaged during use, for example if they’re dropped, permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- If there are any signs of interior damage to the instrument or accessories (e.g. loose parts in the housing), permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- The instrument and the accessories may only be used for the tests/measurements described in the documentation for the instrument.
- Equipment and accessories from Gossen Metrawatt GmbH are designed to function ideally with products from Gossen Metrawatt GmbH which are specifically intended for this purpose. Unless expressly confirmed otherwise in writing by Gossen Metrawatt GmbH, they are not intended or suitable for use with other products.
- The inside pocket in the case’s lid may not be used for accessories.
  Considerable damage may otherwise be caused to display’s face-plate.
- Transport: Before closing the test case lid, remove all power, measurement and signal cables from the tester’s front panel connector sockets and store them separately to avoid pinching and damaging the cables and scratching the display panel.

Measurements/Tests

- The integrated voltage measuring function and mains connection test included with the measuring/test instrument may not be used to test systems or system components for the absence of voltage.
  Testing for the absence of voltage is only permissible with a suitable (2-pole) voltage tester or voltage measuring system which fulfills the requirements specified in DIN EN 61243.
- When testing electrical systems with RCCBs, back up data and turn off all consumers.
  Data loss may result and/or damage can be caused to data processing systems when RCCBs are tripped.
- Route cables in an orderly fashion, e.g. the mains power cable and accessory cables. Loose, disorderly cables result in unnecessary danger of tripping and falling.

Operating Conditions

- Do not use the instrument and its accessories after long periods of storage under unfavorable conditions (e.g. humidity, dust or extreme temperature).
- Do not use the instrument and its accessories after extraordinary stressing due to transport.
- Do not expose the instrument to direct sunlight for long periods of time. Overheating can cause damage to the instrument.
- Only use the instrument and its accessories within the limits of the specified technical data and conditions (ambient conditions, IP protection code, measuring category etc.).
- Do not use the instrument in potentially explosive atmospheres. Danger of explosion!
- Do not use the instrument in areas subject to the risk of fire. Danger of fire!

Rechargeable/Primary Batteries

- Do not use the instrument while the internal battery is being charged.

Fuses

- The instrument may only be used as long as the fuses are in flawless condition. Defective fuses must be replaced.
- Never bridge the fuses. Never disable the fuses.

Measurement Cables and Establishing Contact

- Plugging in the measurement cables must not necessitate any undue force.
- Never touch conductive ends (for example of test probes).
- Fully unroll all measurement cables before starting a test/measurement. Never perform a test/measurement with the measurement cable rolled up.
- Avoid short circuits due to incorrectly connected measurement cables.
- Ensure that the test probes make good contact.
- In so far as possible, do not move or remove plugs, test probes etc. until testing/measurement has been completed.
  Unwanted sparking may otherwise occur due to test current.

Calibration

- Comply with national calibration regulations and laws.
- Calibration may only be carried out by authorized service centers.

Emissions

- The instrument is equipped with a Bluetooth® module. Determine whether or not use of the implemented frequency band of 2.402 to 2.480 GHz is permissible in your country.

Data Security

- Always create a backup copy of your measurement/test data.
- The instrument is equipped with a data memory to which personal and/or sensitive data can be stored. Observe and comply with respectively applicable national data protection regulations. Take appropriate measures to prevent unauthorized access to the data.

Documentation

- Test reports must be checked for correctness and signed by the inspector.

2 APPLICATIONS

Please read this important information!

2.1 INTENDED USE / USE FOR INTENDED PURPOSE

The PROFITEST PRIME (M516A) and PROFITEST PRIME AC (M516C) measuring and test instruments permit quick and efficient testing for the effectiveness of protective measures in accordance with:

- VDE 0100-600 / DIN VDE 0100-600 / IEC 60364-6
  Electrical installations / systems
- VDE 0105-100 / DIN VDE 0105-100 / EN 50110-1
  Electrical installations / systems
- OVE E 8101
  Electrical installations / systems
- NIV / SN 411000
  Electrical installations / systems
- VDE 0113-1 / DIN EN 60204-1 / IEC 60204-1
  Electric machines / systems
- VDE 0126-23-1 / DIN EN 62446-1 / IEC 62446-1
  PV systems
- VDE 0122-1 / DIN EN 61851-1 / IEC 61851-1
  Electric charging points
- VDE 0100-710 / DIN VDE 0100-710 / IEC 60364-7-710
  Low-voltage systems in medical facilities

Additionally with the PROFITEST PRIME AC

- VDE 0660-600-1 / DIN EN IEC 61439-1
  Low-voltage switchgear and controlgear assemblies
- VDE 0432-1 / DIN EN 60060-1 / IEC 60060-1
  High-voltage test techniques
- VDE 0472 / DIN VDE 0472 (all parts)
  Testing of cables, wires and flexible cords
- Work safety concept for the inspector (with indicator lamp, emergency stop switch and key switch) in accordance with
  VDE 0104 / DIN EN 50191 and VDE 0413-14 / DIN EN 61557-14 / IEC 61557-14

PROFITEST PRIME / PROFITEST PRIME AC are used during setup and initial startup, as well as for periodic testing and for troubleshooting.

The measuring/test instruments can be used in all AC and three-phase systems with nominal voltages of 120, 230, 400 and 690 V and DC systems with a nominal voltage of 850 V DC, at nominal frequencies of 16.7, 50, 60, 200 or 400 Hz, respectively.

Available measurements ⇨ "Included Features" 🗎13.

Measurements can be stored in the internal memory of the PROFITEST PRIME / PROFITEST PRIME AC. Moreover, system structures and customers can be managed in an internal database and measurements/tests can be saved in an element-related manner.

IZYTRONIQ software can be used to archive all measurement data and generate printable measurement and test reports.

Safety of the user, as well as that of the instrument, is only assured when it’s used for its intended purpose.

Safety of the user, as well as that of the instrument, is only assured when it’s used for its intended purpose.

2.2 USE FOR OTHER THAN INTENDED PURPOSE

Using the instrument for any purposes other than those described in the condensed operating instructions or these instrument operating instructions is contrary to use for intended purpose. Use for other than the intended purpose may lead to unforeseeable damage!

2.3 LIABILITY AND GUARANTEE

The warranty provided by Gossen Metrawatt GmbH, as well as its liability, are governed by the applicable contractual and mandatory statutory provisions.

3 DOCUMENTATION

3.1 INFORMATION CONCERNING THESE INSTRUCTIONS

Read these instructions carefully and attentively. They contain all necessary information for safe use of the instrument. Comply with them in order to protect yourself and others from injury, and to avoid damaging the instrument.

The latest version of these instructions is available on our website:

https://www.gossenmetrawatt.de/en/services-support/download-center/

Descriptions of Instrument Variants

This documentation describes PROFITEST PRIME and PROFITEST PRIME AC instruments.

As a result, features and functions may be described which do not apply to your instrument. Furthermore, illustrations may differ from your instrument.

Errors and Suggestions for Improvement

These instructions have been prepared with utmost care in order to ensure correctness and completeness. Unfortunately, errors can never be entirely avoided. Continuous improvement is part of our quality goal, so we always appreciate your comments and suggestions.

Gender Equality

For better readability, only the masculine form is used in these instructions in a grammatically impartial sense. The feminine and diverse forms are of course always implied as well.

Trademark Law

Product designations used in this document may be subject to trademark and patent law. They are the property of their respective owners.

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3.2 SCOPE OF VALIDITY

This document describes a test instrument with software/firmware version 04.02.00.

3.3 IDENTIFICATION OF WARNINGS

Instructions for your safety and for the protection of the instrument and its environment are provided as warnings and notes at certain points within these instructions.

They're laid out as shown below and are graded in terms of the severity of the respective hazard. They also describe the nature and cause of the hazard, the consequences of non-observance and what must be done to avoid it.

DANGER
Death or serious injury is almost certain.

WARNING
Death or serious injury is possible.

CAUTION
Minor or moderate injury is possible.

ATTENTION
Damage to the product or the environment is possible.

Note
Important information

Tip
Useful additional information or application tip

Tab. 1: Identifiers in this Document

3.4 SYMBOLS IN THE DOCUMENTATION

The following symbols are used in this documentation:

Symbol	Meaning
	Read and adhere to the product documentation.
	General warning symbol
	Warning regarding electrical voltage

Tab. 2: Symbols Used in this Document

3.5 DEFINITION OF TERMS

Term	Definition
Measuring/ test instrument	PROFITEST PRIME / PROFITEST PRIME AC
Device under test (DUT)	Object to be examined/tested, e.g. installation, system, machine

Tab. 3: Definition of Terms

3.6 LIST OF ABBREVIATIONS AND THEIR MEANINGS IN THE SAME ORDER AS THE ROTARY SWITCH POSITIONS

U – Voltage Measurement

f	Line voltage frequency
f_N	Nominal frequency
U	Voltage measured at the test probes during and after insulation measurement Riso, or for the measurement of residual voltage Ures
U_{L-L}	Voltage between two phase conductors
U_{L-N}	Voltage between L and N
U_{L-PE}	Voltage between L and PE
U_N	Nominal line voltage

R_{LO} – Low-Resistance of Protective, Grounding and Equipotential Bonding Conductors

R_{LO}	Resistance of equipotential bonding conductors, designated R_{PE}
R_{LO}+	Resistance of equipotential bonding conductors, (+ pole to PE)
R_{LO}–	Resistance of equipotential bonding conductors, (– pole to PE)
U_q	Open circuit voltage
R_{OFFSET}	Offset resistance for compensation of cables during low-resistance measurement
I_{HIGH}	High test current of 25 A for low-resistance measurement

R_{ISO} – Insulation Resistance Measurement

R_{ISO}	Insulation resistance
U_{ISO}	When measuring R_{ISO}: test voltage for ramp function: tripping or breakdown voltage
U	Voltage measured at the test probes during and after insulation measurement R_{ISO}

RCD – Testing of Residual Current Devices

I_Δ	Tripping current
$I_{\Delta N}$	Nominal residual current
I_N	Nominal current
I_{F}◢	Rising test current (residual current)
I_T	Test current
RCD	RCCB (residual current circuit breaker)
PRCD	Portable residual current device PRCD-S: with protective conductor detection and monitoring PRCD-K: with undervoltage trigger and protective conductor monitoring
RCD-S	Selective RCCB
RCBO	Combined RCCB / overcurrent protector (residual current operated circuit-breaker with overcurrent protection)
R_E	Calculated earth or electrode loop resistance
SRCD	Socket residual current device (permanently installed)
t_a	Time to trip / breaking time
$U_{I\Delta}$	Touch voltage at moment of tripping
$U_{I\Delta N}$	Touch voltage relative to nominal residual current $I_{\Delta N}$
U_L	Touch voltage limit value

Z_{LOOP} – Loop Impedance Measurement

I_K	Calculated short-circuit current (at nominal voltage)
U_L	Touch voltage limit value
Z	Loop impedance (Z_{L-N} line impedance, Z_{L-PE} loop impedance)

UresResidual voltage measurement

U_{res}	Measured residual voltage after discharge time tu, at which voltage drops to equal to or less than 60 V

IMD – Insulation Monitoring Device

RCM – Residual Current Monitor

I_L – Leakage Current Measurement

≤1V≅ – $I_{L/AMP}$ Leakage Current and (apparent) Power (measurement with current clamp sensor)

S	Apparent power

T, %r.h. – Temperature / Atmospheric Humidity

ϑ	Temperature in °C or °F
r. H.	Atmospheric humidity as %

HV – Testing for Dielectric Strength, HV AC (PROFITEST PRIME AC only)

I_{LIM}	Maximum current which may flow before high-voltage is shut down (limit value to be specified)
I	Shutdown current for the test for dielectric strength
U_{max}	Test voltage to be specified for the test for dielectric strength

U	Momentary test probe voltage
U_D	Breakdown voltage
t◢	Rise time: time during which test voltage climbs to Umax
t_{on}	Test duration at maximum test voltage Umax (without rise time t◢)

Setup – Settings Menu

U_{Batt}	Battery Voltage

Mains System

IT system	In IT systems, all active components are isolated from earth, or one point is connected to earth via an impedance. The bodies of the electrical system are grounded either individually or mutually, or are mutually connected to the system's earthing.
TT system	One point of the current source is directly grounded (French: terre terre).
TN system	As opposed to TT systems, the electrical circuit is neutralized with the consuming system in TN systems (French: terre neutre)

4 GETTING STARTED

This chapter provides an overview of the initial steps for working with the measuring/test instrument.

1. Read and adhere to the product documentation. In particular observe all safety information in the documentation, on the measuring/test instrument and on the packaging.
   - Safety instructions ⇨🗎6
   - Applications ⇨🗎8
   - Documentation ⇨🗎9
2. Familiarize yourself with the measuring/test instrument ⇨🗎12.
3. Start up the measuring/test instrument ⇨🗎44.
4. Read the connection instructions ⇨🗎46.
5. Configuration and operation:
   - Enter the basic instrument settings ⇨🗎49.
   - Create a database (distribution structure) ⇨🗎54.
6. Perform measurements.
   - Read the general notes concerning measurements first ⇨🗎58.
   - ⇨ "U – Measuring Voltage and Frequency" 🗎64
   - ⇨ "RLO – Measuring Low-Value Resistance" 🗎66
   - ⇨ "RCD – Testing of Residual Current Devices" 🗎79
   - ⇨ "RCD IF + IΔN – Testing RCDs by Simultaneously Measuring Tripping Current and Time to Trip with Rising Test Current" 🗎86
   - ⇨ "ZLOOP – Testing of Breaking Requirements for Overcurrent Protective Devices, Measurement of Line or Loop Impedance and Determination of Short-Circuit Current" 🗎96
   - ⇨ "Ures – Residual Voltage Measurement" 🗎105
   - ⇨ "IMDs – Testing Insulation Monitoring Devices" 🗎106
   - ⇨ "RCM – Testing of Residual Current Monitoring Devices" 🗎108
   - ⇨ "IL – Leakage Current" 🗎110
   - ⇨ "IL/AMP – Current and Apparent Power Measurement with Current Clamp Sensor" 🗎111
   - ⇨ "T %r.H. – Measurement of Temperature and Atmospheric Humidity" 🗎113
   - ⇨ "Extra – Special Functions" 🗎114
   - ⇨ "HV – Testing for Dielectric Strength,(PROFITEST PRIME AC only)" 🗎122
   - ⇨ "AUTO – Test Sequences (automatic test sequences)" 🗎132
7. Transfer the measurement/test results to a PC with IZYTRONIQ report generating software for data backup and evaluation ⇨🗎135.

Further topics of interest: Maintenance ⇨🗎136

5 THE INSTRUMENT

5.1 SCOPE OF DELIVERY

Please check the scope of delivery for completeness and intactness.

1 Measuring/test instrument (PROFITEST PRIME M516A or PROFITEST PRIME AC M516C)
1 Mains power cable, 1.5 m
1 Probe for L with test tip, 4 m probe cable and alligator clip [1)]
1 Probe for N with test tip, 4 m probe cable and alligator clip [1]
1 Probe for PE with test tip, 4 m probe cable and alligator clip [1]
1 Accessories pouch, 400 × 350 × 50
1 USB cable
1 Condensed operating instructions (this document)
1 DAkkS calibration certificate
1 Card with registration key for IZYTRONIQ software [2)]

1) Measuring category with safety cap attached: 300 V CAT IV, 600 V CAT III, 1 A;
Measuring category without safety cap attached: 600 V CAT II, 16 A

2) IZYTRONIQ Business Starter. In some cases Business Starter is replaced by another version, e.g. for packages.

5.2 OPTIONAL ACCESSORIES

Some measurements necessitate optional accessories:

I-SK4-PROFITEST-PRIME (Z516T)	Intelligent measuring probe with remote triggering (4 m connector cable).
I-SK12-PROFITEST-PRIME (Z516U)	Intelligent measuring probe with remote triggering (12 m connector cable).
PROFITEST CLIP (Z506H)	Clamp meter for leakage or fault current as of 0.1 mA, direct or differential current up to 25 mA.
METRAFLEX P300 (Z502E)	Flexible current sensors for 3 A / 30 A / 300 A, 1 V … 10m V/A, 450 mm loop circumference. PROFITEST-PRIME ADAPTER (Z506J), required for connection.
PROFITEST PRIME T/H Sensor (Z506G)	Temperature/humidity sensor. Measuring ranges: -10.0 … + 50.0 °C / 10.0 … 90.0%
Barcode Profiscanner RS232 (Z502F)	Barcode reader/scanner with laser and RS 232 port.

We urgently recommend the following safety-relevant accessories for dielectric strength testing with the PROFITEST PRIME AC:

SIGNAL PROFITEST PRIME AC (Z506B)	Signal lamp combination for dielectric strength testing per DIN EN 50191/VDE 0104 and DIN EN 61557-14/VDE 0413-14
STOP PROFITEST PRIME AC (Z506D)	Emergency off switch for dielectric strength testing per DIN EN 50191/ VDE 0104 and DIN EN 61557-14/ VDE 0413-14.
CLAIM PROFITEST PRIME AC (Z504G)	Barrier for dielectric strength testing consisting of pouch with chain, stands and warning signs per DIN EN 50191/VDE 0104 and DIN EN 61557-14/ VDE 0413-14.
HV-P PROFITEST PRIME AC (Z506V)	High-voltage pistol for dielectric strength testing with coded plugs (1 piece per article number)

The complete range of accessories is listed in the data sheet. Complete information regarding accessories can be found in the product documentation for the respective accessory and the measuring/test instrument.

5.3 INCLUDED FEATURES

PROFITEST …	PRIME	PRIME AC
Voltage and frequency measurement up to 1 kV		
In single-phase AC/DC systems	✓	✓
In 3-phase systems ($U_{L1\text{-}L3}$, $U_{L1\text{-}L2}$, $U_{L2\text{-}L3}$)	✓	✓
Phase sequence testing	✓	✓
Protective conductor resistance measurement R_{LO}		
With 0.2 A test current: constant/ramp, polarity and test time can be selected	✓	✓
With 25 A measuring current	✓	✓
Insulation resistance measurement R_{ISO}		
With constant DC test voltage (50 V …1000 V)	✓	✓
With DC ramp function	✓	✓
Testing of residual current devices		
General and selective including RCD, SRCD, PRCD, G/R and RCBO (FI-LS) variants	✓	✓
Testing of AC/DC sensitive RCDs, types B, B+, B-MI and B+MI	✓	✓
Testing of 6 mA RDC-DDs and RCMBs	✓	✓
Measurement of residual voltage without tripping the RCD	✓	✓
Measurement of tripping current with ramp function	✓	✓
Tripping time measurement	✓	✓
Simultaneous measurement of tripping current and time to trip with “intelligent ramp”	✓	✓
Loop impedance measurement		
Measurement with full-wave, test current: 10 $A_{AC/DC}$	✓	✓
Measurement in 690 V systems	✓	✓
Measurement in DC systems up to 840 V_{DC}	✓	✓
Without tripping the RCD (type AC, A) by means of “DC saturation method”	✓	✓
Combined process without tripping the RCD: “impedance Z + R”	✓	✓
Without tripping the RCD: 15 mA method	✓	✓
Display of permissible fuse types in a table	✓	✓
Residual voltage test	✓	✓
Testing of insulation monitoring devices (IMDs)	✓	✓
Testing of residual current monitors (RCMs)	✓	✓
Leakage current measurement (direct)	✓	✓
Current measurement (with optional current clamp sensor)	✓	✓
Power measurement (with optional current clamp sensor) [1]	✓	✓

PROFITEST …	PRIME	PRIME AC
Measurement of temperature and atmospheric humidity	✓	✓
Voltage drop measurement ΔU	✓	✓
Documentation of charging station tests	✓	✓
Documentation of fault simulations at PRCDs with the PROFITEST PRCD PRO0 adapter	✓	✓
HV AC dielectric strength test, 2.5 kV/200 mA		
With constant AC test voltage	—	✓
Breakdown voltage measurement with ramp function	—	✓
Pulse control mode for troubleshooting	—	✓
Features		
Automatic test sequence function	✓	✓
Selectable menu language	✓	✓
Push-print function (storage or transmission via Bluetooth® or USB)	✓	✓
Database (up to 30,000 objects can be stored)	✓	✓
Operation via optional control probe (Start/IΔN/Save/Light)	❍	❍
RS 232 port for RFID/barcode reader	✓	✓
Bluetooth®	✓	✓
USB port	✓	✓
IZYTRONIQ database and report generating software for PC	✓	✓
Measuring category for basic measuring functions: 600 V CAT III / 300 V CAT IV	✓	✓
HV AC terminals: 2.5 kV / 200 mA	—	✓
DAkkS calibration certificate	✓	✓

[1] Apparent power, as of firmware 04.01.00

✓ available ❍ optional — not available

5.4 SCOPE OF FUNCTIONS DEPENDING ON TYPE OF POWER SUPPLY

Auxiliary Power (source)	Charge	Basic Functions	R_{LO} 25 A	HV_{AC}	HV_{DC}	RCD_{DC} [1)]
Battery operation	–	✓	–	–	–	– See note below.
Mains operation, 230 V/240 V ±10% / 50/60 Hz ±1 Hz	✓	✓	✓	✓	✓	✓
Mains operation, 115 V ±10% / 50/60 Hz ±1 Hz	✓	✓	✓	–	✓	✓
Mains operation, 85 V … 264 V / 16.7 Hz … 400 Hz	✓	✓	–	–	✓	✓

[1)] Functions for RCD type B, B+ and loop measurements with DC disabling (Loop+DC)

Note

Battery operation: Incorrect measurement results when the battery is low!

Only conduct Z_{LOOP} DC+ (DC-H), RCD I_F and RCD I_N measurements using DC test current with a battery charge level of at least 50%.

Key ✓ Function available – Not possible/sensible

Quick Charging Mode

No measurements can be conducted during the quick charging process. This is assured by the “Charge” position at the rotary switch.

5.5 INSTRUMENT OVERVIEW

5.5.1 CONNECTION, CONTROL AND DISPLAY PANEL, PROFITEST PRIME

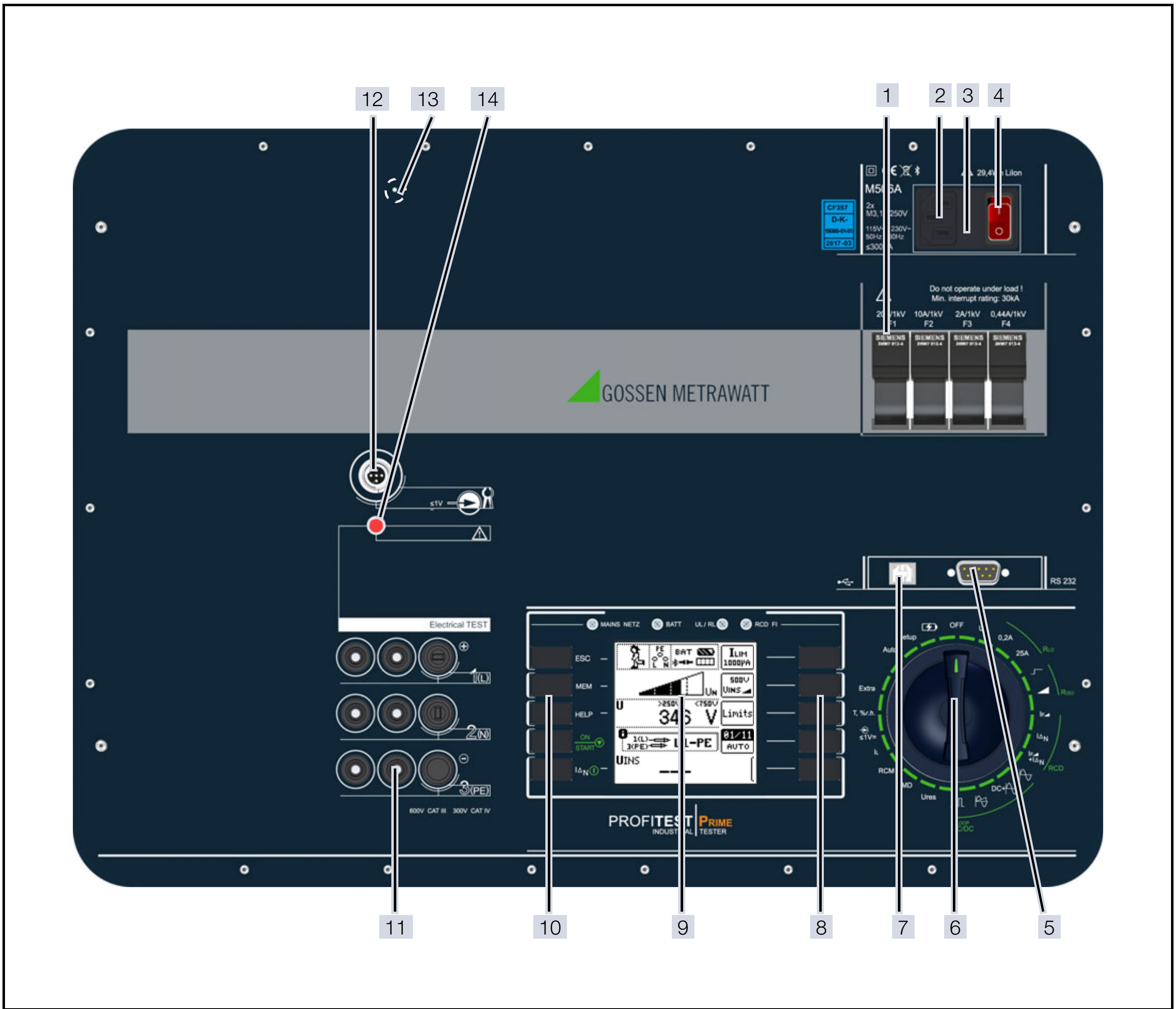


Fig. 1: Instrument Overview, PROFITEST PRIME

1. Measuring circuit fuses
2. Connector for inlet plug with country-specific mains plug
3. Mains connection fuses
4. Illuminated on/off switch
5. RS 232 interface for connecting T/H sensor (Z506G) and Barcode Profiscanner RS232 (Z502F)
6. Rotary selector switch
7. USB port for PC connection
8. Softkeys (menu-dependent)
9. Display panel
10. Fixed function keys (**ESC**, **MEM**, **HELP**, **ON/START** and **IΔN**)
11. Coded probe connector sockets (probes for 1(L), 2(N) and 3(PE) as well as L1, L2 and L3)
12. Connection for current clamp sensor (PROFITEST CLIP Z506H, METRAFLEX P300 Z502E*, WZ12C*, Z3512A*)
    * With Z506J adapter
13. Reset key
14. LED for **Electrical TEST** ➪🗎19
15. Bluetooth® Port

5.5.2 CONNECTION, CONTROL AND DISPLAY PANEL, PROFITEST PRIME AC

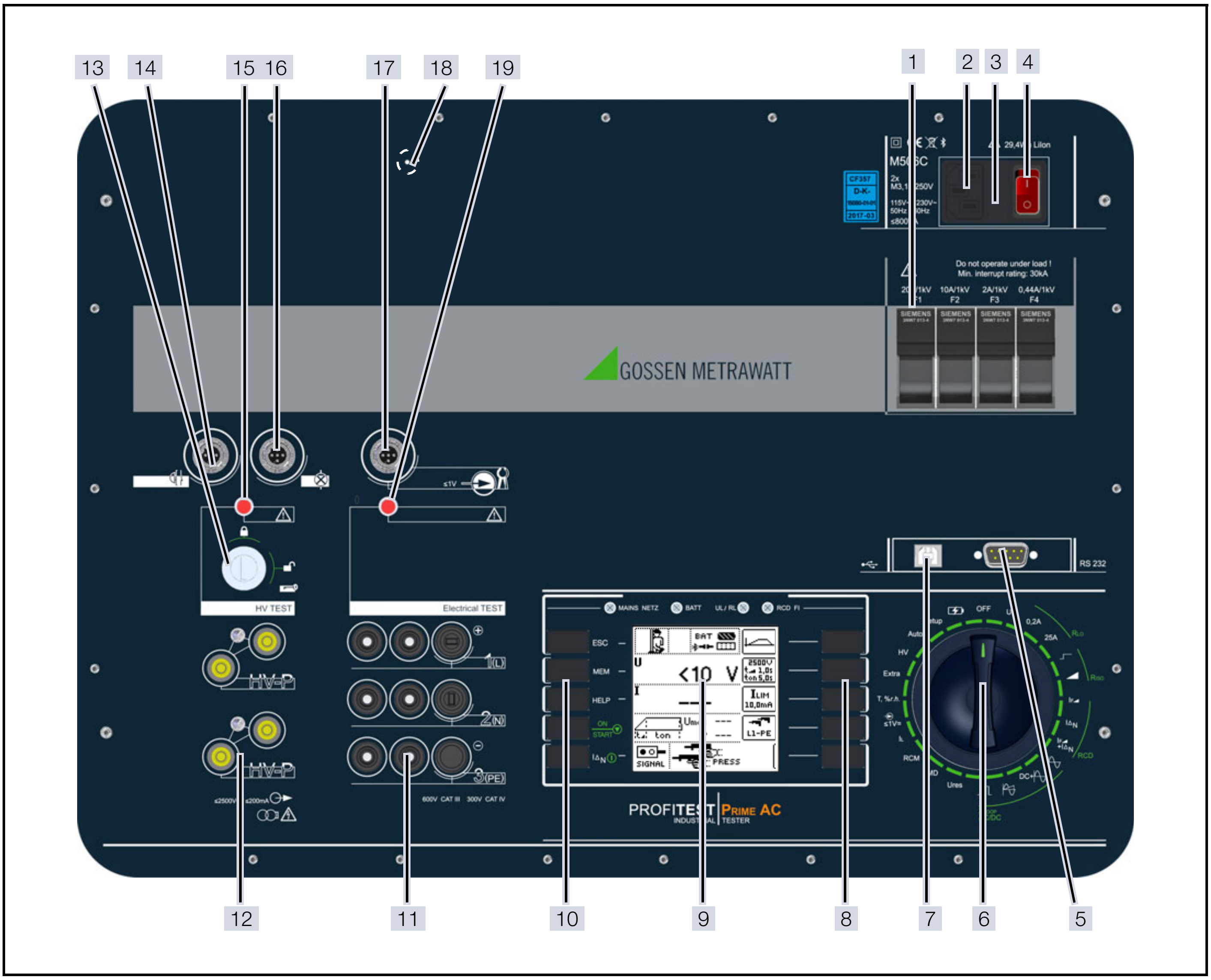


Fig. 2: Instrument Overview, PROFITEST PRIME AC

1. Measuring circuit fuses
2. Connector for inlet plug with country-specific mains plug
3. Mains connection fuses
4. Illuminated on/off switch
5. RS 232 interface for connecting T/H sensor (Z506G) and Barcode Profiscanner RS232 (Z502F)
6. Rotary selector switch
7. USB port for PC connection
8. Softkeys (menu-dependent)
9. Display panel
10. Fixed function keys (**ESC**, **MEM**, **HELP**, **ON/START** and **IΔN**)
11. Coded probe connector sockets (probes for 1(L), 2(N) and 3(PE) as well as L1, L2 and L3)
12. Coded probe connector sockets for HV (probes 1 and 2), and for high-voltage pistols
13. Key switch for enabling HV test voltage
14. Connector socket for emergency off switch: STOP PROFITEST PRIME AC (Z506D)
15. LED for **HV TEST** ➪🗎19
16. Connector socket for signal lamp combination: SIGNAL PROFITEST PRIME AC (Z506B)
17. Connection for current clamp sensor (PROFITEST CLIP Z506H, METRAFLEX P300 Z502E*, WZ12C*, Z3512A*)
    * With Z506J adapter
18. Reset key
19. LED for **Electrical TEST** ➪🗎19
20. Bluetooth® Port

5.5.3 CONTROL AND DISPLAY PANEL

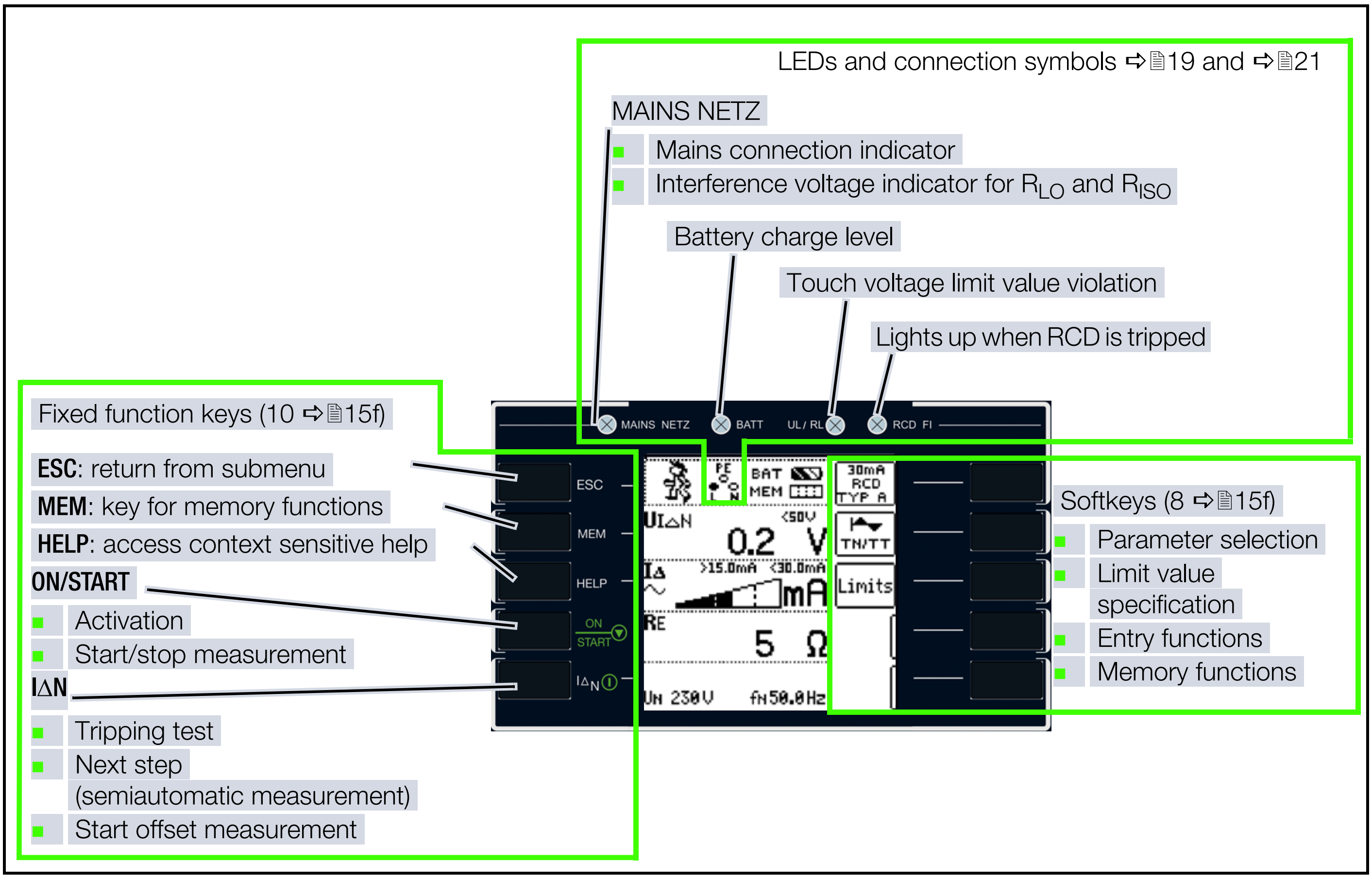


Fig. 3: Control and Display Panel

LEDs

MAINS NETZ

The **MAINS NETZ** LED indicates the current status of voltage connected to the test probes.

It lights up green, red or orange, or blinks green or red depending upon how the measuring/test instrument has been connected and the selected function ➪ 19.

This LED also lights up if line voltage is present when measuring R_{LO} and R_{ISO}.

BATT

The BATT **LED** indicates the charging status of the integrate rechargeable battery:

Lights up when the battery is discharging during battery operation.

Blinks green slowly while charging or rapidly in the quick charge mode.

Lights up red in the event of a battery error.

UL/RL

The **UL/RL** LED indicates that limit values have been exceeded or fallen short of.

This LED lights up red if touch voltage is greater than 25 V or 50 V during RCD testing, as well as after safety shutdown occurs.

It also lights up if R_{LO} or R_{ISO} limit values have been exceeded or fallen short of.

RCD FI

The RCD FI LED lights up red in the case of faulty tripping performance of the residual current device under test.

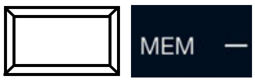
This LED lights up red if the RCCB is not tripped within 400 ms (1000 ms for selective RCDs – type RCD S) during the tripping test with nominal residual current. It also lights up if the RCCB is not tripped before nominal residual current has been reached during measurement with rising residual current.

Keys

ESC

Return from the submenu.

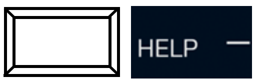
MEM



Access the memory structure.

The measurement is stopped when the MEM key is pressed.

HELP



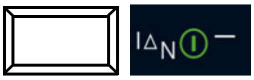
The following information can be displayed for each switch position and basic function after it has been selected with the rotary selector switch: wiring diagram, measuring range, nominal range of use and measuring uncertainty, as well as nominal value.

ON/START

The measuring sequence for the function selected in the menu is started by pressing this key on the control panel. Exception: voltage measurement U or U_{res}.

The key has the same function as the ▼ key on intelligent measuring probes I-SK4-PROFITEST-PRIME Z516T[1] and I-SK12-PROFITEST-PRIME Z516U[2] .

IΔN



The following sequences are triggered by pressing this key on the control panel:

- Starts the tripping test after measurement of touch voltage during RCCB testing ($I_{\Delta N}$).
- Measurement of R_{OFFSET} is started within the R_{LO} function.
- Semiautomatic polarity reversal (see ➪🗎60)

The key has the same function as the I_L key on intelligent measuring probes I-SK4-PROFITEST-PRIME Z516T[3] and I-SK12-PROFITEST-PRIME Z516U[4] .

Display

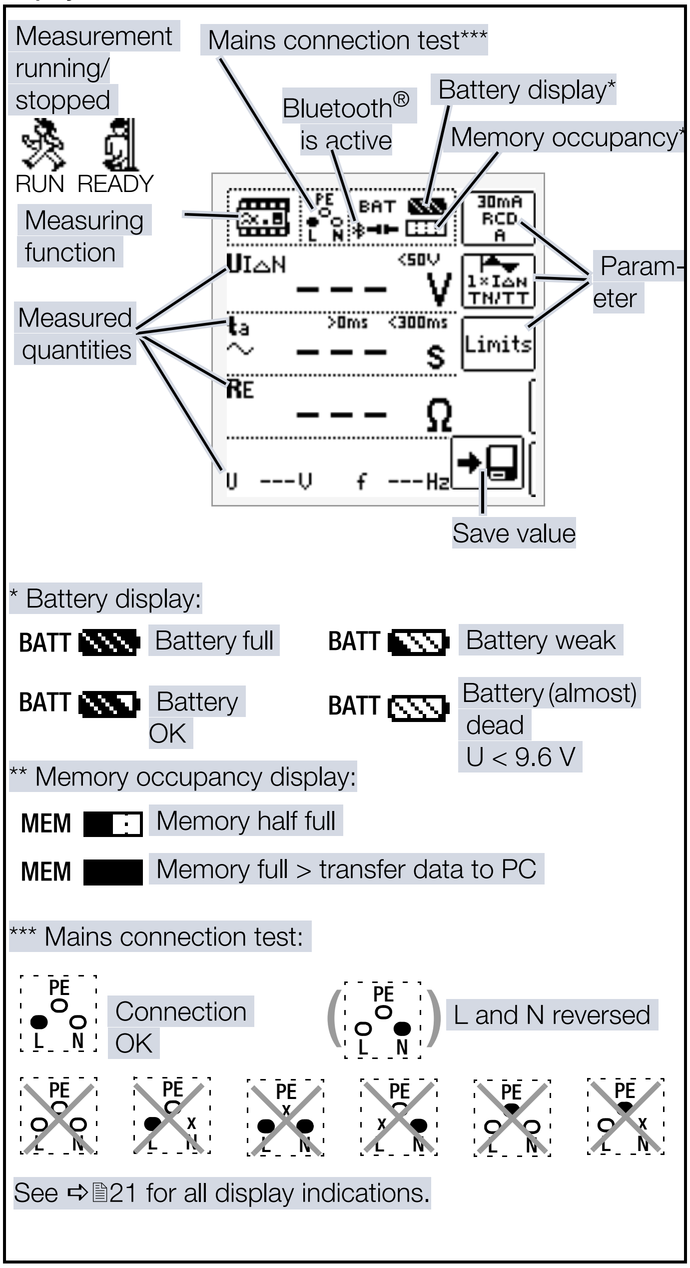


Fig. 4: Display

1) Optional accessory, not included
2) Optional accessory, not included
3) Optional accessory, not included
4) Optional accessory, not included

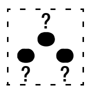
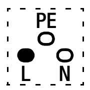
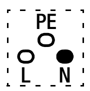
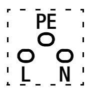
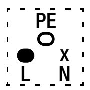
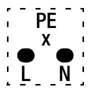
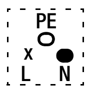
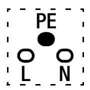
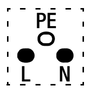
5.5.4 SIGNALING VIA LEDS

LED	Status	Rotary Switch Position	Function/Meaning
MAINS NETZ	Lights up green	RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} , Z_{LOOP} DC+, Z_{LOOP} , Z_{LOOP} , IMD, RCM, Δ_U	Correct connection, line voltage present, measurement enabled
	Blinks green	RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} , Z_{LOOP} DC+, Z_{LOOP} , Z_{LOOP} , IMD, RCM, Δ_U	Probe socket 2(N) not connected, measurement enabled
	Lights up yellow	RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} , Z_{LOOP} DC+, Z_{LOOP} , Z_{LOOP} , U_{res}, IMD, RCM, Δ_U	Line voltage of 65 to 253 V to PE, 2 different phases active (no N conductor at mains), measurement enabled
	Blinks yellow	RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} , Z_{LOOP} DC+, Z_{LOOP} , Z_{LOOP} , IMD, RCM, Δ_U	Probe sockets 1(L) and 2(N) are connected to the phase conductors
	Lights up red	R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, I_L, $I_{L/AMP}$	Interference voltage detected, measurement disabled
	Blinks red	RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} , Z_{LOOP} DC+, Z_{LOOP} , Z_{LOOP} , IMD, RCM, Δ_U	No line voltage PE interrupted RCD tripped
BATT	Lights up green	All	Battery is fully charged
	Blinks green		Blinks rapidly: quick charging (charging to 90% only) Blinks slowly: trickle charge (charge as of 90%)
	Lights up yellow		Battery operation and not fully charged
	Lights up red		Battery dead Battery defective
UL/RL	Lights up red	R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, LOOP , Z_{LOOP} DC+, Z_{LOOP} , U_{res}, I_L, $I_{L/AMP}$, Δ_U	Limit value exceeded or fallen short of
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} , Z_{LOOP} DC+, Z_{LOOP}	Limit value for touch voltage UL exceeded
		IMD, RCM, PRCD, E-mobility	Evaluation: “NOT OK”

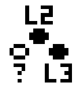
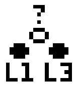
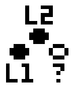
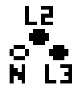
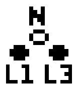
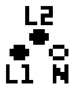
LED	Status	Rotary Switch Position	Function/Meaning
RCD FI	Lights up red	RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$,	RCD I_F⊿: RCD was tripped outside of the specified tripping current limits, or was not tripped. RCD $I_{\Delta N}$: RCD was tripped outside of the specified time-to-trip limits, or was not tripped. RCD I_F⊿+$I_{\Delta N}$: limit value violation for tripping current, time to trip or no-trip
Electrical test	Lights up red	U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, extra, auto, setup	Basic measuring functions active
	Off	OFF, T% r.H., HV, charge	Basic measuring functions not active Possible causes: ■ T% r.H. measuring function active ■ HV measuring function active ■ “Charge” function active ■ Measuring/test instrument is deactivated ■ No supply power
HV Test (PROFITEST PRIME AC)	Lights up red	HV	HV measuring function is selected. Basic measuring functions are deactivated.
	Blinks red	HV	HV measuring function is active. High-voltage is present. Basic measuring functions are deactivated.
	Off	OFF, U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, RCD IF⊿, RCD IΔ$_N$, RCD IF⊿+IΔ$_N$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, T% r.H., extra, auto, setup, charge	HV measuring function is not active. Possible causes: ■ Basic measuring functions are active ■ “Charge” function active ■ Measuring/test instrument is deactivated ■ No supply power

5.5.5 INDICATIONS AT THE DISPLAY

Status Bar: Mains Connection Test – Single-Phase System

Symbol	Status	Rotary Switch Position	Function/Meaning
	Is displayed	R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM, I_L, $I_{L/AMP}$, Δ_U, Setup	Connection not yet detected
	Is displayed		Connection OK
	Is displayed		L and N are reversed, neutral conductor charged with phase voltage
	Is displayed		No mains connection
	Is displayed		Neutral conductor N interrupted
	Is displayed		Protective conductor PE interrupted, neutral conductor N and/or phase conductor L charged with phase voltage
	Is displayed		Phase conductor L interrupted, neutral conductor N charged with phase voltage
	Is displayed		Phase conductor L and protective conductor PE reversed
	Is displayed		L and N are connected to the phase conductors

Status Bar: Mains Connection Test – 3-Phase System

Symbol	Status	Rotary Switch Position	Function/Meaning
	Is displayed	U – U3~	Clockwise rotation
	Is displayed		Counterclockwise rotation
	Is displayed		Conductor-to-conductor short-circuit between phase conductors L1 and L2
	Is displayed		Conductor-to-conductor short-circuit between phase conductors L1 and L3
	Is displayed		Conductor-to-conductor short-circuit between phase conductors L2 and L3
	Is displayed		Phase conductor L1 not detected
	Is displayed		Phase conductor L2 not detected
	Is displayed		Phase conductor L3 not detected
	Is displayed		Probe L1 connected to neutral conductor N
	Is displayed		Probe L2 connected to neutral conductor N
	Is displayed		Probe L3 connected to neutral conductor N

Intelligent Probe Status

Symbol	Status	Rotary Switch Position	Function/Meaning
	Is displayed		The symbol is displayed instead of “BAT” as soon as an I-SK4/12 intelligent probe is connected.

Battery Status

Symbol	Status	Rotary Switch Position	Function/Meaning
	Is displayed	U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}, RCD I_F, RCD $I_{\Delta N}$, RCD I_F+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Δ_U, e-mobility, PRCD, HV-AC, Setup	Battery charge level ≥ 80%
	Is displayed		Battery charge level ≥ 50%
	Is displayed		Battery charge level ≥ 30%
	Is displayed		Battery charge level ≥ 15%
	Is displayed		Battery charge level ≥ 0%
	Is displayed	U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}, RCD I_F, RCD $I_{\Delta N}$, RCD I_F+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Battery voltage is too low. Reliable measurements and storage of measured values are no longer possible. Charge the battery or replace it if it has reached the end of its service life. Operate the measuring/test instrument with auxiliary power.

Memory Status

Symbol	Status	Rotary Switch Position	Function/Meaning
	Is displayed	U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}, RCD I_F, RCD $I_{\Delta N}$, RCD I_F+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Δ_U, e-mobility, PRCD, HV-AC, Setup	Memory occupancy ≥ 100%
	Is displayed		Memory occupancy ≥ 87.5%
	Is displayed		Memory occupancy ≥ 75%
	Is displayed		Memory occupancy ≥ 62.5%
	Is displayed		Memory occupancy ≥ 50%
	Is displayed		Memory occupancy ≥ 37.5%
	Is displayed		Memory occupancy ≥ 25%
	Is displayed		Memory occupancy ≥ 12.5%
	Is displayed		Memory occupancy ≥ 0%

Bluetooth® Status

Display only appears if the Bluetooth® function has been activated ➪ 53.

Symbol	Status	Rotary Switch Position	Function/Meaning
	Is displayed	U, R_{LO} 0.2A, R_{LO} 25A,	Bluetooth® connection terminated
	Is displayed	R_{ISO}, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Δ_U, e-mobility, PRCD, HV-AC, setup	Bluetooth® connection established

Error

Any errors that might occur are displayed in error pop-ups. ➪ "Error Messages" 140. They have to be acknowledged by pressing the following keys:

- At the measuring/test instrument: **ESC**
- At intelligent measuring probes I-SK4-PROFITEST-PRIME Z516T[1)] and I-SK12-PROFITEST-PRIME Z516U[2)] : , or

[1)] Optional accessory, not included

[2)] Optional accessory, not included

5.5.6 OVERVIEW OF DEVICE SETTINGS AND MEASURING FUNCTIONS

Switch Position	Picto-graph	Device Settings, Measuring Functions	
Device Settings			
OFF		Measuring instrument is switched off, charging function inactive. The integrated rechargeable batteries are charged in all other rotary switch positions.	
QUICK CHARGE		The batteries are charged and the charging monitor is displayed. Prerequisite: the charging cable is connected and the mains switch is set to on.	
SETUP ⇨ 154		TESTS LED's	Test: LEDs
		TESTS	Test: display, acoustic signal, battery
		SETTING	Bluetooth®, database mode, brightness/contrast, time/date, user language, profiles, shutdown times, default settings
		SW-INFO CALIB...	Firmware, calibration date, adjustment date
			Enter, select, delete inspector

Switch Position	Picto-graph	Device Settings, Measuring Functions	
MEASURING FUNCTIONS			
Measurements with line voltage:			
U ⇨ 154		Voltage measurement – 2-pole:	
		U_{L}-PE	2-pin voltage measurement
		Voltage measurement – 3-phase system:	
		$U_{L3\text{-}L1}$	Voltage between L3 and L1
		$U_{L1\text{-}L2}$	Voltage between L1 and L2
		$U_{L2\text{-}L3}$	Voltage between L2 and L3
		f	Frequency
			Phase sequence
Displayed for all measurements listed below:		U / U_N	Line voltage / nominal line voltage
		f / f_N	Line frequency / nominal line frequency
RCD I_F⊿ ⇨ 82		$U_{I\Delta N}$	Touch voltage
		I_Δ	Fault current
		R_E	Earth loop resistance
RCD $I_{\Delta N}$ ⇨ 84		$U_{I\Delta N}$	Touch voltage
		ta ~	Time to trip
		R_E	Earth loop resistance
RCD I_F⊿ + $I_{\Delta N}$ ⇨ 86		$U_{I\Delta N}$	Touch voltage
		ta ~	Time to trip
		I_Δ	Fault current
		R_E	Earth loop resistance
Z_{LOOP} ⇨ 98		Z	Loop impedance / line impedance ZL-PE/ZL-N
		I_K	Short-circuit current
Z_{LOOP} DC+ ⇨ 100		Z	Loop impedance with suppression of tripping of type A RCD
		I_K	Short-circuit current
Z_{LOOP} ⇨ 102		Z	Loop impedance / line impedance ZL-PE/ZL-N with suppression of tripping of type B RCD
		I_K	Short-circuit current

Switch Position	Picto-graph	Device Settings, Measuring Functions	
Z_{LOOP} ➪ 103		Z	Loop impedance with $I_{\Delta N}$/2 for avoiding RCD tripping
		I_K	Short-circuit current
Measurements at voltage-free objects:			
R_{LO} 0.2 A R_{LO} 25 A ➪ 66		R_{LO} 0.2 A	Low-resistance measurement with 200 mA and automatic polarity reversal
		R_{LO} 25 A	Low-resistance measurement with 25 A (IHIGH) * * Only possible with mains connection
		R_{OFFSET}	Offset resistance for extension cords
R_{ISO} ➪ 74 R_{ISO} ramp ➪ 76		R_{ISO}	Insulation resistance (constant test current)
		R_{ISO} ramp	Insulation resistance (test current with ramp)
		U	Voltage at the test probes
		U_{ISO}	Test voltage Ramp: triggering/breakdown voltage
U_{res} ➪ 105		Ures	Undervoltage / residual voltage after discharge time tU
		U	Momentary voltage (supply voltage)
		t_U	Discharge time: Value must drop to $U \leq U_{lim}$
IMD ➪ 106		$R_{L\text{-}PE}$	Specify insulation resistance
		t_A	Time to trip is calculated
RCM ➪ 108		$U_{I\Delta N}$	RCM (residual current monitoring)
I_L ➪ 110		I_L	Fault, leakage or stray current
		f	Frequency
≤1V≅ ➪ 111		$I_{L/AMP}$	Fault, leakage or stray current (Apparent) power
T%rh ➪ 113		ϑ	Temperature
			r. H. (relative humidity)

Switch Position	Picto-graph	Device Settings, Measuring Functions	
EXTRA ➪ 114		Δ_U	Voltage drop measurement
		E-mobility	Electric vehicles at charging stations (IEC 61851)
		PRCD	Testing of type S and K PRCDs
HV ➪ 122		HV AC	AC testing for dielectric strength (PROFITEST PRIME AC only)
AUTO ➪ 132			Test sequences / automatic test sequences

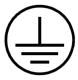
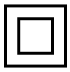
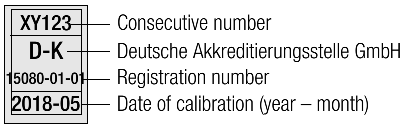
5.5.7 PROBE FUNCTIONALITY

Probe Functionality

Probe	Rotary Switch Position	Function
Standard	U, R_{LO} 0.2A, R_{LO} 25A, RCD I_F, RCD $I_{\Delta N}$, RCD I_F+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM, I_L, $I_{L/AMP}$, Δ_U, kWh, AUTO	Measure
Active probe "I-SK"	U, R_{LO} 0.2A, R_{LO} 25A, RCD I_F, RCD $I_{\Delta N}$, RCD I_F+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM, I_L, $I_{L/AMP}$, ΔU, kWh, AUTO *	Measure and control
HV pistols	HV [1]	Measure

[1] The key functions are disabled when the rotary switch is set to "AUTO".

5.5.8 SYMBOLS ON THE INSTRUMENT AND THE INCLUDED ACCESSORIES

Symbol	Meaning
	Warning concerning a point of danger (attention, observe documentation!)
	Protection category I device
	Double insulation (protection category II)
	Specialist technical knowledge (qualified personnel) is required. For use in the B2B sector only.
	European conformity marking
	The instrument may not be disposed of with household trash ⇨ "Disposal and Environmental Protection" 🗎152.
	Guarantee seal Removing the TORX screw to the right of the measuring circuit fuses, which is coated with blue sealing varnish, renders any guarantee claims null and void.
	Calibration seal

Tab. 4: Symbols on the Instrument and the Included Accessories

5.6 RELEVANT STANDARDS

The measuring/test instrument complies with the relevant requirements specified in the following standards:

DIN EN 60529 IEC 60529	Test instruments and test procedures – Degrees of protection provided by enclosures (IP code)
DIN EN 61010-1 IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
DIN EN 61010-2-030 IEC 61010-2-030	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits
DIN EN 61010-031 IEC 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated probe assemblies for electrical test and measurement
DIN EN 61010-2-032 IEC 61010-2-032	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement
DIN EN 61326-1 IEC 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
DIN EN 61326-2-1 IEC 61326-2-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-1: Particular requirements – Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications
DIN EN 61557-1 IEC 61557-1	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 1: General requirements
DIN EN 61557-2 IEC 61557-2	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 2: Insulation resistance
DIN EN 61557-3 IEC 61557-3	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 3: Loop resistance measurement
DIN EN 61557-4 IEC 61557-4	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 4: Resistance of earth conductors, protective conductors and equipotential bonding conductors
DIN EN 61557-6 IEC 61557-6	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 6: Effectiveness of residual current devices (RCDs) in TT, TN and IT systems
DIN EN 61557-7 IEC 61557-7	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 7: Rotary field
DIN EN 61557-10 IEC 61557-10	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 10: Combined measuring equipment for testing, measuring or monitoring protective measures
DIN EN 61557-11 IEC 61557-11	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 11: Effectiveness of residual current monitors (RCM) in TT, TN and IT systems
DIN EN 61557-14 IEC 61557-14	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Devices for testing, measuring or monitoring protective measures – Part 14: Equipment for testing the safety of electrical equipment of machinery

Tab. 5: Relevant Standards

5.7 TECHNICAL DATA

Power Supply	Mains operation:	Auxiliary power (mains connection):	85 V … 264 V 16.7 Hz … 50 Hz … 400 Hz
		Power consumption:	PROFITEST PRIME: < 300 VA PROFITEST PRIME AC: < 800 VA
		Mains interrupt:	Mains connection socket with line disconnector
	Battery operation:	Battery pack:	3 lithium-ion cells (permanently installed, type: FEY PA-LN1038.K01.R001), charging current: 1.9 A, charging voltage: 12.3 V, charging time (switch position): 1.5 hrs., nominal range of use: 9.7 V … 10.8 V … 12.3 V
		Number of measurements:	R_{LO} 0.2 A: approx. 500 measurements R_{INS}: approx. 1000 measurements
		Standby time:	32 hours
Ambient Conditions	Operating temperature:	+5 °C … +50 °C	
	Accuracy:	0 °C … +40 °C	
	Storage temperature:	-20 °C … +60 °C	
	Charging temperature range:	+10 °C … +45 °C	
	Protective shutdown:	> 75 °C	
	Relative atmospheric humidity:	Max. 75%, no condensation allowed	
	Elevation:	Max. 2000 m	
Electrical Safety	Measuring category:	Power supply: CAT II 300 V Measuring circuit / probes, basic measuring functions: 600 V CAT III / 300 V CAT IV, (without safety caps: 600 V CAT II) HV measuring circuit: 2500 V, 200 mA, HV AC potential: 2.5 kV	
	Nominal voltage:	230 V	
	Test voltage:	5.4 kV 50 Hz (measurement connections, probe L-N-PE to mains/PE)	
	HV AC test voltage:	Mains / PE / key switch / external signal lamp combination to high voltage measurement connections: 7.1 kV AC, 50 Hz Mains to PE: 3.0 kV AC Mains to external signal lamps: 3.0 kV AC Impedance to earth: ≥ 1 MΩ (typ. ~ 15 MΩ)	
	Pollution degree:	2	
	Protection category:	I and II	
	Safety shutdown:	In case of interference voltage and measuring/test instrument overheating	
	Fuses:	Mains connection:	2 × M3.15 / 250 V
		Measuring inputs:	F1: 1 kV / 20 A (3-578-319-01 [1)]) F2:1 kV / 10 A (3-578-264-01 [1)]) F3:1 kV / 2 A (3-578-318-01 [1)]) F4: 1 kV / 440 mA (3-578-317-01 [1)]) Basic measuring functions: Min. shutdown power: 30 kA
		HV AC test pistols:	5 kV / 200 mA AC

Electromagnetic Compatibility (EMC)	Interference emission:	EN 55011 class A		
	Interference immunity:	DIN EN 61326-1 / IEC 61326-1		
		DIN EN 61326-2-1 / IEC 61326-2-1		
		EN 61000-4-2	contact/atmospheric: 4 kV/8 kV	B
		EN 61000-4-3	10 V/m	A
		EN 61000-4-4	mains connection: 2 kV	B
		EN 61000-4-5	mains connection: 2 kV	B
		EN 61000-4-6	mains connection: 3 V	A
		EN 61000-4-8	30 A/m	A
		EN 61000-4-11	1; 250/300 periods / 100%	C
Mechanical Design	Protection:	Measuring/test instrument connections: IP 40 (protection against ingress of solid foreign objects: ≥ 1.0 mm dia., ∅; protection against ingress of water: not protected)		
		Case closed: IP 65 (protection against ingress of solid foreign objects: dust-proof ∅; protection against ingress of water: protection against water jets (nozzle) from any angle)		
		per DIN EN 60529 / IEC 60529		
	Housing (W × H × D):	Approx. 50 × 21 × 41 cm		
	Weight:	PROFITEST PRIME: 10.15 kg		
		PROFITEST PRIME AC: 15.10 kg		
	Display:	Multiple display with dot matrix, b&w, 128 × 128 pixels, illuminated		
Data Interfaces	*Bluetooth*®:	Frequency range: 2400 MHz … 2483.5 MHz		
		Transmission intensity: max. + 3 dBm		
		For push-print function and connection option for a Bluetooth® keyboard (only Bluetooth® Classic Modus 3.0 [2)])		
	USB:	Slave for PC connection (USB type B socket)		
	RS-232:	For barcode reader and T/H sensor		
Internal Memory	Max. 50,000 objects			

1) Can only be ordered from GMC-I Service GmbH.

2) The following keyboard models have been successfully tested: Rapoo E6080, Logitech K380, Keychron K3. We offer no guarantee for other devices.

5.8 CHARACTERISTIC VALUES

Legend for the following tables:
D = digit(s) / rdg. = reading (measured value) / ● = required connections / light gray areas are not relevant

U

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections				
								1(L)	2(N)	3(PE)	Current Clamp	Other
U	0.0 V to 99.9 V 100 V … 999 V	0.1 V 1 V	5 MΩ	2.0 V_{TRMS} … 99.9 V_{TRMS} 100 V_{TRMS} … 999 V_{TRMS}		±(2% rdg.+5 d) ±(2% rdg. + 1 d)	±(1% rdg.+5 d) ±(1% rdg.+1 d)	●		●		
$U_{3\sim}$	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V_{TRMS} … 99.9 V_{TRMS} 100 V_{TRMS} … 999 V_{TRMS}		±(3% rdg.+5 d) ±(3% rdg.+1 d)	±(2% rdg.+5 d) ±(2% rdg.+1 d)	●	●	●		
f	DC: 15.0 Hz… 99.9 Hz 100 Hz… 999 Hz	0.1 Hz 1 Hz		DC: 15.4 Hz… 420 Hz		±(0.2% rdg.+1 d)	±(0.1% rdg.+1 d)	●		●		

R_{LO} 0.2 A

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections				
								1(L)	2(N)	3(PE)	Current Clamp	Other
R_{LO}	0.00 Ω … 9.99 Ω 10.0 Ω … 99.9 Ω 100 Ω … 199 Ω	0.01 Ω 0.1 Ω 1 Ω	I ≥ 200 mA_{DC} I < 260 mA_{DC}	0.10 Ω… 5.99 Ω 6.00 Ω … 99.9 Ω	U_q = 4.5 V	±(4% rdg.+2d)	±(2% rdg.+2d)	●		●		PRCD adapter
R_{OFFSET}	0.00 Ω … 9.99 Ω	0.01 Ω	I ≥ 200 mA_{DC}	0.10 Ω … 5.99 Ω								

R_{LO} 25 A

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections				
								1(L)	2(N)	3(PE)	Current Clamp	Other
R_{LO}	1 mΩ … 999 mΩ 1.00 Ω … 9.99 Ω 10.0 Ω … 20.0 Ω	1 mΩ 0.01 Ω 0.1 Ω	I ≥ 25 A_{AC} [1)] I < 25 A_{AC} [1]	10 mΩ … 50 mΩ 51 mΩ … 20.0 Ω	U_q < 8.8 V_{AC}	±(4% rdg.+2 d)	±(2% rdg.+2 d)	●		●		
R_{OFFSET}	1 mΩ … 999 mΩ	1 mΩ	I ≥ 25 A_{AC} [1]	10 mΩ … 50 mΩ 51 mΩ … 999 mΩ								

1) With a load of < 50 mΩ: auxiliary power: 230 V (-0% +10%), 50 Hz and the included 4 m probe cables. EN 61439-1 specifies a test current of > 10 A AC for protective conductor testing. The limit value is 0.1 Ω.

R_{ISO}

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
R_{ISO}	1 kΩ … 999 kΩ 1.00 MΩ … 9.99 MΩ 10.0 MΩ … 49.9 MΩ	1 k Ω 0.01 MΩ 0.1 MΩ	I_K < 1.6 mA (for U_{INS} = 15 V … 1.00 kV)	50 kΩ … 999 kΩ 1,00 MΩ … 49.9 MΩ	U_N = 50 V I_N = 1 mA	±(5% rdg.+10 d) ±(5% rdg.+2 d)	±(3% rdg.+10 d) ±(3% rdg.+1 d)	●		●		
	1 kΩ … 999 kΩ 1.00 MΩ … 9.99 MΩ 10.0 MΩ … 99.9 MΩ	1 k Ω 0.01 MΩ 0.1 MΩ		50 kΩ … 999 kΩ 1,00 MΩ … 99.9 MΩ	U_N = 100 V I_N = 1 mA	±(5% rdg.+10 d) ±(5% rdg.+2 d)	±(3% rdg.+10 d) ±(3% rdg.+1 d)					
	1 kΩ … 999 kΩ 1.00 MΩ … 9.99 MΩ 10.0 MΩ … 99.9 MΩ 100 MΩ … 200 MΩ	1 k Ω 0.01 MΩ 0.1 MΩ 1 MΩ		50 kΩ … 999 kΩ 1,00 MΩ … 200 MΩ	U_N = 250 V I_N = 1 mA	±(5% rdg.+10 d) ±(5% rdg.+2 d)	±(3% rdg.+10 d) ±(3% rdg.+1 d)					
	1 kΩ … 999 kΩ 1.00 MΩ … 9.99 MΩ 10.0 MΩ … 99.9 MΩ 100 MΩ … 999 MΩ 1.00 GΩ … 1.20 GΩ	1 k Ω 0.01 MΩ 0.1 MΩ 1 MΩ 0.01 GΩ		50 kΩ … 999 kΩ 1,00 MΩ … 499 MΩ 500 MΩ … 1.20 GΩ	U_N = 325 V U_N = 500 V U_N = 1000 V I_N = 1 mA	±(5% rdg.+10 d) ±(5% rdg.+2 d) ±(10% rdg.+2 d)	±(3% rdg.+10 d) ±(3% rdg.+1 d) ±(6% rdg.+1 d)					
U U_{ISO}	10 V_{DC} … 999 V_{DC} 1.00 kV … 1.19 kV	1 V 0.01 kV		25 V … 1.19 kV	U_N = 50 V_{DC} / 100 V_{DC} / 250 V_{DC} / 325 V_{DC} / 500 V_{DC} / 1000 V_{DC}	±(3% rdg.+1 d)	±(1.5% rdg. + 1 d)					

R_{INS}

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
U U_{ISO}	10 V_{DC} … 999 V_{DC} 1.00 kV … 1.19 kV	1 V 0.01 kV	I_K < 1.6 mA	25 V … 1.19 kV	U_N = 50 V / 100 V / 250 V / 325 V / 500 V / 1000 V	±(3% rdg.+1 d)	±(1.5% rdg. + 1 d)	●		●		

RCD I_F ◢

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$U_{I\Delta N}$	0.0 V … 70.0 V	0.1 V	0.33 × $I_{\Delta N}$ $I_{\Delta N}$ = 10 mA … 1000 mA	20.0 V … 70.0 V		+(1% rdg. + 1 d) … +(10% rdg. + 1 d)	+(1% rdg. + 1 d) … +(9% rdg. + 1 d)					
R_E	10 Ω … 999 Ω 1.00 kΩ … 6.51 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 10 mA × 1.05	Calculated value based on $R_E = U_{I\Delta N} : I_{\Delta N}$	$U_{I\Delta N}$ = 25 V / 50 V / 65 V							
	3 Ω … 999 Ω 1.00 k Ω … 2.17 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 30 mA × 1.05									
	1 Ω … 651 Ω	1 Ω	$I_{\Delta N}$ = 100 mA × 1.05									
	0.3 Ω … 99.9 Ω 100 Ω … 217 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 300 mA × 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 130 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 500 mA × 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 65 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 1000 mA × 1.05					●	● 1))	●		PRCD adapter
I_Δ	3.0 mA … 99.9 mA 100 mA … 999 mA 1.00 A … 2.50 A	0.1 mA 1 mA 0.01 A	(0.3 … 1.3) × $I_{\Delta N}$ (0.3 … 1.4) × $I_{\Delta N}$ (0.2 … 2.5) × $I_{\Delta N}$ $I_{\Delta N}$ = 10 mA … 1000 mA	3.0 mA … 2.50 A	U_N = 120 V / 230 V / 400 V f_N = 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz $I_{\Delta N}$ = 10 mA / 30 mA / 100 mA / 300 mA / 500 mA / 1000 mA	±(5% rdg.+3d)	±(3.5% rdg. + 2 d)					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V	5 MΩ	2.0 V … 99.9 V 100 V … 440 V		±(2% rdg.+5 d) ±(2% rdg.+1 d)	±(1% rdg.+5 d) ±(1% rdg.+1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 420 Hz		±(0.2% rdg.+1 d)	±(0.1% rdg.+1 d)					

1) Only required when testing with direct current.

RCD $I_{\Delta N}$

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$U_{I\Delta N}$	0.0 V … 70.0 V	0.1 V	0.33 × $I_{\Delta N}$ $I_{\Delta N}$ = 10 mA … 1000 mA	20.0 V … 70.0 V		+1% rdg. + 1 d … +10% rdg. + 1 d	+ (1% rdg. + 1 d) … + (9% rdg. + 1 d)	●	● [1]	●		PRCD adapter
R_E	10 Ω … 999 Ω 1.0 kΩ … 6.1 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 10 mA × 1.05	Calculated value based on $R_E = U_{I\Delta N} : I_{\Delta N}$	$U_{I\Delta N}$ = 25 V / 50 V / 65 V							
	3 Ω… 999 Ω 1.0 kΩ … 2.7 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 30 mA × 1.05									
	1 Ω … 651 Ω	1 Ω	$I_{\Delta N}$ = 100 mA × 1.05									
	0.3 Ω … 99.9 Ω 100 Ω … 217 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 300 mA × 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 130 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 500 mA × 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 65 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 1000 mA ×1.05									
I_T			0.5 times: 0.5 × 0. × $I_{\Delta N}$		U_N = 120 V / 230 V / 400 V f_N = 16.7 [2] / 50 Hz / 60 Hz / 200 Hz / 400 Hz $I_{\Delta N}$ = 10 mA / 30 mA / 100 mA / 300 mA / 500 mA / 1000 mA	(0. × $I_{\Delta N}$) -10% ... +0%	(0.95 × 0.5 × $I_{\Delta N}$) ± 3.5%					
			1×: 1.05 × $I_{\Delta N}$ 1.4×: 1.47 × $I_{\Delta N}$ 2×: 2.1 × $I_{\Delta N}$ 5×: 5.25 × $I_{\Delta N}$			(X × $I_{\Delta N}$) + 0% … + 10%	(1.05 × X × $I_{\Delta N}$) ± 3.5%					
t_a	0 ms … 999 ms	1 ms	^{5} 0.5 ×, 1 ×, 2 ×, 5 × ^{5} 0.5 ×, 1 × ^{5} 1 × $I_{\Delta N}$ = 10 mA … 1000 mA	0 ms … 999 ms		±4 ms	±3 ms					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 440 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					

1) Only required when testing with direct current.

2) Depending on maximum permissible touch voltage.

RCD I_F ◢ + $I_{\Delta N}$

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$U_{I\Delta N}$	0.0 V … 70.0 V	0.1 V	0.33 × $I_{\Delta N}$ $I_{\Delta N}$ = 10 mA … 1000 mA	20.0 V … 70.0 V	$U_{I\Delta N}$ = 25 V / 50 V / 65 V	+ (1% rdg. + 1 d) … + (10% rdg. + 1 d)	+ (1% rdg. + 1 d) … + (9% rdg. + 1 d)	●		●		PRCD adapter
R_E	10 Ω … 999 Ω 1.00 kΩ … 6.51 kΩ	1 Ω 10 Ω	$I_{\Delta N}$ = 10 mA × 1.05	Calculated value based on R_E = $U_{I\Delta N}$: $I_{\Delta N}$								
	3 Ω … 999 Ω 1.00 kΩ … 2.17 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 30 mA × 1.05									
	1 Ω … 651 Ω	1Ω	$I_{\Delta N}$ = 100 mA × 1.05									
	0.3 Ω … 99.9 Ω 100 Ω … 217 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 300 mA × 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 130 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 500 mA × 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 65 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 1000 mA × 1.05									
t_a	0 ms … 300 ms	1 ms	(0.3 … 1.3) × $I_{\Delta N}$ $I_{\Delta N}$= 10 mA … 1000 mA	0 ms … 300 ms	U_N = 120 V / 230 V / 400 V f_N = 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz $I_{\Delta N}$ = 10 mA_{AC} / 30 mA_{AC} / 100 mA_{AC} / 300 mA_{AC} / 500 mA_{AC} / 1000 mA_{AC}	±4 ms	±3 ms					
I_Δ	3.0 mA … 99.9 mA 100 mA … 999 mA 1.00 A … 1.30 A	0.1 mA 1 mA 0.01 A		3.0 mA … 1.30 A		±(5% rdg. + 3 d)	±(3.5% rdg. + 2 d)					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 … 440 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					

Z_{LOOP} AC/DC

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$Z_{AC/DC}$ 1)	0 mΩ … 999 mΩ 1.00 Ω … 9.99 Ω	1 mΩ 0.01 Ω	≥ 10 $A_{AC/DC}$ where U = 120 V (-0%) U = 230 V (-0%) U = 400 V (-0%) U = 690 V (-0%) U = 850 V_{DC} (–0 %)	50 mΩ … 999 mΩ 1.00 … 5.00 Ω 2)	U_N = 120 V / 230 V 400 V_{AC} / 690 V_{AC} U_N = 850 V_{DC} f_N = DC 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	±(10% rdg. + 10 d) ±(6% rdg. + 4 d)	±(5% rdg. + 10 d) ±(3% rdg. + 3 d)					
Z_{DC} 3)	0.00 Ω… 9.99 Ω 10.0 Ω … 99.9 Ω	0.01 Ω 0.1 Ω	≥ 5 $A_{AC/DC}$ where U = 120 V (-0%) U = 230 V (-0%) U = 400 V (-0%) U = 690 V (-0%) U = 850 V_{DC} (- 0%)	0.50 Ω … 9.99 Ω 10.0 Ω … 40.0 Ω	U_N = 120 V / 230 V 400 V_{AC} / 690 V_{AC} U_N = 850 V_{DC} f_N = DC	±(10% rdg. + 10 d) ±(8% rdg. + 2 d)	±(5% rdg. + 10 d) ±(3% rdg. + 3 d)	●		●		
I_K	0.0 A … 9.9 A 10 A … 999 A 1.00 kA … 9.99 kA 10.0 kA … 50.0 kA	0.1 A 1 A 0.01 kA 0.1 kA	≥ 10 $A_{AC/DC}$ where U = 120 V (-0%) U = 230 V (-0%) U = 400 V (-0%) U = 690 V (-0%) U = 850 V_{DC} (–0 %)	Calculated value based on I_K = U : Z	120 V / 230 V 400 V_{AC} / 690 V_{AC} U_N = 850 V_{DC} f_N = DC 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	Calculated value based on I_K = U : Z	Calculated value based on I_K = U : Z					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V_{AC} … 725 V_{AC} 100 V_{DC} … 850 V_{DC}		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	DC: 15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		DC: 15.4 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					

1) With 100% test current

2) Depending on maximum permissible touch voltage.

3) With 50% test current

Z_{LOOP} DC+

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections				
								1(L)	2(N)	3(PE)	Current Clamp	Other
Z	0 mΩ … 999 mΩ 1.00 Ω … 9.99 Ω 10.0 Ω … 29.9 Ω	1 mΩ 0.01 Ω 0.1 Ω	≥ 10 A_{AC} where U = 120 V (-0%) U = 230 V (-0%) U = 400 V (-0%) and 0.5 A_{DC} (DC-L) 2.5 A_{DC} (DC-H)	250 … 999 mΩ 1.00 … 5.00 Ω	U_N = 120 V / 230 V 400 V f_N = 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	±(18% rdg. + 30 d) ±(10% rdg. + 5 d)	±(6% rdg. + 50 d) ±(6% rdg. + 5 d)	●	●	●		
I_K	0.0 A … 9.9 A 10 A … 999 A 1.00 A … 9.99 kA 10.0 kA … 50.0 kA	0.1 A 1 A 0.01 kA 0.1 kA		Calculated value based on I_K = U : Z		Calculated value based on I_K = U : Z	Calculated value based on I_K = U : Z					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 440 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					

Z_{LOOP} Z+R_{LO}

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections				
								1(L)	2(N)	3(PE)	Current Clamp	Other
Z	0.00 Ω … 9.99 Ω 10.0 Ω … 99.9 Ω	0.01 Ω 0.1 Ω	I_{LN} ≥ 10 A_{AC} where U = 120 V (-0%) U = 230 V (-0%) U = 400 V (-0%) I_N = $I_{\Delta N}$: 2	0.50 Ω … 9.99 Ω 10.0 Ω … 99.9 Ω	U_N = 120 V / 230 V 400 V f_N = 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	±(10% rdg. + 10 d) ±(8% rdg. + 2 d)	±(4% rdg. + 5 d) ±(1% rdg. + 1 d)	●	●	●		
I_K	0.0 A … 9.9 A 10 A … 999 A 1.00 kA … 9.99 kA 10.0 kA … 50.0 kA	0.1 A 1 A 0.01 kA 0.1 kA		Calculated value based on I_K = U : Z		Calculated value based on I_K = U : Z	Calculated value based on I_K = U : Z					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 440 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz… 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 99.9 Hz 100 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					

Z_{LOOP} *

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections				
								1(L)	2(N)	3(PE)	Current Clamp	Other
Z	0.6 Ω … 99.9 Ω 100 Ω … 999 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$: 2	10.0 Ω … 99.9 Ω 100 Ω … 999 Ω	U_N = 120 V / 230 V 400 V f_N = 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	±(10% rdg. +1 0 d ±(8% rdg. + 2 d)	±(2% rdg. + 2 d) ±(1% rdg. + 1 d)	●		●		
I_K	0.10 A … 9.99 A 10.0 A … 99.9 A 100 A … 999 A	0.01 A 0.1 A 1 A		Calculated value based on I_K = U : Z		Calculated value based on I_K = U : Z	Calculated value based on I_K = U : Z					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 440 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz… 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 420 Hz		±(0.2% rdg.+1 d)	±(0.1% rdg. + 1 d)					

* Specifications apply to selected RCD types ≥ 30 mA $I_{\Delta N}$

U_{RES}

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
U, U_{res}	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 999 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	DC, 15.0 Hz … 99.9 Hz 100 Hz… 999 Hz	0.1 Hz 1 Hz	5 MΩ	DC, 15.4 Hz … 99.9 Hz 100 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)	●		●		
t_U	0.0 s … 99.9 s	0.1 s		0.4 s … 99.9 s		±(2% rdg. + 2 d)	±(1% rdg. + 1 d)					

IMD

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$R_{L\text{-}PE}$ 1)	15.0 kΩ … 99.9 kΩ 100 kΩ … 574 kΩ 2.50 MΩ	0.1 k Ω 1 k Ω 0.01 MΩ		15.0 kΩ … 199 kΩ 200 kΩ … 574 kΩ 2.50 MΩ	$U_{N\text{-}IT}$ = 120 V / 230 V 400/ 690 V	±7% ±17% ±3%	±5% ±15% ±2%					
t_a	0.00 s … 9.99 s 10.0 s … 99.9 s	0.01 s 0.1 s		0.00 s … 9.99 s 10.0 s … 99.9 s		±(2% rdg. + 2 d)	±(1% rdg. + 1 d)					
U_{L1PE}, U_{L2PE}, U_{L1L2}	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 690 V	f_N = 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	±(3% rdg. + 5 d) ±(3% rdg. + 1 d)	±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	●	●	●		
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 420 Hz		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					
$I_{L\text{-}PE}$	0.00 … 9.99 mA 10.0 … 99.9 mA	0.01 mA 0.1 mA		0.10 mA … 9.99 mA 10.0 mA … 25.0 mA		±(6% rdg. + 2 d)	±(3.5% rdg. + 2 d)					

1) Resistance value $R_{L\text{-}PE}$ is a setting value, not a measured value.

RCM

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$U_{I\Delta N}$	0.0 V … 70.0 V	0.1 V	0.33 · $I_{\Delta N}$ $I_{\Delta N}$ = 10 mA … 1000 mA	20.0 V … 70.0 V	U_N = 120 V / 230 V / 400 V f_N = 16.7 /50 Hz / 60 Hz / 200 Hz / 400 Hz $I_{\Delta N}$ = 10 mA / 30 mA / 100 mA / 300 mA / 500 mA / 1000 mA	+ (1% rdg. + 1 d) … + (10% rdg. + 1 d)	+ (1% rdg. + 1 d) … + (9% rdg. + 1 d)	●	● [1]	●		
R_E	10 Ω … 999 Ω 1.00 kΩ … 6.51 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 10 mA · 1.05	Calculated value based on $R_E = U_{I\Delta N} : I_{\Delta N}$								
	3 Ω … 999 Ω 1.00 kΩ … 2.17 kΩ	1 Ω 0.01 k Ω	$I_{\Delta N}$ = 30 mA · 1.05									
	1 Ω … 651 Ω	1Ω	$I_{\Delta N}$ = 1 00 mA · 1.05									
	0.3 Ω … 99.9 Ω 100 Ω … 217 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 300 mA · 1.05									
	0.2 Ω … 9.9 Ω 10 Ω … 130 Ω	0.1 Ω 1 Ω	$I_{\Delta N}$ = 500 mA · 1.05									
t_a	0.0 s … 10.0 s	0.1 s	$I_{\Delta}N$ = 10 mA … 1000 mA ∿ [2] 0.5 ×, 1 × ⌒ [2] 0.5 ×, 1 × ⎍ [2] 1 ×	0.5 s … 10.0 s		±(2% rdg. + 2 d)	±(1% rdg. + 1 d)					
I_{Δ}	0.0 mA … 99.9 mA 100 mA … 999 mA 1.00 A … 2.50 A	0.1 mA 1 mA 0.01 A		3.0 mA … 2.50 A		±(5% rdg. + 3 d)	±(3.5% rdg. + 2 d)					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V … 440 V		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 99.9 Hz 100 Hz… 420 Hz		±(0.2% rdg.+1 d)	±(0.1% rdg. + 1 d)					

1) Only required when testing with direct current.

2) Tripping test conducted with:
– ∿ : as specified
– ⌒ : 0.7/1.4 × $I_{\Delta}N$
– ⎍: 2 × $I_{\Delta}N$
Max. test current: 2.50 A. All figures are TRMS values.

I_L [1]

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
I_L	1 µA … 999 µA 1.00 mA … 9.99 mA 10.0 mA … 16.0 mA	1 µA 0.01 mA 0.1 mA	R_S = 2 kΩ ±20 Ω	15 µA … 999 µA 1.00 mA … 9.99 mA 10.0 mA … 16.0 mA		±(3% rdg. + 4 d)	±(2% rdg. + 3 d)	●		●		
f	15.0 Hz … 99.9 Hz 100 Hz … 999 Hz	0.1 Hz 1 Hz		15.4 Hz … 99.9 Hz 100 Hz … 420 Hz 2)		±(0.2% rdg. + 1 d)	±(0.1% rdg. + 1 d)					

[1] I_L = leakage current

[2] Frequency is only displayed as of a level of I_L > 100 µA.

≤ 1V≅ 1)

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
$I_{L/AMP}$	0.00 mA … 9.99 mA	0.01 mA	337 k Ω	0.20 mA … 9.99 mA		±(15% rdg. + 4 d)	±(2% rdg. + 5 d)				PROFITEST CLIP 100 mV/mA	
S	0 VA … 999 VA	1VA		U = 0.3 V … 600 V $U_{Esensor}$ = 0 V_{eff}… 1.0 V_{eff}	U_N = 120 V / 230 V / 400 V f_N = 50 Hz / 60 Hz	Calculated value from S = U × I						
	1.00 kVA … 9.99 kVA	0.01 kVA										
	10.0 kVA … 99.9 kVA	0.1 kVA										
	100 kVA … 999 kVA	1 kVA										
	1.00 MVA … 9.99 MVA	0.01 MVA										

1: Measuring range of the signal input at the test instrument, U_E: 0 V_{TRMS} … 1.0 V_{TRMS} (0 V_{peak} … 1.4 V_{peak}) AC/DC

T % R.H.

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other	Other
ϑ	-99.9 °C … +99.9 °C	0.1 °C		-10.0 °C … +50.0 °C		±2 °C	±2 °C						T/H sensor
r. h.	0.0% ... 99.9%	0.1%		10.0% ... 90.0%		±5 %	±5 %						

EXTRA$_{\Delta U}$

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Other
Z_{L-N} Z_{Offset}	0 m Ω … 999 mΩ 1.00 Ω … 9.99 Ω	1 mΩ 0.01 Ω	≥10 $A_{AC/DC}$ where U = 120 V (– 0%) U = 230 V (– 0%) U = 400 V (– 0%) U = 690 V (– 0%) U = 850 V_{DC} (- 0 %)	50 mΩ … 999 mΩ 1.00 Ω … 5.00 Ω	U_N = 120/230 V 400/690 V_{AC} U_N = 850 V_{DC} f_N = DC 16.7 Hz / 50 Hz / 60 Hz / 200 Hz / 400 Hz	±(10% rdg. + 10 d) ±(6% rdg. + 4 d)	±(5% rdg. + 10 d) ±(3% rdg. + 3 d)	●		●		
ΔU ΔU_{Offset}	0.00% ... 9.99%	0.01%		Calculated value ΔU = (I_N · Z_{LN}) / U_N · 100%		Calculated value ΔU = (I_N · Z_{LN}) / U_N · 100%	Calculated value ΔU = (I_N · Z_{LN}) / U_N · 100%					
U	0.0 V … 99.9 V 100 V … 999 V	0.1 V 1 V		2.0 V … 99.9 V 100 V_{AC} … 725 V_{AC} 100 V_{DC} … 850 V_{DC}		±(2% rdg. + 5 d) ±(2% rdg. + 1 d)	±(1% rdg. + 5 d) ±(1% rdg. + 1 d)					

HV (PROFITEST PRIME AC ONLY)

Measured Quantity	Display Range	Resolution	Input Impedance / Test Current	Measuring Range	Nominal Values	Measuring Uncertainty	Intrinsic Uncertainty	Connections 1(L)	2(N)	3(PE)	Current Clamp	Probe HV-P	HV-P
U	10 V … 999 V 1.00 kV … 2.55 kV	1 V 10 V	Impedance to earth: ≥1 MΩ (typ. ~ 15 MΩ)	200 V … 999 V 1.00 kV … 2.50 kV	1.0 kV / 1.5 kV / 2.0 kV / 2.5 kV	±(5% rdg. + 5 d) ±(5% rdg. + 5 d)	±(2.5% rdg. + 5 d) ±(2.5% rdg. + 5 d)					●	●
I	1.0 mA … 99.9 mA 100 mA … 200 mA	0.1 mA 1 mA		1.0 mA … 99.9 mA 100 mA … 200 mA		±(7% rdg. + 5 d) ±(7% rdg. + 5 d)	±(5% rdg. + 5 d) ±(5% rdg. + 5 d)					●	●
φ	0° to 90°	1°		0° to 90°		±(12% rdg. + 10 d)	±(10% rdg. + 10 d)					●	●

Influencing Quantities and Influence Error

Abbrevia-tion	Influencing Quantity	U	EN61557-4 R_{LO}	EN61557-2 R_{ISO}	EN61557-3 Z_{LOOP}	EN61557-6 RCD I_F	EN61557-6 RCD $I_{\Delta N}$
A	Intrinsic uncertainty	±(1 % rdg. + 5 d) for 2.0 V … 99.9 V ±(1 % rdg. + 1 d) for 100 V … 999 V	±(2 % rdg. + 2 d) for 0.10 Ω … 5.99 Ω	±(3 % rdg. + 10 d) for 50 kΩ … 999 kΩ ±(3 % rdg. + 1 d) for 1.00 MΩ … 1.20 GΩ	±(5 % rdg. +10 d) for 50 mΩ … 999 mΩ ±(3 % rdg. + 3 d) for 1.00 Ω … 5.00 Ω	±(3.5 % rdg. + 2 d) for 3.0 mA … 2.50 A	±3 ms for 5.0 ms … 999 ms
E1	Reference position ±90°	0%	0%	0%	0%	0%	0%
E2	Supply voltage	0%	1%	1%	1%	1%	1%
E3	Temperature 0 °C … +40 °C	0.5%	1%	2.5%	1%	2.5%	5%
E4	Series interference voltage						
E5	Probe resistance					0%	0%
E6	Phase angle 0° to 18°				1%		
E7	Line frequency 99% ... 101% of nominal frequen-cy				1%		
E8	Line voltage 85% ... 110% of nominal voltage				1%		
E9	Mains harmonics				1%		
E10	DC component				1%		

Light gray areas are not relevant

Reference Conditions

Line voltage	230 V, deviation: ≤ 0.1%
Line frequency	50 Hz, deviation: ≤ 0.1%
Measured qty. frequency	45 … 65 Hz
Line voltage	Sine (deviation between effective and rectified value: ≤ 0.1%)
Line impedance angle	cosφ = 1
Probe resistance	< 10 Ω
Auxiliary power (mains)	230 V, deviation: ≤ 10%
Auxiliary power (battery)	10.8 V, deviation: ≤ 10%
Ambient temperature	+23 °C, deviation ≤ ±2 K
Relative humidity	40% ... 60%
Extraneous field strength	< 0.1 A/m
Load resistors	Linear, strictly ohmic

Nominal Ranges of Use

Voltage	120 V (108 V … 132 V) 230 V (196 V … 253 V) 400 V (340 V … 440 V) 690 V (656 V … 725 V) 850 V_{DC} (765 V_{DC} … 893 V_{DC})	
Frequency f_N	16.7 Hz (15.4 Hz … 18 Hz) 50 Hz (49.5 Hz … 50.5 Hz) 60 Hz (59.4 Hz … 60.6 Hz) 200 Hz (190 Hz … 210 Hz) 400 Hz (380 Hz … 420 Hz)	
	Line voltage waveform:	Sinusoidal
	Temperature range:	0 °C ... + 40 °C
	Supply impedance angle:	Corresponds to cos φ = 1… 0.95

Overload Capacity

U, U_{res}	1100 V $_{TRMS}$ continuous
R_{LO}	Electronic protection prevents starting a measurement when interference voltage > 12 V is present.
R_{LO}HP	Electronic protection prevents starting a measurement when interference voltage > 12 V is present. Measurement aborted at test currents > 31 A. 10 s “on-time”, 30 s “off-time”.
R_{ISO}	1200 V_{DC} continuous
I_N , I_F , I_N+I_F , RCM	440 V continuous
Z_{LOOP}	725 V_{AC}, 893 V_{DC} (Limits the number of measurements and pause duration. If overload occurs, the measuring function is disabled by means of a thermostatic switch.)
Z_{LOOP}	440 V (Limits the number of measurements and pause duration. If overload occurs, the measuring function is disabled by means of a thermostatic switch.)
IMD	690 V, I_{LPE} < 25 mA continuous
I_L	15 mA_{TRMS} continuous, measurement is stopped in case of interference voltage > 60 V
	1 V $_{TRMS}$ continuous

6 INITIAL STARTUP (SUPPLY VOLTAGE)

6.1 GENERAL INFORMATION

Measuring mode operation is possible with either of two different sources of electrical power, which are however restricted depending on auxiliary power or the application:

1. Mains operations
2. Mains-independent with integrated rechargeable battery

Auxiliary Power (source)	Charge	Basic Functions	R_{LO} 25 A	HV_{AC}	HV_{DC}	RCD_{DC} 1)
Battery operation	–	✓	–	–	–	– (See note below.)
Mains operation 230 V/240 V ±10% / 50/60 Hz ±1 Hz	✓	✓	✓	✓	✓	✓
Mains operation 115 V ±10% / 50/60 Hz ±1 Hz	✓	✓	✓	–	✓	✓
Mains operation 85 V … 264 V / 16.7 Hz … 400 Hz	✓	✓	–	–	✓	✓

1) Functions for RCD type B, B+ and loop with DC disabling (LOOP+DC)

Note

Battery operation: Incorrect measurement results when the battery is low!

Only conduct Z_{LOOP} DC+ (DC-H), RCD I_F and RCD I_N measurements using DC test current with a battery charge level of at least 50%.

6.2 USING THE MEASURING/TEST INSTRUMENT WITH MAINS POWER (AUXILIARY POWER)

Connect the measuring/test instrument to 230 or 115 V mains power (depending on country version) via the included mains power cable. Insert the inlet plug into the respective outlet next to the line disconnector to this end. Connect the other end of the mains power cable with the country specific plug to the electrical system's earthing contact outlet.

The measuring/test instrument may only be connected to electrical systems with up to 230/240 V (e.g. IEC 60346, VDE 0100) and are protected with a fuse or circuit breaker with a maximum rating of 16 A.

If connection is not made via an earthing contact outlet, switch the measuring/test instrument on and off.

1. Set the mains switch to ON "**I**" – the red lamp lights up.
2. Set the rotary selector switch to **U** or any other position (except **OFF**).
   ↳ The menu which corresponds to the rotary selector switch is displayed.
3. The measuring/test instrument can be switched off manually by setting the rotary selector switch to the **OFF** position.
4. The measuring/test instrument is disconnected from the mains by setting the red line disconnector to off **0**.

6.3 USING THE MEASURING/TEST INSTRUMENT IN BATTERY MODE

The measuring/test instrument can be powered by a rechargeable lithium-ion battery ➪44. The battery must be charged at regular intervals.

ATTENTION

Use of the battery under unsuitable ambient conditions!

Battery damage.

- The measuring/test instrument and its battery may only be used under the specified ambient conditions ➪29. In particular, observe permissible temperature ranges.
- At temperatures of above 75 °C, the rechargeable battery is shut down entirely for safety reasons and must be replaced by our service department (➪150).

ATTENTION

Deep discharge of the battery!

Battery damage.

- Charge the battery at regular intervals (preferably once a month).
  This ensures that the battery's protective shutdown circuit is supplied with the required current.
- In the event of a deep discharge, the battery may need to be replaced by our service department (➪150).

Please note that the system clock stops in the case of excessive discharge for a long period of time and must be set to correct time after the instrument has been restarted.

Note

The internal battery is built in and cannot be replaced by the user.

Please contact our service department if replacement is required ➪150.

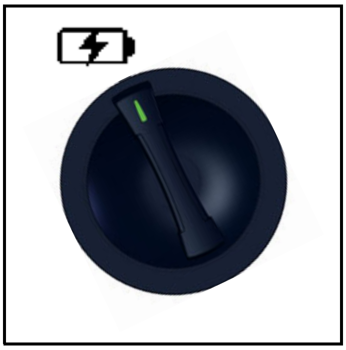
Charging the Battery

The battery is continuously charged as long as the measuring/test instrument is connected to the mains (➪44) and the mains switch is set to ON "I", regardless of the selector switch position.

Quick Charging

1. Connect the measuring/test instrument to mains power via the inlet plug ⇨44.
2. Set the mains switch to on **I** – the red lamp lights up.

3. In order to quick charge the integrated batteries, set the rotary selector switch to the position.



↳ The pictogram appears at the display if the instrument is not connected to the mains or if the mains switch is not set to on **I**.
In either of these cases, the batteries are not charged.
No measurements can be conducted during the quick charging process. This is assured by means of the switch position.
↳ The pictogram indicates that the batteries are fully charged.

Battery Charge Level

Indication of the momentary charge level:

- By means of LEDs ⇨19
- By means of symbols at the display ⇨21

If rechargeable battery voltage has fallen below the allowable lower limit, the pictograph shown at the right appears. **Low Batt!!!** is also displayed along with a rechargeable battery symbol.

BATT

The measuring/test instrument does not function in the battery operating mode if the batteries have been depleted excessively and no display appears.

Switch to the mains operating mode in this case (⇨44).

Switching the Measuring/Test Instrument On and Off

✓ The batteries are charged.
✓ The mains switch is set to off **0**.

1. Set the rotary selector switch to **U** or any other position (except **OFF**).
   ↳ The menu which corresponds to the rotary selector switch is displayed.
2. The measuring/test instrument can be switched off manually by setting the rotary selector switch to the **OFF** position.

6.4 STANDBY FUNCTION

The measuring/test instrument is switched to the standby status for all measuring functions except for continuous measurement after the shutdown time specified in **SETUP** (⇨49). The display is turned off in this case.

There are two ways to switch the measuring/test instrument back on again:

- Press the **ON/START** key on the measuring/test instrument.
- Turn the rotary switch to the **OFF** position and then select a measurement function again.

7 CONNECTING PROBES AND OTHER ACCESSORIES

Various accessories need to be connected to the measuring/test instrument in order to perform measurements and tests.

Some of these, for example accessories for high-voltage tests with the PROFITEST PRIME AC, are absolutely essential.

Other accessories are optional and make work more efficient and convenient.

7.1 GENERAL

Accessories Overview

An overview of available accessories and order information can be found in the data sheet.

Technical Information for Accessories

Detailed information regarding the respective product (in particular its technical data) can be found in the corresponding product documentation.
Exception: The standard probes included in the scope of delivery are described in this document (see chapter "Standard Measuring Probes (included in scope of delivery)" ➪🗎46).

Using Accessories with the Measuring/Test Instrument

The use of each respective accessory is described in detail in the associated product documentation.

Furthermore, applications in combination with the PROFITEST PRIME / PROFITEST PRIME AC are described in this chapter and in the chapter on the respective measurement/test.

7.2 PROBES AND PROBE ATTACHMENTS

Standard measuring probes are included in the scope of delivery (➪🗎12).

Various measuring probes for more convenient operation and with longer cables are available as optional accessories.

Accessories such as probe attachments and replacement test tips are also available.

LED Indication for Connected Probes

2 LEDs indicate whether the standard test probes or the HV test probes/pistols are active. Both LEDs light up briefly when the system is started up, in order to indicate that the instrument is ready for operation.

Detailed information on LED indications can be found here ➪ "Signaling via LEDs" 🗎19.

7.2.1 STANDARD MEASURING PROBES (INCLUDED IN SCOPE OF DELIVERY)

The standard test probes with 4-wire measuring technology for the 1(L), 2(N) and 3(PE) sockets are coded differently by means of their connector plugs, in order to rule out the possibility of connecting them to the wrong sockets.

Connect the respective probe to the corresponding probe connection (see figure ➪🗎15).

Technical Data / Use

DANGER

Dangerous Voltage!

Risk of electric shock.

Observe the measuring category: without safety caps on the probes, measurements may only be performed in CAT II.

Maximum rated voltage	300 V	600 V	600 V
Measuring category	CAT IV	CAT III	CAT II
Maximum rated current	1 A	1 A	16 A *
With safety cap attached	✓	✓	×
Without safety cap	×	×	✓
With attached alligator clip	×	×	✓

The safety caps must be removed in order to make contact inside 4 mm jacks.

Removing and attaching the safety caps:
Pry the safety cap’s snap fastener open, for example with a second test probe.
The caps can be attached easily by hand.

7.2.2 MEASURING PROBES WITH LONGER CONNECTOR CABLES (OPTIONAL ACCESSORY)

Probes with longer connector cables are available for connections 1(L), 2(N) and 3(PE), which provide additional leeway.

Connect the respective probe to the corresponding probe connection (see figure ➪🗎15).

7.2.3 INTELLIGENT MEASURING PROBE I-SK4-PROFITEST-PRIME (Z516T) OR ISK-12-PROFITEST-PRIME (Z516U) (OPTIONAL ACCESSORY)

Above and beyond the functionality of the standard probe, an intelligent probe also makes remote control of the measuring/test instrument possible. It can be used to start and stop measurements, and to save or transfer recorded measurement data. Measuring points can also be illuminated.

Complete information on use and operation can be found in the corresponding product documentation.

7.2.4 PROBE ATTACHMENTS (OPTIONAL ACCESSORIES)

Attachments such as flat measuring clamps and cable shoes are available for easy contacting of difficult-to-access measuring points and/or continuous contact.

They can be used for measurements in accordance with the technical documentation for the respective accessory.

7.3 CURRENT CLAMP SENSORS (OPTIONAL ACCESSORIES)

Current clamps are required for measuring current and apparent power $I_{L/AMP}$.

- PROFITEST CLIP,
- Z3512A [1)],
- WZ12C [2)],
- METRAFLEX P300 [3)]

These are connected to the function socket marked with the

max. 3 V

symbol. Settings must be configured at the accessory and measuring/test instrument for the measurement. See chapter "IL/AMP – Current and Apparent Power Measurement with Current Clamp Sensor" ➪🗎111..

7.4 ADAPTERS (OPTIONAL ACCESSORIES)

Various adapters are available for different connection purposes, for example:

- 3-phase current adapter for connection to 7-pole CEE outlets
- Adapter for standards-compliant testing of type S and K PRCDs
- E-mobility adapter for testing charging cables and e-charging points

Complete information on use and operation can be found in the corresponding product documentation.

7.5 SENSORS

The PROFITEST PRIME (Z506G) T/H sensor is required for measuring temperature and relative humidity ➪ "T %r.H. – Measurement of Temperature and Atmospheric Humidity" 🗎113.

7.6 HIGH-VOLTAGE ACCESSORIES FOR THE PROFITEST PRIME AC

See chapter "HV – Testing for Dielectric Strength,(PROFITEST PRIME AC only)" ➪🗎122.

7.7 BARCODE READER / SCANNER

The Barcode-Profiscanner-RS232 (Z502F)[4)] can be connected and operated via the RS 232 interface.

Barcodes can be used to encrypt test object IDs. Scanning the barcodes makes it quicker and more convenient to detect test objects and assign measured values to them during recurrent tests.

Frequently recurring designations, such as test object types, can also be encrypted as codes in order to be able to read them in from a list for use as comments if required.

The barcodes (labels) must be printed on a separate label printer to this end.

Connection

Connect the Barcode-Profiscanner-RS232 to the RS 232 port at the measuring/test instrument. See chapter "Instrument Overview" ➪🗎15.

Scanning Barcodes

The starting point (switch position and menu) is arbitrary.

✓ A barcode must have been generated beforehand, e.g. for the identification (ID) of a test object.

1. Scan the object's barcode.
   ↳ The recognized barcode is displayed inversely.
2. This value is accepted after pressing the **ENTER** key.
   If the menu for alphanumeric entry is active, any scanned value is accepted directly.
   Regardless of whether or not an object has been found, searching can be continued by pressing the key shown at the right:
   - Object found: searching is continued below the previously selected object.
   - No further object found: the entire database is searched at all levels.

Note

A previously selected object is not taken into consideration by the search.

7.8 BLUETOOTH® KEYBOARD

An external keyboard can be connected via Bluetooth® for easier entry of text, numbers and other characters.

Compatible Bluetooth® Keyboards

Only Bluetooth® keyboards that support Bluetooth® Classic mode (3.0) are compatible. Keyboards that can only connect to Bluetooth® Low Energy hosts (LE) (as of Bluetooth® 4.x) are not supported.

The following models have been successfully tested:

- Rapoo E6080
- Logitech K380
- Keychron K3

We cannot guarantee correct operation with other Bluetooth® keyboards.

Pairing a Bluetooth® Keyboard

The measuring/test instrument and the Bluetooth® keyboard must first be paired (one time only). After pairing, future connections are established automatically, provided that both devices are switched on and Bluetooth® is activated.

1) Only with ADAPTER-Z506J-PROFITEST-PRIME
2) Only with ADAPTER-Z506J-PROFITEST-PRIME
3) Only with ADAPTER-Z506J-PROFITEST-PRIME
4) Optional accessory, not included

Note

Only pair one single Bluetooth® keyboard with the measuring/test instrument.

Interference may otherwise disrupt the connection.

✓ The Bluetooth® function is activated at the measuring/test instrument ➪🗎53.

✓ Bluetooth® visibility is activated at the measuring/test instrument ➪🗎53.

1. Turn the rotary switch to **Setup**.
   ↳ The settings menu is displayed.
2. Press the **SETTING** key.
   ↳ The **SETTING** submenu is displayed.
3. Press the key with the Bluetooth® icon.
   ↳ The **BLUETOOTH** submenu is displayed.
4. If Bluetooth® is deactivated, turn it on by setting the **ON OFF** key to **ON**.
   ↳ Bluetooth® is switched on.
5. Press the key with the Bluetooth® and heart icons.
   ↳ The **BLUETOOTH TRUSTED DEVICES** submenu is displayed.
6. Activate the Bluetooth® pairing mode at the keyboard. Read the product documentation for the keyboard to this end.
   ↳ The Bluetooth® keyboard is ready for pairing.
7. Press the **ADD** key.
   ↳ The measuring/test instrument searches for Bluetooth® devices.
   The list shows all detected Bluetooth® devices.
8. Select the Bluetooth® keyboard from the list.
9. Acknowledge your selection by pressing the **ADD** key. The pairing confirmation dialog appears.
10. Enter the code displayed at the measuring/test instrument via the Bluetooth® keyboard and confirm with Enter.

↳ The Bluetooth® keyboard is now paired.
It appears in the list of trusted devices.

Note

Set the language of the measuring/test instrument to match the keyboard layout ➪ "Test Instrument Settings – Setup" 🗎49.

8 TEST INSTRUMENT SETTINGS – SETUP

Measuring/test instrument parameters are selected, the database and the Bluetooth® interface are configured, and the firmware version is queried in this switch position.

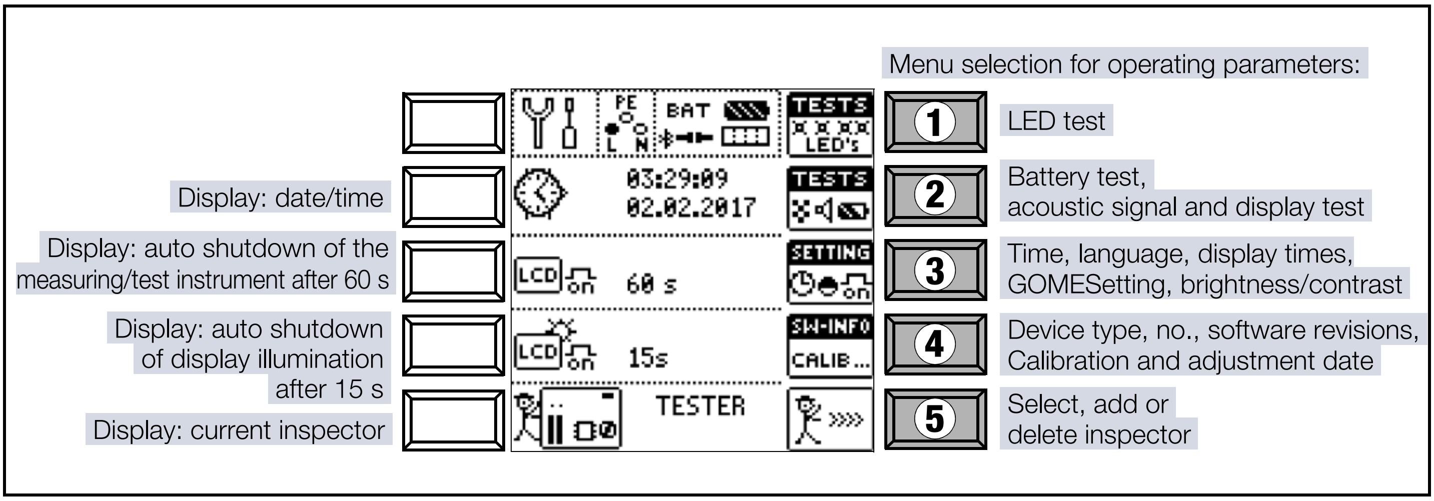
Key for the following figures:

Currently enabled key

Key with no current function

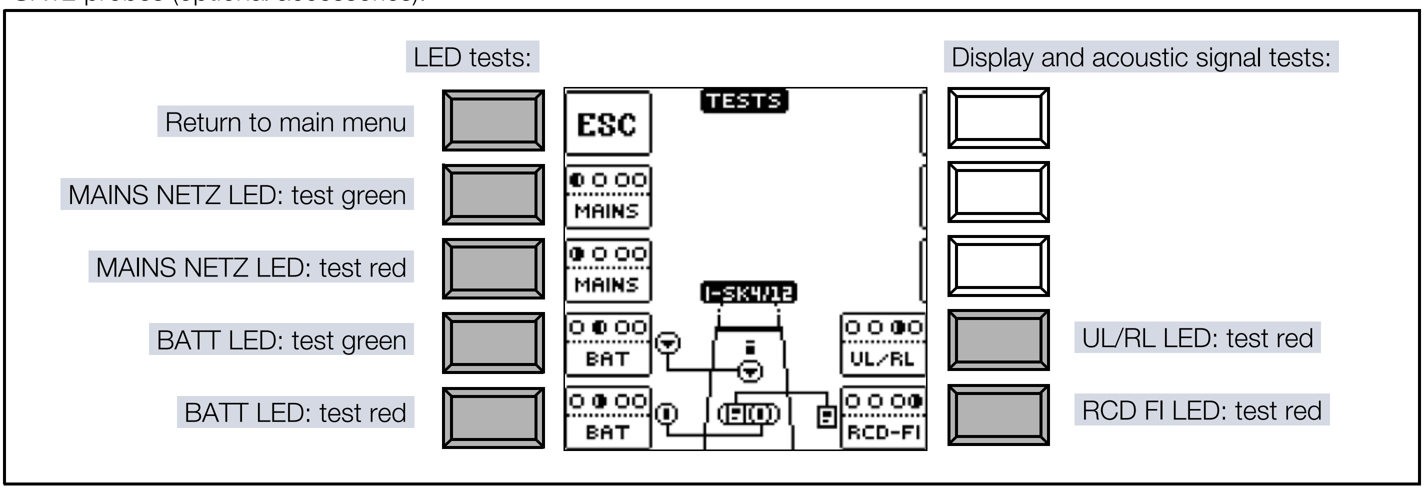
Press **ESC** in order to return to the main menu.

Main menu:



LED test

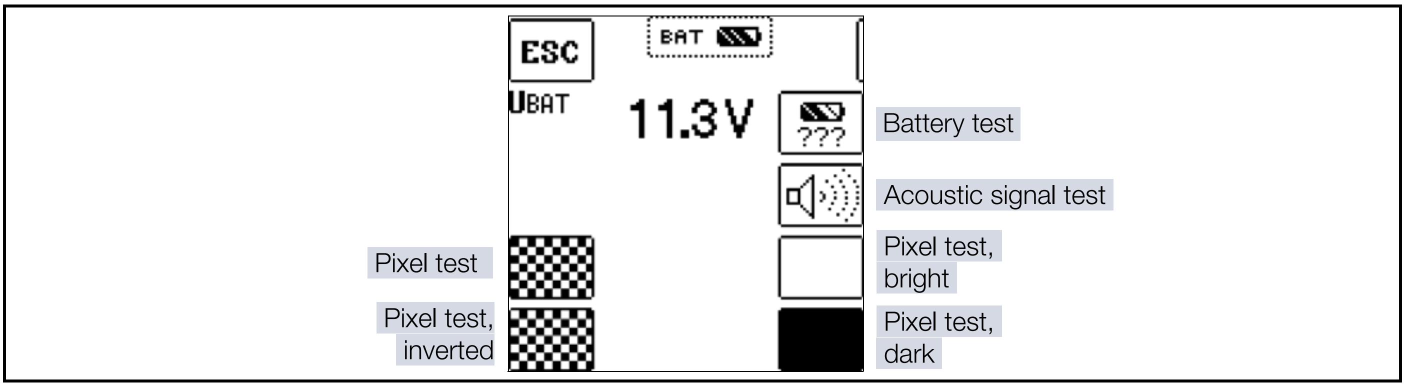
The LEDs on the measuring/test instrument and their various statuses can be checked here (red or green).
Beyond this, testing of the three key functions (measurement, triggering and save key) can be tested here for I-SK4 or I-SK12 probes (optional accessories).



2 Battery Test, Acoustic Signal and Display Test

Various tests can be conducted:

- Display: pixel tests
- Acoustic signal
- Battery



Battery test: battery voltage is displayed, along with charge level as a percentage.

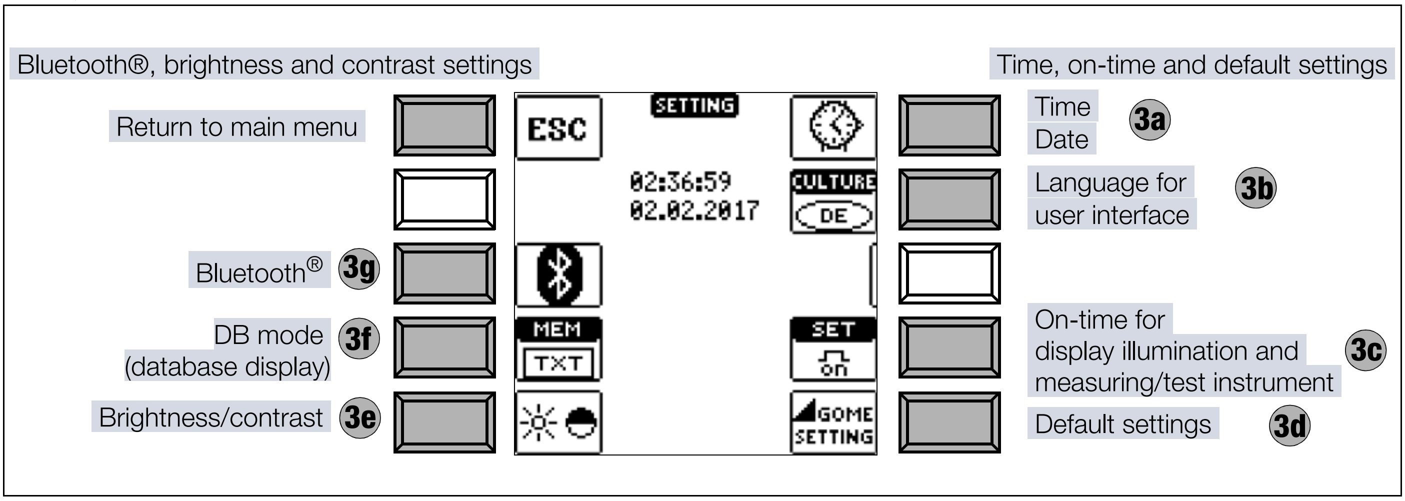
Note

Battery voltage ≤ 9.6 V

If battery voltage has dropped to 9.6 V or less, the **UL/RL LED** lights up red and an acoustic signal is generated as well.

If battery voltage drops to below 9.6 V during a measuring procedure, this is indicated by means of a pop-up window as well as an acoustic signal. Measured values are invalid. The measurement results cannot be saved to memory.

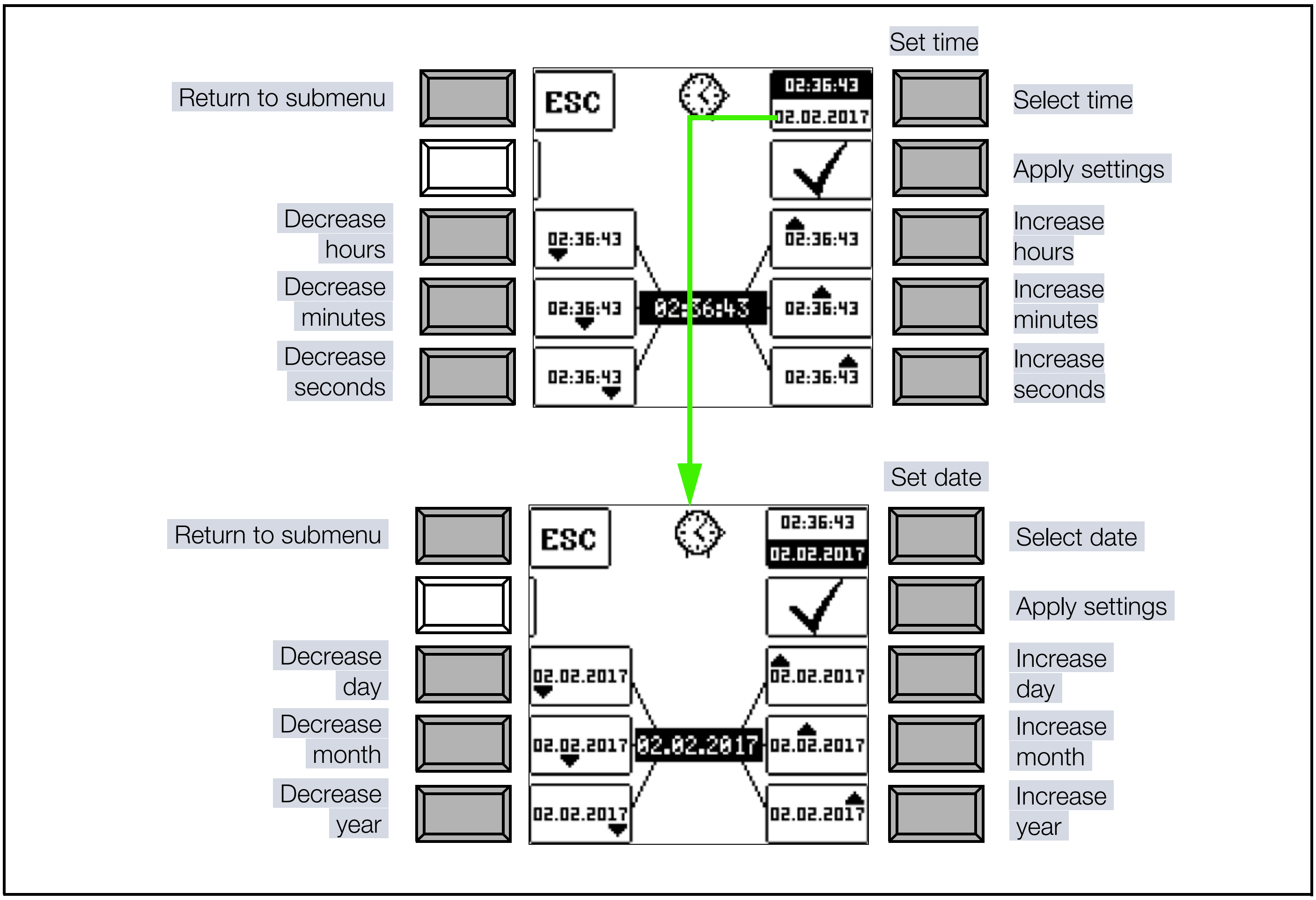
3 Time/Date, User Language, Shutdown Times, Default Settings, Brightness/Contrast, Database Mode, Bluetooth®



3a Time and Date Settings

Note

If the measuring/test instrument is not used for a lengthy period of time and the battery is discharged, the system clock stops and must be reset when the instrument is started up again.



3b User Interface Language (CULTURE)

Select the desired country setup with the appropriate country code.

ATTENTION

Changing the Language

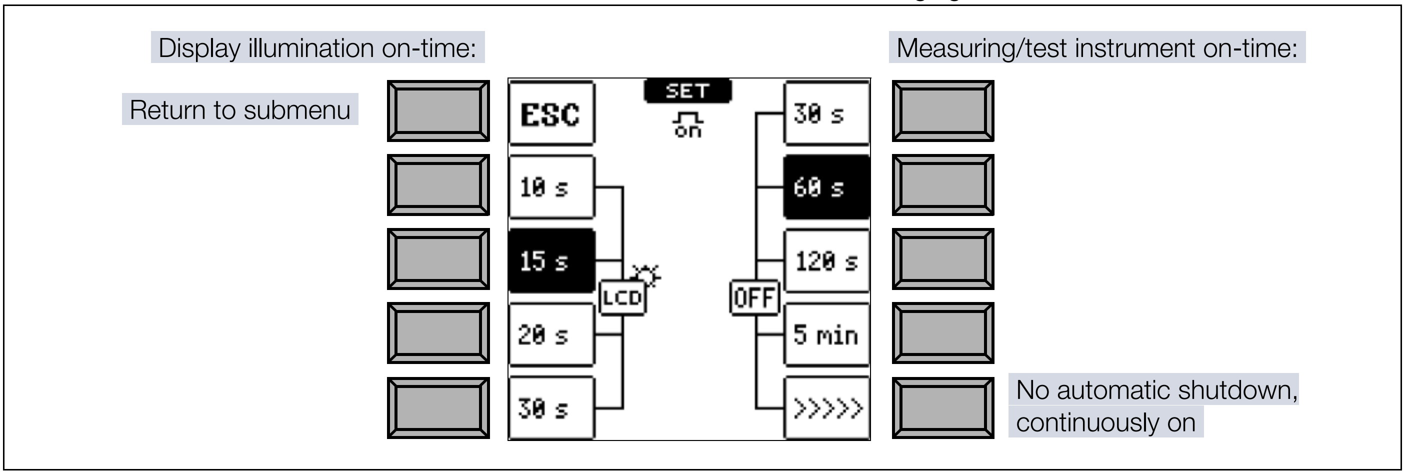
Data loss.

(loss of all measurement data, database, instrument configuration, test sequences etc.)

- Back up your structures, measurement data and sequences to a PC before pressing the respective key.
- A security prompt appears, allowing you to change your mind if desired.

3c Test Instrument / Display Illumination On-Time

The period of time after which the measuring/test instrument and display illumination is automatically shut off can be selected here. This selection has a considerable influence on the service life and the charging status of the batteries.



3d Default Settings (GOME SETTING)

ATTENTION

Reset to Default Settings

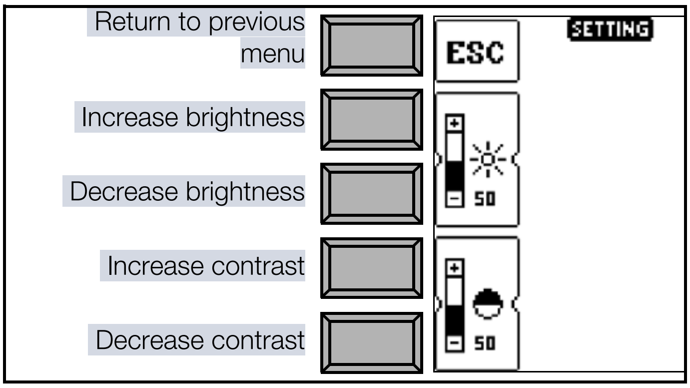
Data loss.

(loss of all measurement data, database, instrument configuration, test sequences etc.)

- Back up your structures, measurement data and sequences to a PC before pressing the respective key.
- A security prompt appears, allowing you to change your mind if desired.

The measuring/test instrument is returned to its original default settings when this key is activated.

3e Adjusting Brightness and Contrast

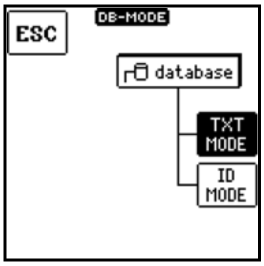


3f DB-MODE – Display of the Database in the Text or ID Mode

Note

Structures can be created in the measuring/test instrument in either the text mode or the ID mode.

In contrast to this, designations and ID numbers are always assigned in the report generating program.

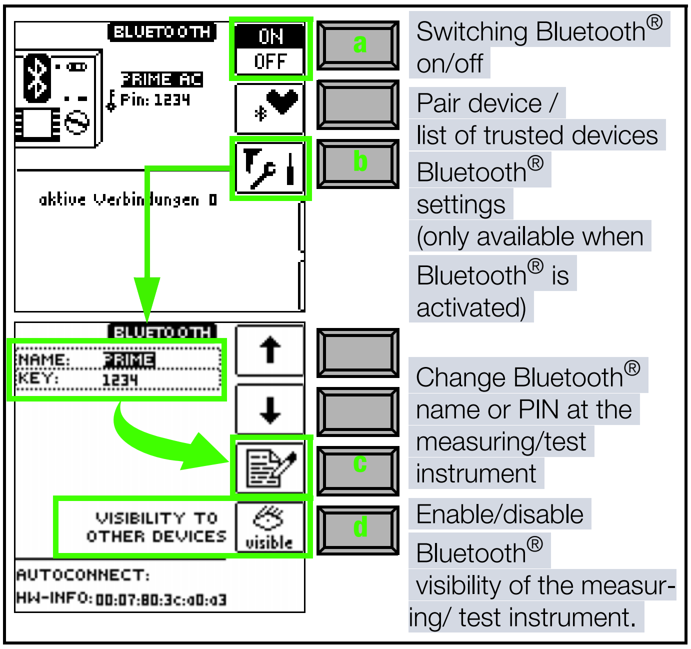


The database in the measuring/test instrument is set to the text mode as a default feature and “TXT” appears in the header. You can create structure elements in the measuring/test instrument and label them in plain text, e.g. Customer XY, Distributor XY and Circuit XY.

You can work in the ID MODE as an alternative, in which case “ID” appears in the header. You can create structure elements in the measuring/test instrument and label them with any desired ID numbers.

If no texts or ID numbers have been entered to the measuring/test instrument when creating structures, the report generating program creates the missing entries automatically. These can then be edited in the report generating program and transferred back to the measuring/test instrument if required.

3g Bluetooth®



Bluetooth® functions:

- Bluetooth® keyboard ➪🗎47
- Push-print function ➪🗎63

ATTENTION

Exploitation of Bluetooth® Vulnerabilities

Unauthorized access via Bluetooth®.

- Deactivate Bluetooth® if you're not using the function.
- Change the measuring/test instrument's Bluetooth® PIN.
- Disable visibility after pairing your devices in order to conceal the interface.

In order to use Bluetooth® functions, the function must first be activated (a).

Bluetooth® settings can then be configured (b):

- Bluetooth® name (c) – for distinguishing amongst several measuring/test instruments.
- PIN (c) – default = 1234.

Note

The measuring/test instrument supports only 4 digits and only numbers 0 through 9.

Visibility must also be enabled (d) so that the other devices can find the measuring/test instrument for pairing.

Pairing is described within the context of the respective function.

Devices which have been paired with the measuring/test instrument can be found in the list of trusted devices.

The current Bluetooth® status is displayed in the header ➪🗎24.

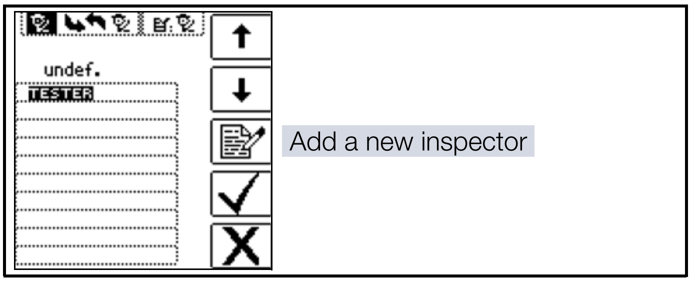
4 Device Type, No., Software Revisions, Calibration and Adjustment Date (example)

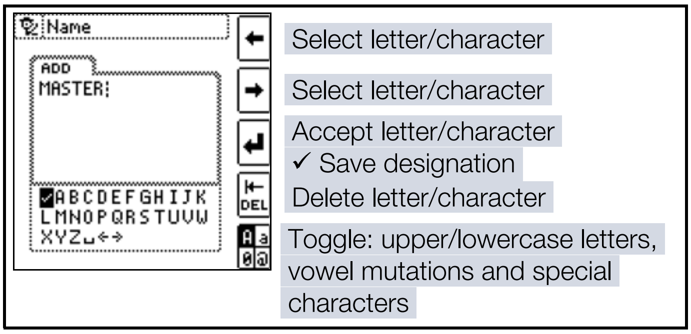
SW-INFO CALIB...

Displays information.

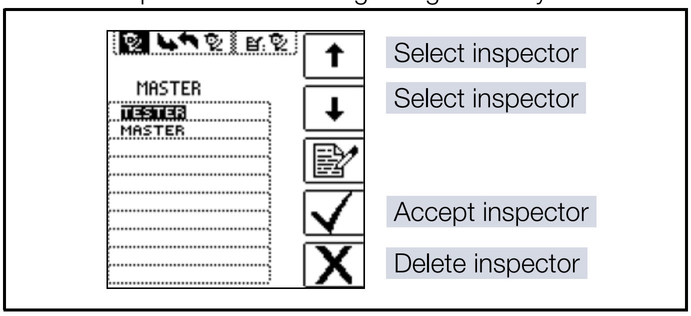
Press any key in order to return to the main menu.

5 Selecting, Adding or Deleting an Inspector





See also Kap. 10.4 Seite 59 regarding the entry of a text.



9 INTERNAL DATABASE

A complete distributor structure with data for electrical circuits and RCDs can be created in the measuring/test instrument. This structure makes it possible to assign measurements to the electrical circuits of various distributors, buildings and customers, and to save the results.

Up to 30,000 structure elements can be stored at the measuring/test instrument as a distributor structure.

ATTENTION

Sensitive Data

Violation of data protection regulations.

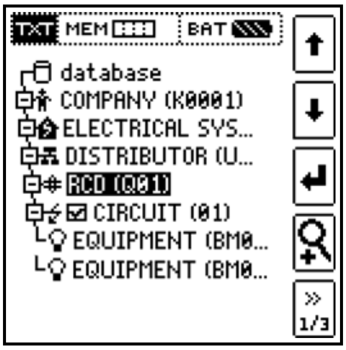
Observe and comply with respectively applicable national data protection regulations.

Take further appropriate measures, for example in order to restrict access to the measuring/test instrument.

9.1 CREATING DISTRIBUTOR STRUCTURES, GENERAL

There are two possible procedures:

1. Create at the measuring/test instrument (e.g. directly on site)



or

2. Create with IZYTRONIQ report generating program and then transfer to the measuring/test instrument

This section describes creation of the distributor structure at the measurement/test instrument.

If you would like to create the distributor structure using IZYTRONIQ, please read the corresponding product documentation, in particular the online help. The distributor structure can then be transferred to the measuring/test instrument ➩🗎135.

9.2 CREATING A DISTRIBUTOR STRUCTURE AT THE MEASURING/TEST INSTRUMENT

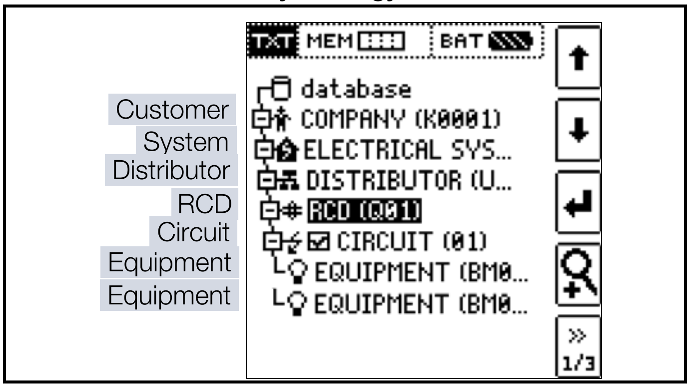
9.2.1 OVERVIEW OF THE MEANINGS OF ICONS USED TO CREATE STRUCTURES

Icon		Meaning
Main Level	Sub-level	
		Memory Menu, Page 1 of 3
		Cursor UP: scroll up
		Cursor DOWN: scroll down
		ENTER: Acknowledge selection. + → – change to sublevel (open directory) – → + change to main level (close directory)
		Display the complete structure designation (max. 63 characters) or ID number (25 characters) in a zoom window.
		Temporarily switch back and forth between structure designation and ID number. These keys don't have any effect on the main setting in the setup menu (see "DB Mode" ➩🗎52).
		Hide the zoom window.
		Change display to menu selection.

Icon		Meaning
		Memory Menu, Page 2 of 3
		Add a structure element.
		Selection: UP/DOWN scroll keys and ↵ In order to add a designation to the selected structure element, refer to the edit menu in following column.
Measuring/ test instrument	**IZYTRONIQ**	
		LOCATION TREE
		Property
		Building
		Floor
		Room
		E-TREE (electrical tree)
		Customer
		Electrical system
		Machine
		Distributor
		Circuit
	RCD	RCD
	RCM	RCM
		RCBO
	IMD	IMD
		Operating equipment
		Equipotential bonding busbar
		Equipotential bonding conductor
		Earth electrode
		Measuring point

Icon		Meaning	
	EDIT	For additional icons see the edit menu below.	
		Delete the selected structure element.	
		Show measurement data, if a measurement has been performed for this structure element.	
		Edit the selected structure element.	
		Memory Menu, Page 3 of 3	
ID		Search for ID number > Enter complete ID number	
TXT		Search for text > Enter full text (complete word)	
ALL		Search for ID number or text	
	»	Continue searching	
		Edit Menu	
		Cursor LEFT: Select an alphanumeric character	
		Cursor RIGHT: Select an alphanumeric character	
		ENTER: accept an individual character	
	✓	Acknowledge entry	
	←	Scroll left	
	→	Scroll right	
DEL		Delete character	
Aa 0@		Switching amongst different types of alphanumeric characters:	
	A	✓ABCDEFGHIJK LMNOPQRSTUVW XYZ␣←→	Upper case letters
	a	✓abcdefghijk lmnopqrstuvw xyz␣←→	Lower case letters
	0	✓0123456789+ -*/=:,;_()<> .!?␣←→	Numbers
	@	✓@äÄöÖüÜß€$% &#àâéèíìóòúù ñÑæ␣←→	Special characters

Distributor Structure Symbology / Tree Structure



Same type of element as in the Windows Explorer:
+: sub-objects available, display by pressing ↵.
–: sub-objects are displayed, hide by pressing ↵.

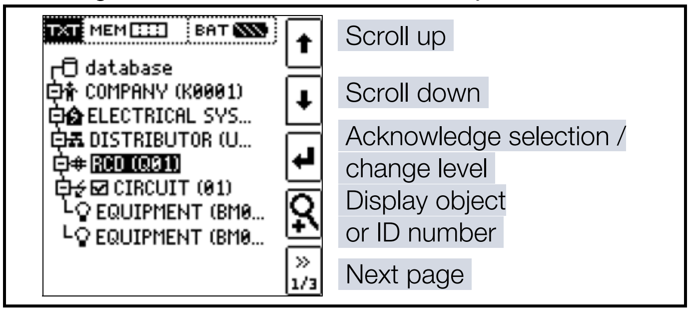
Symbols to the right of a structure element:
Checkmark: all measurements within the respective hierarchy have been passed.
x: at least one measurement has not been passed.
No symbol: Measurement has not yet been performed.

9.2.2 CREATING A STRUCTURE (BASED ON THE EXAMPLE OF AN ELECTRIC CIRCUIT)

After selection with the **MEM** key, all setting options for the creation of a tree structure are made available on three menu pages (1/3, 2/3 and 3/3).

The tree structure consists of structure elements, referred to below as objects.

Selecting the Position at which a New Object will be Added

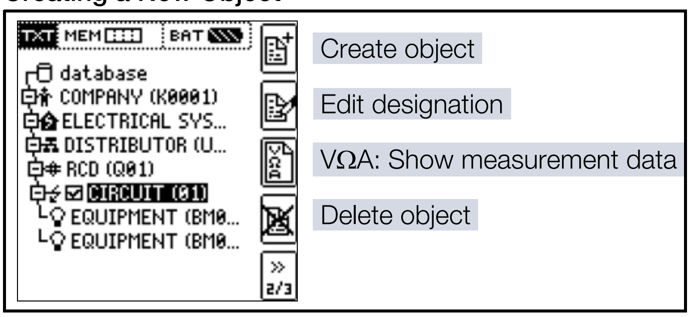


Use the ↓ keys in order to select the desired structure elements.

Change to the sublevel with the ↵ key.

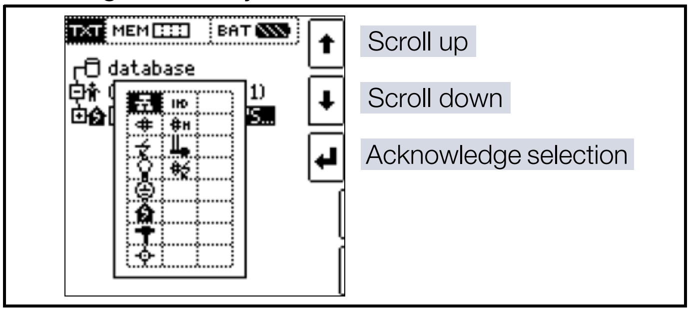
Go to the next page with the >> key

Creating a New Object



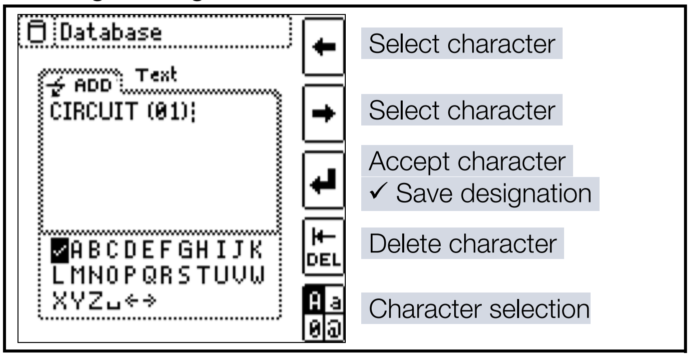
Press the  key in order to create a new object.

Selecting a New Object From a List



Select the desired object from the list with the ↓ keys and acknowledge with the ↵ key.

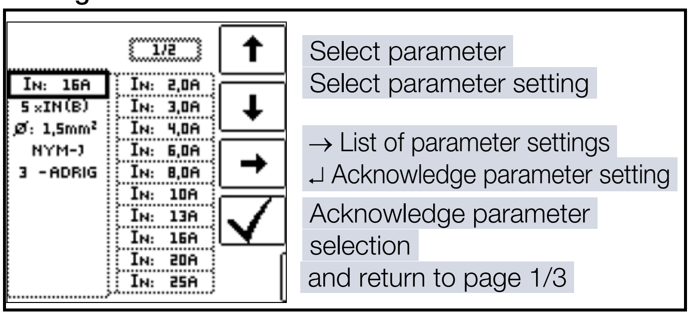
Entering a Designation



Enter a designation and then acknowledge it by entering a ✓.

> **Note**
> Acknowledge the default parameters shown below or the adjusted parameters, because the created designation will otherwise not be accepted and saved.

Setting Electrical Circuit Parameters



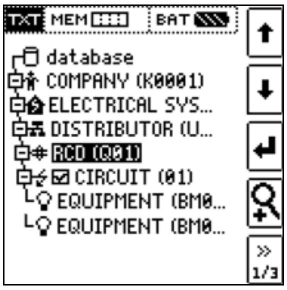
For example, nominal current values must be entered here for the selected electrical circuit. Measuring parameters which have been accepted and saved in this way are subsequently accepted by the current measuring menu automatically when the display is switched from the structure view to measurement.

> **Note**
> Electrical circuit parameters changed during structure creation are also retained for individual measurements (measurement without saving data).
>
> If you change the electrical circuit parameters specified by the structure in the measuring/test instrument, a warning is displayed when the change is saved.

9.3 SEARCHING FOR STRUCTURE ELEMENTS

The database can be searched for objects.

Regardless of the currently selected object, the search is started at **database**.



Scroll up

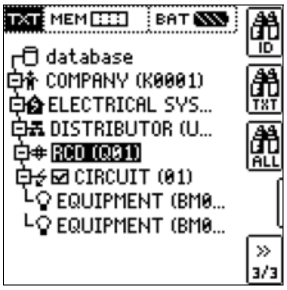
Scroll down

Acknowledge selection / change level

Display object or ID number

Menu selection → page 3/3

Go to page 3/3 in the database menu.

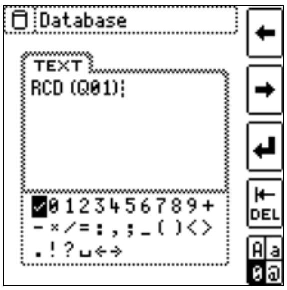


Search for ID number

Search for text

Search for ID number or text

After selecting text search ...



Select character

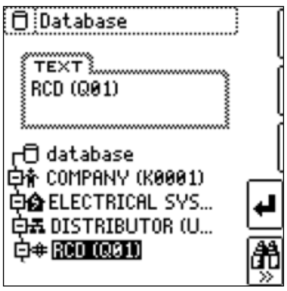
Select character

Accept character
✓ Save designation

Delete character

Character selection

... and entering the desired text (only full matches are found – no wild cards, case sensitive) ...



Continue searching

... the first match is displayed.

Further matches can be found by selecting the icon shown here at the right.

End search

If no further matches are found, the message shown above is displayed.

10 GENERAL NOTES CONCERNING MEASUREMENTS

DANGER

Non-functional measuring/test instrument / LED display:

- **All switch positions except for OFF, quick charge, HV or T %r.h: HV TEST LED doesn't light up**
- **HV switch setting: HV TEST LED doesn't light up**

Life endangering.

Damage to the measuring/test instrument and/or surrounding areas.

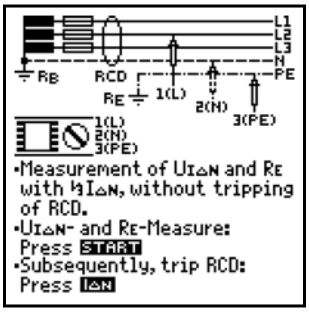
1. Do not perform any more measurements.
2. Remove the measuring/test instrument from service and secure it against inadvertent restart.
3. Contact our service department ⇨150.

10.1 HELP FUNCTION

The following information can be displayed for each switch position and basic function after it has been selected with the rotary selector switch:

- Wiring diagram
- Measuring range
- Nominal range of use and measuring uncertainty
- Nominal value

1. Press the **HELP** key in order to query online help.
2. If several pages of help are available for the respective measuring function, the **HELP** key must be pressed repeatedly.
3. Press the **ESC** key in order to exit online help.



10.2 AUTOMATIC SETTINGS, MONITORING AND SHUTDOWN

Automatic Settings

The measuring/test instrument automatically selects all operating conditions which it's capable of determining itself. It tests line voltage and frequency. If these lie within their valid nominal ranges, they appear at the display panel. If they're not within nominal ranges, prevailing voltage (U) and frequency (f) are displayed instead of U_N and f_N.

Monitoring Touch Voltage

Touch voltage which is induced by test current is monitored for each measuring sequence. If touch voltage exceeds the selected limit value, measurement is immediately interrupted. The **UL/RL** LED lights up red.

Shutdown

If battery voltage falls below the permissible limit value, the measuring/test instrument cannot be switched on or it's immediately switched off.

The measurement is interrupted automatically, or the measuring sequence is blocked (except for voltage measuring ranges and phase sequence testing) in the event of:

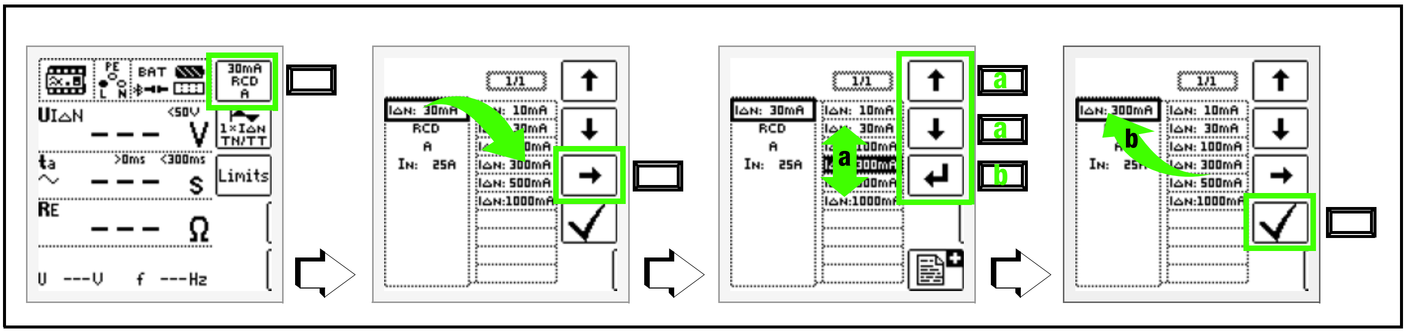
- Impermissible line voltages (< 60 V, > 253 V / > 330 V / > 440 V or > 725 V) for measurements which require line voltage
- Interference voltage during insulation resistance or low resistance measurements
- Interference voltage during a high-voltage measurement (PROFITEST PRIME AC only)
- Overheating at the measuring/test instrument – as a rule, excessive temperatures only occur after approximately 50 measurement sequences at intervals of 5 seconds, when the rotary selector switch is set to the **ZLOOP** position.
  If an attempt is made to start a measuring sequence, an appropriate message appears at the display panel.

The measuring/test instrument only switches itself off automatically after completion of an automatic measuring sequence, and after the predetermined on-time has expired (see ⇨52). On-time is reset to its original value as defined in the setup menu, as soon as any key or the rotary selector switch is activated.

The measuring/test instrument remains on for approximately 75 s in addition to the preset on-time for measurements with rising residual current in systems with selective RCDs.

The measuring/test instrument always shuts itself off automatically.

10.3 SETTING PARAMETERS OR LIMIT VALUES (USING RCD MEASUREMENT AS AN EXAMPLE)



1. Access the submenu for setting the desired parameter.
2. Select a parameter using the or ↓ scroll key.
3. Switch to the setting menu for the selected parameter with the → scroll key.
4. Select a setting value using the or ↓ scroll key.
5. Acknowledge the setting value with the ↵ key. This value is transferred to the settings menu.
6. The setting value is not permanently accepted for the respective measurement until ✓ is pressed, after which the display is returned to the main menu. You can return to the main menu by pressing **ESC** instead of ✓, without accepting the newly selected value.

Parameter Lock (plausibility check)

Individually selected parameter settings are checked for plausibility before transfer to the measurement window.

If you select a parameter setting which doesn't make sense in combination with other parameter settings which have already been entered, it's not accepted. The previously selected parameter setting remains unchanged.

Remedy: select another parameter setting.

10.4 FREELY SELECTABLE PARAMETER SETTINGS OR LIMIT VALUES

ATTENTION

Incorrect Parameters

Damage to the device under test.

Incorrect measurement/test results.

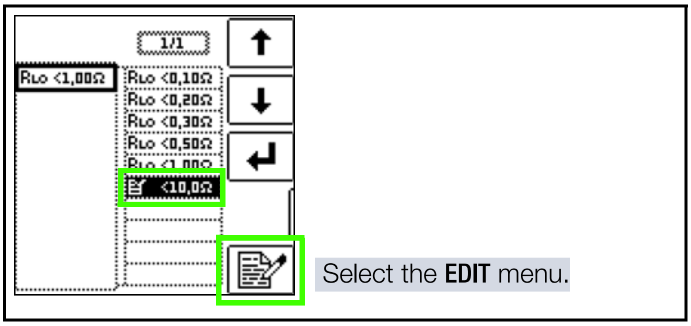
- Observe the specified limits for the new setting value.
- Enter any places to the right of the decimal point as well.

10.4.1 CHANGING EXISTING PARAMETERS

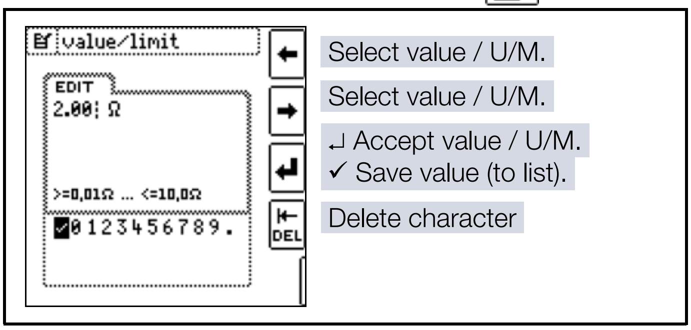
Individual parameters can be changed for certain measuring functions, i.e. adjusted within predetermined limits.

If at all, the **EDIT** menu doesn't appear until after switching to the right-hand column and selecting the editable parameter.

Example for R_{LO} Measuring Function – Parameter: LIMIT R_{LO}



1. Open the submenu for setting the desired parameter (no figure, see chap. 10.3).
2. Select the editable parameter – identified with the icon – with the or ↓ scroll key.
3. Select the edit menu by pressing the key.



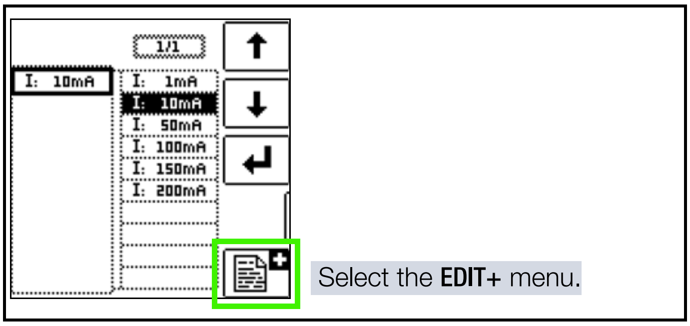
4. Select the respective values with the left or right cursor key. The value is accepted by pressing the ↵ key. The value is acknowledged by selecting ✓ and then pressing the ↵ key.

10.4.2 ADDING NEW PARAMETERS

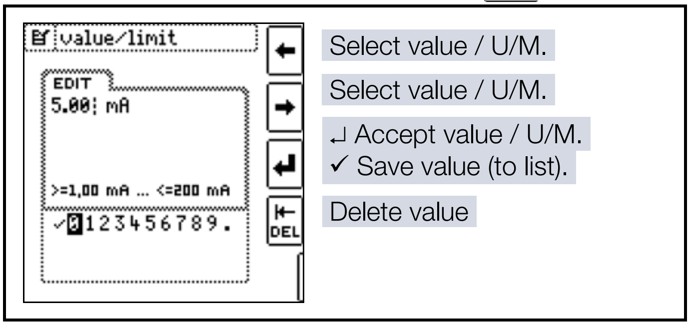
For certain measuring/test functions, additional values within predefined limits can be added in addition to the fixed values.

If at all, the **EDIT** menu doesn't appear until after switching to the right-hand column.

Example for HV-AC Measuring Function – Parameter: LIMIT I_{LIM}



1. Open the submenu for setting the desired parameter (no figure, see chap. 10.3).
2. Select the edit menu by pressing the key.



3. Select the respective values with the left or right cursor key. The value is accepted by pressing the ↵ key. The value is acknowledged by selecting ✓ and then pressing the ↵ key. The new parameter is added to the list.

10.5 2-POLE MEASUREMENT WITH FAST OR SEMIAUTOMATIC POLARITY REVERSAL

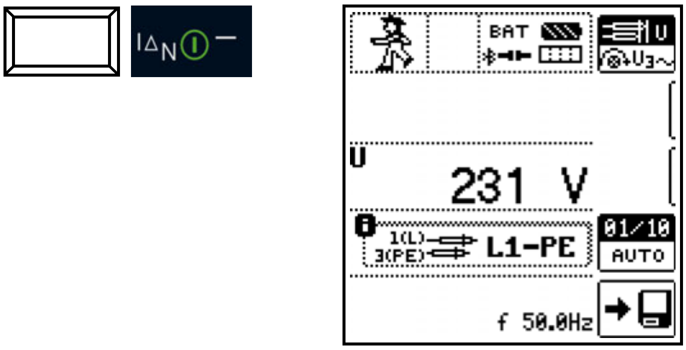
Fast, semiautomatic polarity reversal is possible for the following measurements/tests:

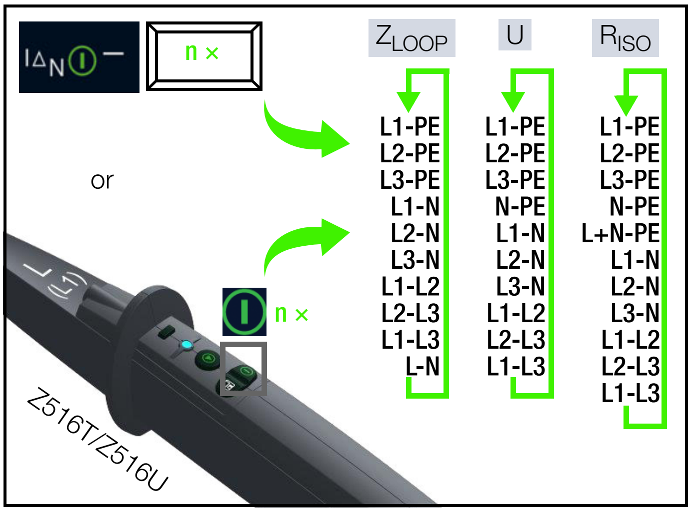
- Loop impedance measurement Z_{LOOP}
- Voltage measurement **U**
  No device-internal polarity reversal takes place – the display is only for the purpose of documentation.
- Insulation resistance R_{INS}
- **HV AC** dielectric strength test (PROFITEST PRIME AC only)

Quick Polarity Reversal

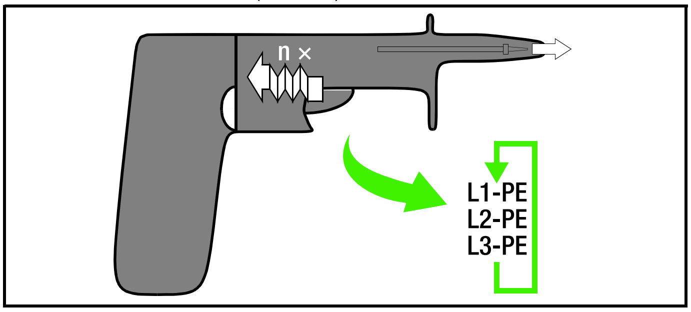
The polarity parameter is set to **AUTO**.

Fast and convenient switching amongst all polarity variants without switching to the parameter settings submenu is possible by pressing the **IΔN** key at the instrument or on the optional I-SK4/12-PROFITEST PRIME probe (Z516T/Z516U).





HV AC measurement (Z506V):



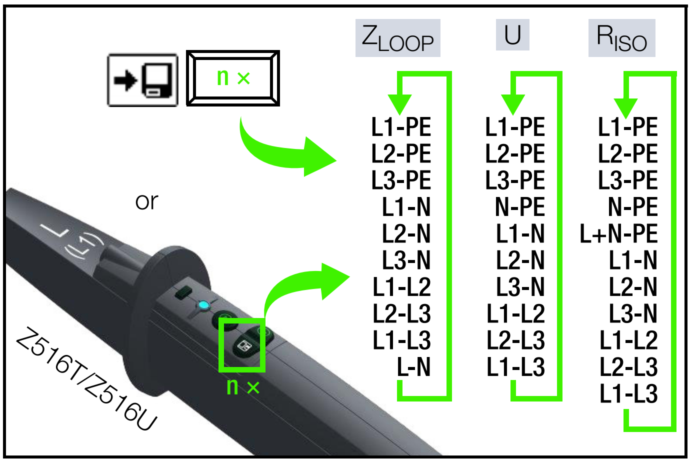
Semiautomatic Polarity Reversal in Memory Mode

The polarity parameter is set to **AUTO**.

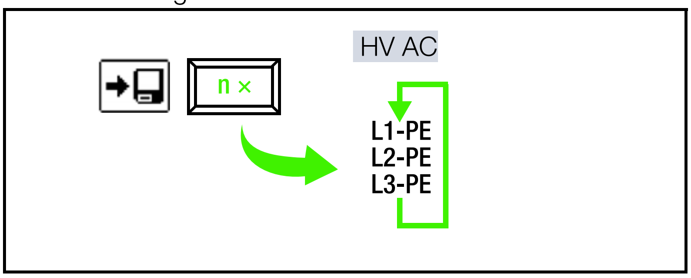
If testing is to be conducted with all polarity variants, automatic polarity changing takes place after each measurement after saving.

Polarity variants can be skipped by pressing the **IΔN** key at the measuring/test instrument or on the optional I-SK4/12 probe.

Loop impedance measurement / voltage measurement / insulation resistance measurement:



Dielectric strength test:



10.6 MEASURED VALUE DISPLAY

The following items appear at the display panel:

- Measured values with abbreviations and units of measure
- Selected function
- Nominal voltage
- Nominal frequency
- Error messages

Measured values for automatic measuring procedures are displayed as digital values until the next measurement sequence is started, or until automatic shutdown of the measuring/test instrument occurs.

If the upper range limit is exceeded, the upper limit value is displayed and is preceded by the “>” symbol (greater than), which indicates measured value overrun.

Note

Reversal of N and PE in a system without RCCBs cannot be detected and is not indicated by the instrument.

If an RCCB is present within the system, it’s tripped during the “touch voltage without tripping” measurement (automatic Z_{LOOP} measurement), if N and PE are reversed.

10.7 SAVING MEASUREMENTS/TESTS

Measurement/test results are stored to the measuring/test instrument as a standard procedure ➪ "Standard Storage Procedure at the Measuring/Test Instrument" 🗎61.

IZYTRONIQ software (➪ "Scope of Delivery" 🗎12) is used for subsequent data backup, evaluation and report generation:

- Data transfer to IZYTRONIQ ➪🗎135
- Use (evaluation, report generation, etc.) ➪🗏 IZYTRONIQ online help

Alternatively, measurement/test results can be transferred directly to IZYTRONIQ software ➪ "Alternative: send measurement data to PC (IZYTRONIQ – push-print)" 🗎63.

10.7.1 STANDARD STORAGE PROCEDURE AT THE MEASURING/TEST INSTRUMENT

Basic Storage Procedure

Measurements/tests can be performed and stored to memory for each structure element. Proceed as follows, adhering to the prescribed sequence:

1. Start and execute the measurement/test. Refer to the corresponding sections in this document.
   ↳ Upon completion of measurement, the **Save Value** key is displayed.

2. Briefly press the **Save Value** key.
   ↳ The display is switched to the memory menu or the structure view.
3. Navigate to the desired memory location, i.e. to the desired structure element / object, for which the measurement data will be saved.

4. If you would like to save a comment along with the measurement, press the key shown at the right and enter a designation via the **EDIT** menu.
5. Complete data storage by pressing the **Save** key.

↳ The measurement is saved to memory.

Rapid Saving

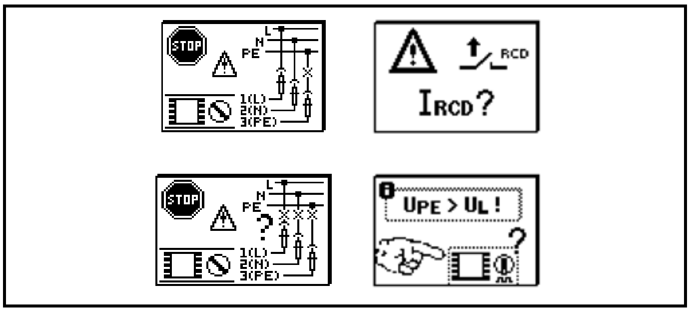
The measured value can be saved to the last selected object in the structure diagram by pressing and holding the **Save Value** key, without switching the display to the memory menu.

> **Note**
>
> If you change the parameters in the measurement view, they're not saved for the structure element. A measurement with changed parameters can nevertheless be saved to the structure element, and any changed parameters are documented in the report for each measurement.

Saving Error Messages (pop-ups)

If a measurement is ended without acquiring a measured value due to an error, the measurement can be saved along with the pop-up by pressing the **Save Value** key.

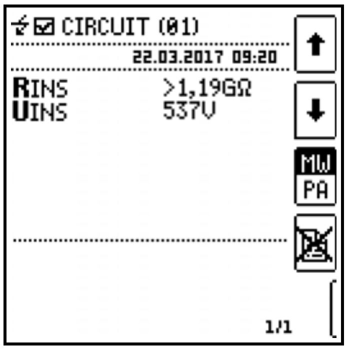
The corresponding text is read out to the report generating software instead of the pop-up symbol. This only applies to a limited number of pop-ups (see below). Neither a symbol nor a text can be accessed in the measuring/test instrument's database itself.



Viewing, and if Desired Deleting, Stored Measured Values

1. Switch to the distributor structure by pressing the **MEM** key.
2. Navigate to the desired electric circuit using the scroll keys.
3. Switch to page 2 by pressing the key shown at the right:
4. Display the measurement data by pressing the key shown at the right:

↳ One measurement with date and time, as well as any comment you might have entered, is displayed in each screen.
Example:
insulation measurement



> **Note**
>
> A check mark in the header means that the respective measurement has been passed.
>
> An X means that the measurement has not been passed.
>
> See chapter "Distributor Structure Symbology / Tree Structure" ➩56.

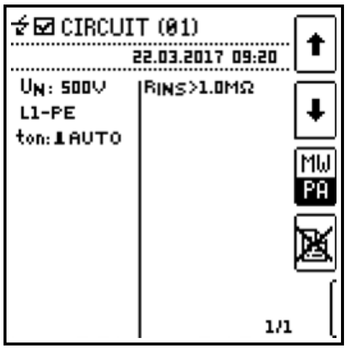
Scrolling amongst measurements is possible with the keys shown here:

The measurement can be deleted with the key shown here:

A prompt window asks you to confirm deletion.

With the help of the key shown at the right (MV: measured value / PA: parameter), the setting parameters can be displayed for this measurement.

Scrolling amongst measurements is possible with the keys shown here:



10.7.2 ALTERNATIVE: SEND MEASUREMENT DATA TO PC (IZYTRONIQ – PUSH-PRINT)

You can send the test results directly to a PC on which IZYTRONIQ software is running.

This function is known as “push-print” and can be implemented via Bluetooth® or USB.

Pairing the Measuring/Test Instrument to a PC/IZYTRONIQ via Bluetooth®

The procedure for pairing the measuring/test instrument to the PC depends on the PC's operating system. Refer to the product documentation for the operating system for details.

✓ The Bluetooth® function is activated at the measuring/test instrument ➪🗎53.
✓ Bluetooth® visibility is activated at the measuring/test instrument ➪🗎53.
✓ You know the measuring/test instrument’s Bluetooth® PIN ➪🗎53.

1. Activate the Bluetooth® pairing mode at the PC.
   ↳ The PC is ready for pairing.
2. Start and follow the Bluetooth® pairing procedure at your PC. The measuring/test instrument’s PIN must be entered to this end.

↳ PC and measuring/test instrument are paired.
The measuring/test instrument appears at the PC in the list of paired devices.
The PC appears in the measuring/test instrument’s list of trusted devices.

Connecting the Measuring/Test Instrument to a PC/IZYTRONIQ via USB

✓ IZYTRONIQ software is installed on the PC.
✓ The USB interface cable (included in the scope of delivery) is at hand.

1. Connect the measuring/test instrument and the PC via the USB cable.
2. Start IZYTRONIQ.

↳ Driver installation takes place automatically in the background.
The measuring/test instrument is connected to the PC/IZYTRONIQ and is ready for use.

Sending Results to the PC/IZYTRONIQ with Push-Print

Complete information regarding push-print and a description of the application can be found in IZYTRONIQ online help.

11 U – MEASURING VOLTAGE AND FREQUENCY

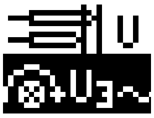
11.1 GENERAL

Select Measuring Function

The **U** measuring function provides the opportunity of measuring direct voltage, as well as alternating voltage and its associated frequency.

It's subdivided into two views:

- **U**: 2-pole measurement of voltage and frequency ➩64
- **U3~**: Measurement of voltage and frequency in 3-phase systems including phase sequence testing ➩65



Selection is made by pressing one of the softkeys shown at the right. The momentary selection is displayed inversely (white on black).

Direct and alternating voltage can be measured in a single-phase system in the "2-pole" view.

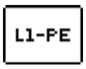
Parameter

Conductor relationship:

This parameter serves the purpose of documentation. No device-internal polarity reversal takes place.

The specification of conductor relationship points makes it possible to allocate measured values and measuring points to each other. Selection can be made between:

- **Manual**: The measured value is saved for the selected measuring point only.



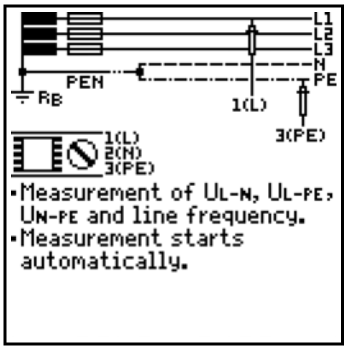
- **AUTO**: The user can scroll through all available measuring points by pressing the **IΔN** key. Measured values are saved for the momentary setting.

11.2 U MEASUREMENT

Connection

Probe 1(L)

Probe 3(PE)



Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.

Measurement is continuously active, i.e. measurement takes place directly without pressing the **ON/START** key.

Corresponding report generation is possible after measurement has been completed by pressing the save key (softkey).

Voltage Polarity

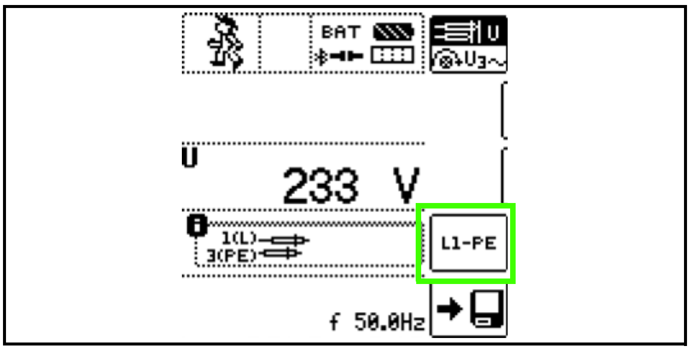
If the installation of single-pole switches to the neutral conductor is prohibited by the standards, voltage polarity must be tested in order to assure that all existing single-pole switches are installed to the phase conductors.

DANGER

Dangerous Voltage!

Risk of electric shock.

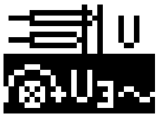
Observe the measuring category: without safety caps on the probes, measurements may only be performed in CAT II.



11.3 U3~ MEASUREMENT

General

If “U3~” is selected via softkey, voltage, frequency and phase sequence can be measured in 3-phase systems.

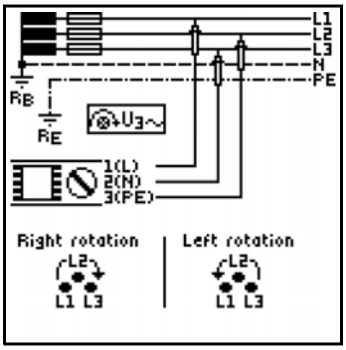


Connection

L1: Probe 1(L)

L3: Probe 2(N)

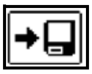
L2: Probe 3(PE)



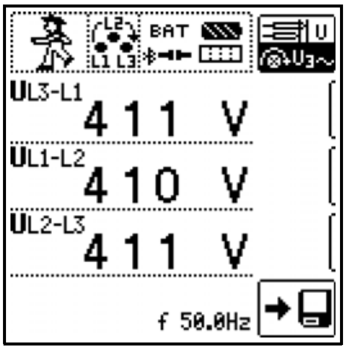
Measurement

Measurement is continuously active, i.e. measurement takes place directly without pressing the **ON/START** key.

Corresponding report generation is possible after measurement has been completed by pressing the



save key (softkey).



Direction of rotation is indicated by means of the following displays:

Clockwise rotation

Counterclockwise rotation

Notes:

- As a rule, clockwise rotation is required at 3-phase electrical outlets.
- Various adapters are available as accessories for measurements at CEE outlets. See data sheet.

Connection for 3-wire measurement, plug L1-L2-L3 in clockwise direction beginning at PE socket

Tip

Indications for mains connection test ➪ "Signaling via LEDs" 🗎19

12 R_{LO} – MEASURING LOW-VALUE RESISTANCE

12.1 R_{LO} 0.2 A – MEASURING LOW-VALUE RESISTANCE WITH 0.2 A TEST CURRENT

12.1.1 GENERAL

Select Measuring Function

General

In accordance with IEC 60364-6/DIN VDE 0100-600, the continuity of protective conductors (including the equipotential bonding conductor via the main grounding busbar and the additional equipotential bonding conductor) and active conductors in final ring circuits must be tested.

Measuring Method

Continuity of conductors is ascertained by means of a constant test current and voltage drop at the device under test.

Note

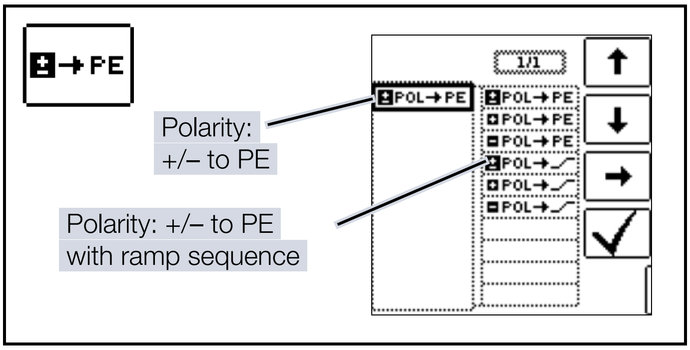
If direct voltage is used as the test voltage, DIN EN 61557-4 specifies performance of the measurement with polarity reversal.

And thus measurement must be performed with (automatic) polarity reversal of the measuring voltage or with the flow of current first in one direction (+ pole to PE) and then in the other (– pole to PE).

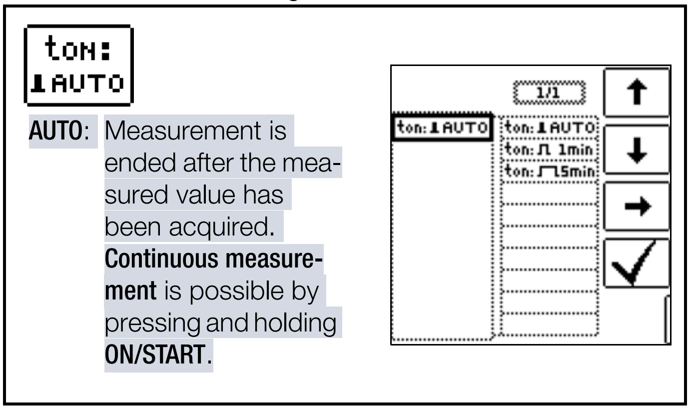
Parameter

The test signal can be selected according to the following criteria:

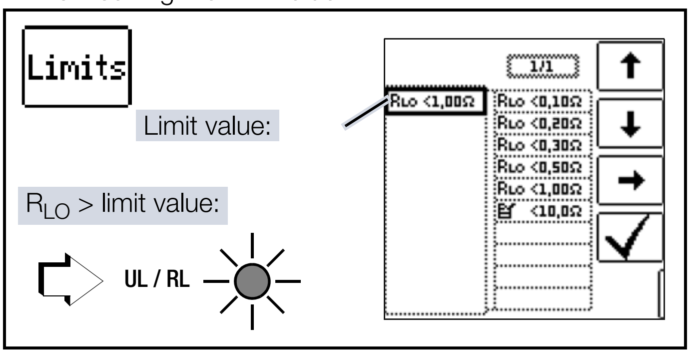
- Function: constant or ramp
- Polarity: positive +, negative –, automatic polarity reversal ±



Test duration – measuring times:



Limits – setting the limit value:



The limit value for resistance can be set as desired. If measured values occur which are above this limit value, the red **UL/RL** LED lights up. Limit values can be selected within a range of 0.10 Ω to 10.0 Ω (editable). The limit value is displayed above the measured value.

12.1.2 R_{OFFSET} MEASUREMENT

DANGER

Dangerous Voltage!

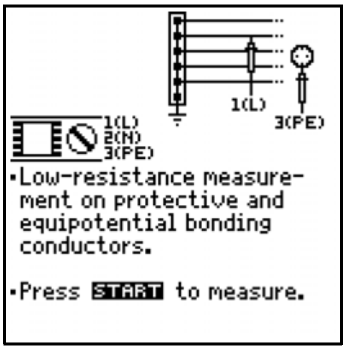
Risk of electric shock.

- The low-resistance measurement may only be conducted at voltage free devices under test or system components.
- Contact the measuring point first and then start the measurement.

Connection

Probe 1(L)

Probe 3(PE)



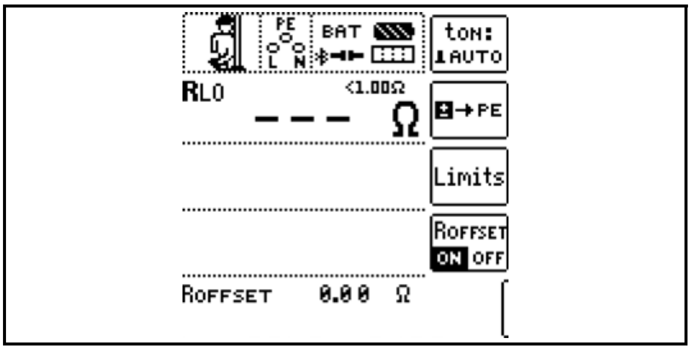
ROFFSET: ON ↔ OFF

Compensation for Extension Cables with up to 10 Ω

The **R_{OFFSET}** function provides the user with the opportunity of deducting the resistance of extension cords in advance which are used in addition to the probe cables, in order to avoid distorted measurements.

This value is deducted from the measurement result.

Measuring R_{OFFSET}

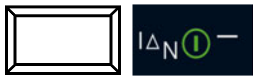


✓ You have set the parameters for the measurement at the measuring/test instrument.

1. Activate the **R_{OFFSET}** function by pressing the corresponding softkey.
2. **R_{OFFSE}T = 0.00 Ohm** is displayed.
3. Select the test signal with which you intend to conduct the measurement.
4. Then short circuit the measurement cables.
5. Start measurement by pressing the **IΔN** key.

↳ An intermittent acoustic signal is generated and the message shown at the right is displayed.

6. The measuring procedure is started by once again pressing the **IΔN** key.



The procedure can be aborted by pressing **ON/START** or **ESC**.

Note

If offset measurement is stopped upon appearance of a pop-up error window indicating R_{OFFSET}> 10 Ω or a difference between R_{LO+} and R_{LO-} of greater than 10%, the last measured offset value is retained. Inadvertent deletion of a previously ascertained offset value is thus practically ruled out. The respectively smaller value is otherwise stored to memory as an offset value. The maximum offset value is 10.0 Ω

Negative resistances may result due to the offset value.

The following points must be observed:

- The acquired R_{OFFSET} value is deleted when the test signal is changed or if the function is deactivated.
- If an error message appears, the last acquired, valid value is retained.
- As a result of the utilized 4-wire technology, resistance of the probe cables does not have to be calculated into the measurement results.

Note

Extension Cords

Only use this function when working with extension cords.

When different extension cords are used, the above described procedure must always be repeated.

12.1.3 R_{LO} 0.2 A MEASUREMENT

DANGER

Dangerous Voltage!

Risk of electric shock.

- The low-resistance measurement may only be conducted at voltage free devices under test or system components.
- Contact the measuring point first and then start the measurement.

ATTENTION

Type and source of danger!

Measuring/test instrument's fuse blows or measurement is disabled.

Always contact with the DUT with the test probes before pressing the **ON/START** key.

Note

Measurement results may be distorted due to parallel connected impedances and equalizing current.

Note

Measuring Low-Value Resistance

Measurement cable and 2-pole measuring adapter resistance is compensated automatically thanks to the 4-wire method and thus doesn't effect measurement results. However, if an extension cord is used its resistance must be measured and deducted from the measurement results.

Resistances which do not demonstrate a stable value until after a "settling in period" should not be measured with automatic polarity reversal, but rather one after the other with positive and negative polarity.

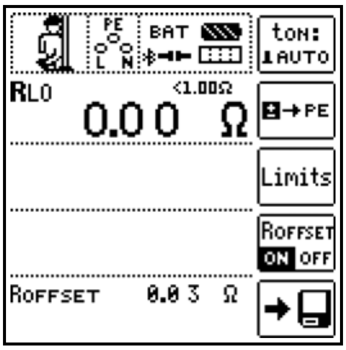
Examples of resistances whose values may change during measurement include:

- Lamp resistance with changing values caused by warming due to measuring current
- Resistances with a large inductive component
- Contact resistance
- Line reactors

Start Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.

Press and hold for long-term measurement



Save: possible via softkey after successful measurement.

Automatic Polarity Reversal

After the measuring sequence has been started, the measuring/test instrument performs the measurement with automatic polarity reversal, first with current flow in one direction, and then in the other. In the case of long-term measurement (press and hold the **ON/START** key), polarity is switched once per second.

If the difference between R_{LO+} and R_{LO-} is greater than 10% with automatic polarity reversal, R_{LO+} and R_{LO-} values are displayed instead of R_{LO}. The respectively larger value, R_{LO+} or R_{LO-}, appears at the top and is saved to the database as the R_{LO} value.

The measured values are displayed after test time has elapsed in accordance with the following table:

Polarity Selection	Display	Condition
+ pole to PE	**RLO+**	None
– pole to PE	**RLO–**	None
± pole to PE	**RLO**	If $\Delta R_{LO} \leq 10\%$
	RLO+ **RLO–**	If $\Delta R_{LO} > 10\%$

All four values are always saved: R_{LO}, $R_{LO}+$, $R_{LO}-$ and R_{OFFSET}.

Evaluating Measurement Results

Differing results for measurements in both directions indicate voltage at the DUT (e.g. thermovoltages or unit voltages).

Measurement results can be distorted by parallel connected impedances in load current circuits and by equalizing current, especially in systems which make use of "overcurrent protection devices" (previous neutralization) without an isolated protective conductor. Resistances which change during measurement (e.g. inductance), or a defective contact, can also cause distorted measurements (double display).

In order to assure unambiguous measurement results, causes of error must be located and eliminated.

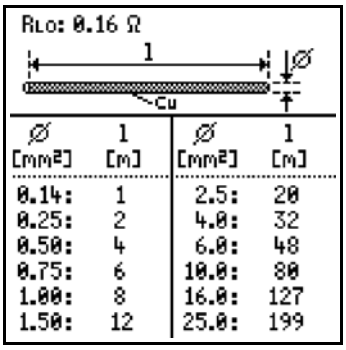
In order to find the cause of the measuring error, measure resistance in both current flow directions.

The measuring/test instrument's batteries are exposed to excessive stress during insulation resistance measurement. For measurement with current flow in one direction, only press and hold the **ON/START** key as long as necessary for the measurement.

Calculation of Cable Lengths for Common Copper Conductors

If the **HELP** key is activated after performance of resistance measurement, the cable lengths corresponding to common conductor cross sections are displayed.

If results vary for the two different current flow directions, cable length is not displayed. In this case, capacitive or inductive components are apparently present which would distort the calculation.



Ø [mm²]	l [m]	Ø [mm²]	l [m]
0.14:	1	2.5:	20
0.25:	2	4.0:	32
0.50:	4	6.0:	48
0.75:	6	10.0:	80
1.00:	8	16.0:	127
1.50:	12	25.0:	199

This table only applies to cables made with commercially available copper conductors and cannot be used for other materials (e.g. aluminum).

12.1.4 EVALUATING MEASURED VALUES

See tables in chap. 33.1.

12.1.5 R_{LO} 0.2A MEASUREMENT AT PRCDS

DANGER

Dangerous Voltage!

Risk of electric shock.

- The low-resistance measurement may only be conducted at voltage free devices under test or system components. Use the PROFITEST PRCD adapter (M512R) for testing PRCDs after carefully reading the operating instructions.

Applications

Protective conductor current is monitored for certain types of PRCDs. Direct activation or deactivation of the test current required for protective conductor resistance measurements of at least 200 mA results in tripping of the PRCD and thus to interruption of the protective conductor connection. Protective conductor measurement is no longer possible in this case.

A special ramp sequence for test current activation and deactivation in combination with the PROFITEST PRCD test adapter permits protective conductor resistance measurement without tripping the PRCD.

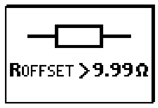
Measuring Sequence

1. Connection: Refer to the operating instructions for the PROFITEST PRCD adapter.
2. Parameters: Select the ramp sequence and the limit value.
3. Activate the PRCD.
4. R_{OFFSET} measurement: See Kapitel 12.1.2.
5. R_{LO} 0.2A measurement: Press the **ON/START** key (see also chapter "RLO 0.2 A Measurement" ➪68).
6. Save: possible via softkey after successful measurement.

Note

Measurement Abortion

Poor contacting with the test probes results in fluctuating test current and causes abortion of the measurement and display of the pop-up message shown at the right.



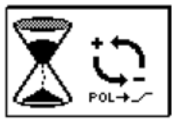
Ramp Function Time Sequence

Due to the physical characteristics of the PRCD, measuring times for this ramp function amount to several seconds.

If test current polarity is reversed, additional waiting time is also required during polarity reversal.

This is programmed into the test sequence in the **automatic polarity reversal** POL operating mode.

Reverse polarity manually, e.g. from **+pole with ramp** POL to **–pole with ramp** POL. The test instrument then detects the reversal of current flow direction, stops measurement for the required waiting time and simultaneously displays a corresponding message (see figure at right).



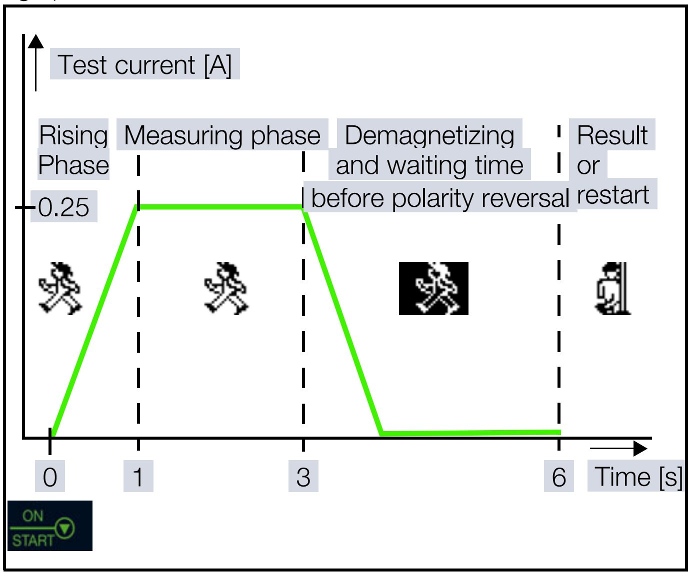


Fig. 5: Representation of Measuring and Waiting Times for Protective Conductor Resistance Measurement at PRCDs

PRCD Tripping due to Poor Contacting

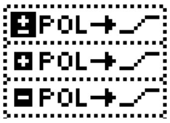
Good contact must be assured between the test probes and the device under test or the sockets at the PROFITEST PRCD test adapter during the measurement. Interruptions can result in considerable test current fluctuation which causes the PRCD to trip under unfavorable conditions.

If this is the case, tripping of the PRCD is automatically detected by the measuring/ test instrument and indicated by a corresponding error message (see figure at the right). In this case as well, the measuring/ test instrument automatically takes subsequently required waiting time into account before you can reactivate the PRCD and start the measurement over again.

Connection

Read the operating instructions included with the PROFITEST PRCD adapter. It includes connection instructions for offset measurement and for protective conductor resistance measurement.

Selecting the Polarity Parameter



Select the desired polarity parameter with ramp.

Measuring R_{OFFSET}

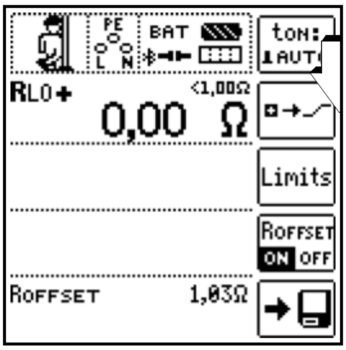
Perform offset measurement as described in chapter "ROFFSET Measurement" ➪🗎67, in order to assure that the test adapter's connector contacts are not included in the measurement results.

Measuring Protective Conductor Resistance

1. Determine whether or not the PRCD is activated. If not, activate it.
2. Perform protective conductor measurement as described in chapter "RLO 0.2 A Measurement" ➪🗎68 above.
   Start the test sequence by briefly pressing the **ON/START** key. The predetermined duration of the measuring phase can be extended by pressing and holding the **ON/START** key.

Start Measurement

✓ You have set the parameters for the measurement at the measuring/ test instrument.



The symbol shown at the right appears during the magnetization phase (rising curve) and the subsequent measuring phase (constant current).

If measurement is aborted already during the rising phase, no measurement results can be ascertained or displayed.

After measurement, the demagnetization phase (falling curve) and subsequent waiting time are indicated by the inverted symbol shown at the right. No new measurements can be started during this time.

Measurement results cannot be read and measurement with the same or another polarity cannot be started until the symbol at the right appears.

12.2 R_{LO} 25 A – MEASURING LOW-VALUE RESISTANCE WITH 25 A TEST CURRENT

12.2.1 GENERAL

Select Measuring Function

Measuring Method

Continuity of protective conductor systems is determined by feeding a test current with line frequency and measuring the resultant voltage drop.

Testing must be conducted between the PE terminal and various points within the protective conductor system.

Due to the high amperage of the utilized test current, this type of measurement is above all suitable for precise continuity testing of especially low-resistance protective conductor systems, i.e. in the case of large cross-sections and/or short cable lengths.

This type of measurement necessitates mains auxiliary power and the mains switch must be set to the **ON** position.

Mains auxiliary power is checked for correctness before measurement is started. Permissible line voltages are 115 and 230 V, and permissible line frequencies are 50 and 60 Hz.

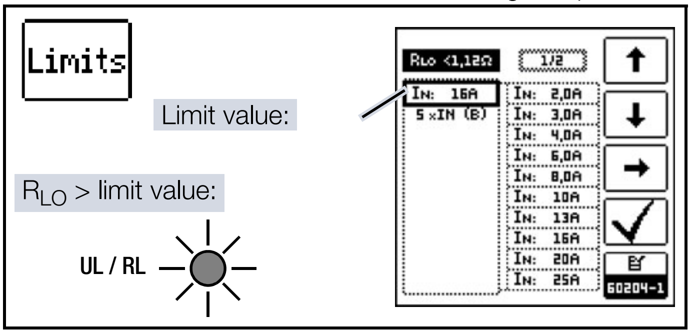
The measurement is aborted if voltage is present at the test probes when measurement is started[1). A corresponding error message appears at the display.

Parameter

The limit value for low-value resistance of the protective conductor to be measured is configured at this point.

The limit value can either be set as desired within a range of 0 Ω to 9.99 Ω or calculated automatically according to the selected overcurrent protection device. Automatic calculation is based on the selected nominal current and the characteristics of the utilized overcurrent protection device.

If the limit value is exceeded, the **UL/RL LED** lights up red.



Determining the Limit Value

The limit value setting for protective conductor resistance is based on the cross-section of phase conductor L and, if applicable, neutral conductor N, and not the cross-section of protective conductor PE. This is necessary because cables with phase conductor cross-sections of greater than 16 square mm are equipped with protective conductors of reduced cross-section, and selection on the basis of protective conductor cross-section would not be unequivocal.

A rated current (nominal current) is assigned to the phase conductor cross-section for the respectively utilized overcurrent protection device:

Limit value for PE test based on conductor cross-section and nominal current of the protective device.

Ø L[N]	Ø PE	I_N
1.5mm²	1.5mm²	16A
2.5mm²	2.5mm²	20A
4.0mm²	4.0mm²	25A
6.0mm²	6.0mm²	32A
10mm²	10mm²	50A
16mm²	16mm²	63A

13/5

Limit value for PE test based on conductor cross-section and nominal current of the protective device.

Ø L[N]	Ø PE	I_N
25mm²	16mm²	80A
35mm²	16mm²	100A
50mm²	25mm²	125A
70mm²	35mm²	160A
95mm²	50mm²	200A
120mm²	70mm²	250A

14/5

You can display this table by pressing the **HELP** key (⇨ "Help Function" 🗎58).

Due to the fact that overcurrent protection devices with different tripping characteristics are permissible for each external conductor cross-section in accordance with DIN EN 60204-1 (VDE 0113-1), various types are offered when selecting the limit value.

Proceed as follows in order to select the limit value:

1. Ascertain the phase conductor cross-section of your connector cable.
2. If applicable, check to see whether or not the nominal current of the utilized overcurrent protection device is allocated to the phase conductor cross-section. If an overcurrent protection device with low nominal current is used, you can determine the limit value on the basis of the phase conductor cross-section assigned to this nominal current.
3. Select the limit value according to nominal current and the tripping characteristics of the utilized overcurrent protection device.

If your machine/system includes components with different power cable cross-sections (e.g. fans, pumps etc.), and if these are equipped with their own overcurrent protection devices, the limit value for the protective conductor test must be selected in accordance with the power cable cross-section of these components, or with the overcurrent protection devices which have been installed for them.

Setting the Limit Value

1. Press the **LIMITS** softkey in order to access the menu for the limit value setting.
2. With the help of the corresponding softkeys, you can navigate within the menu, as well as select and confirm the parameters.

1) This warning might also appear if continuity of the protective conductor connection is impaired, because in this case external voltages have been capacitively induced.

3. You can switch back and forth between the menu for the freely adjustable range and the menu for the automatically calculated value by pressing the softkey.

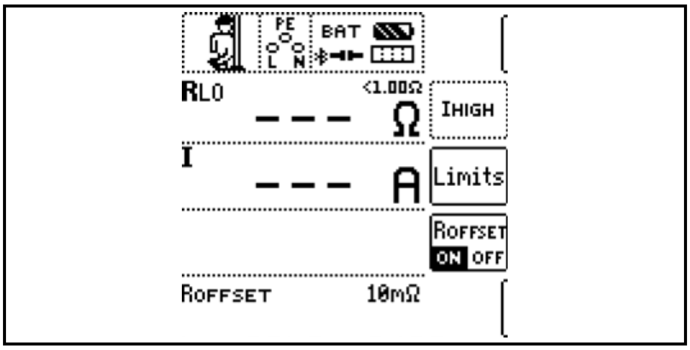
The **LIMITS** menu is exited automatically after pressing the key and its mode is changed. Press the **LIMITS** softkey once again in order to return to the toggled menu.

12.2.2 R_{OFFSET} MEASUREMENT

The R_{OFFSET} function provides the user with the opportunity of deducting the resistance of extension cords in advance which are used in addition to the probe cables, in order to avoid distorted measurements.

This value is deducted from the measurement result.

R_{OFFSET} Measurement



1. Activate the **R_{OFFSET}** function by pressing the corresponding softkey.

2. **R_{OFFSET} = 0.00 Ohm** is displayed.
3. Select the test signal with which you intend to conduct the measurement.
4. Then short circuit the measurement cables.
5. Start measurement by pressing the **IΔN** key.

6. An intermittent acoustic signal is generated and the message shown at the right is displayed.
7. The measuring procedure is started by once again pressing the **IΔN** key.

The procedure can be aborted by pressing **ON/START** or **ESC**.

Test Duration – Measuring Times

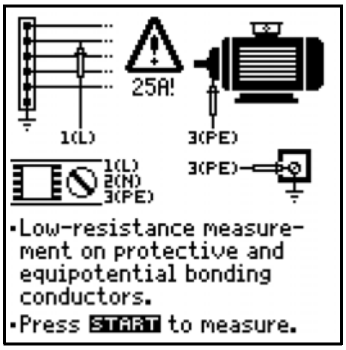
Test duration is limited to10 s. Use for intended purpose specifies at test duration of no more than10 seconds and a pause of at least 30 seconds. If this repetition rate is exceeded, the measuring/test instrument may overheat in which case measurement is disabled.

12.2.3 R_{LO} 25A MEASUREMENT

Connection

Probe 1(L)

Probe 3(PE)



DANGER

Dangerous Voltage!

Risk of electric shock.

Only perform measurements on voltage free system components.

Note

Measurement results may be distorted due to parallel connected impedances and equalizing current.

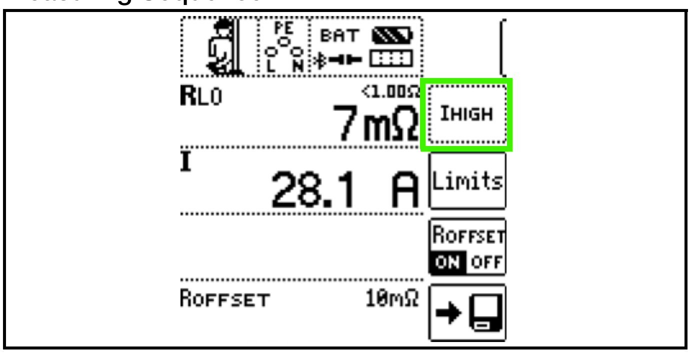
Note

Mains auxiliary power is required for this type of measurement. The mains switch must be turned on (position **1**).

Note

Be sure to fully extend the measurement cables before performing protective conductor testing. The measurement cables may not be rolled up.

Measuring Sequence



✓ You have set the parameters for the measurement at the measuring/test instrument.

1. Press the **ON/START** key.

↳ Test current is applied.

↳ End of measurement: as soon as the measured value is stable or after 10 seconds.

↳ The following measured values are displayed:

- **RLO**: resistance
- **I**: test current

2. **Save**: possible via softkey after successful measurement.
3. Determination of cable length: press the **HELP** key.

Calculation of Cable Lengths for Common Copper Conductors

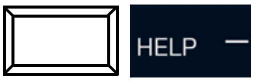
ATTENTION

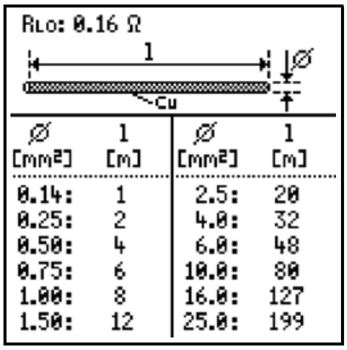
Insufficient Minimum Cross-Section!

Undesired temperature increases or damage.

The cross-section of the device under test must be observed when the R_{LO} 25A measurement is used. As opposed to machines in accordance with DIN EN 60204, system components are frequently laid out with a significantly smaller cross-section.

If the **HELP** key is activated after performance of resistance measurement, the cable lengths corresponding to common conductor cross sections are displayed.





Ø [mm²]	l [m]	Ø [mm²]	l [m]
0.14:	1	2.5:	20
0.25:	2	4.0:	32
0.50:	4	6.0:	48
0.75:	6	10.0:	80
1.00:	8	16.0:	127
1.50:	12	25.0:	199

If results vary for the two different current flow directions, cable length is not displayed. In this case, capacitive or inductive components are apparently present which would distort the calculation.

This table only applies to cables made with commercially available copper conductors and cannot be used for other materials (e.g. Aluminum).

12.2.4 EVALUATING MEASURED VALUES

See tables in chap. 33.1.

13 R_{ISO} – INSULATION RESISTANCE MEASUREMENT

13.1 INSULATION MEASUREMENT WITH CONSTANT TEST VOLTAGE

13.1.1 GENERAL

In order to avoid hazards or damage resulting from fault current and creepage current which can occur due to faulty cable insulation, IEC 60364-6/DIN VDE 0100-600 requires testing of insulation resistance between the active conductors and the protective conductor connected to earth.

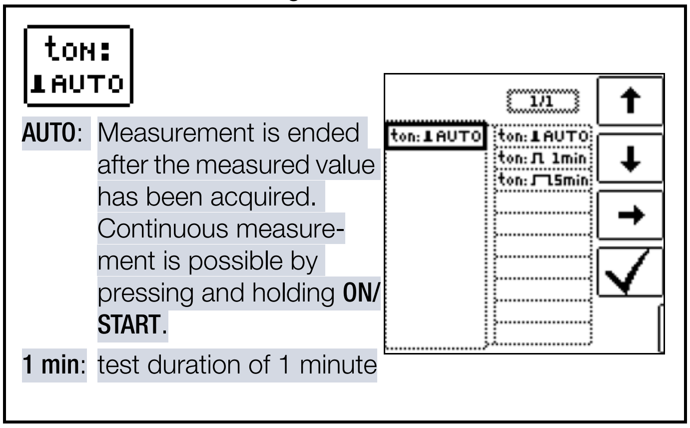
Select Measuring Function

Measuring Method

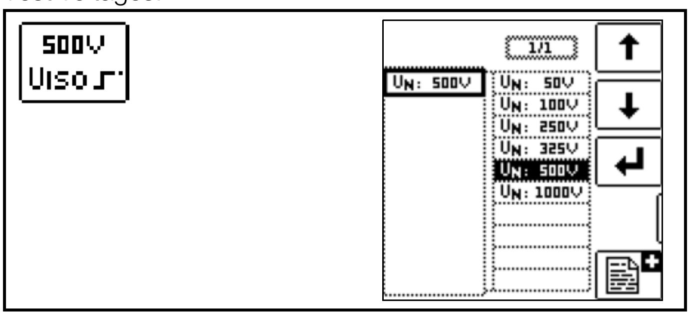
Insulation resistance measurement is performed by applying a constant direct voltage of 50 V to 1 kV. In accordance with DIN EN 61557-2, test current is at least 1 mA, and short-circuit current is limited to < 1.6 mA for safety reasons.

Parameter Settings

Test duration – measuring times:

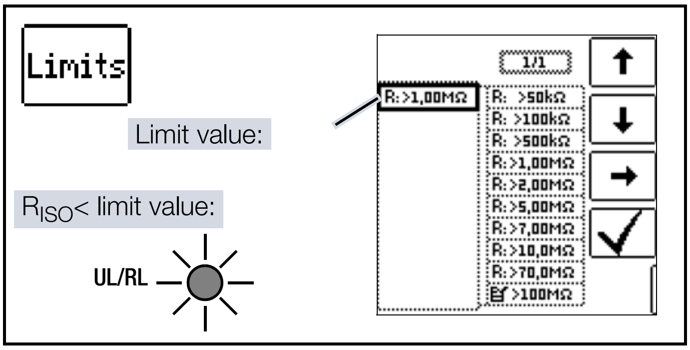


Test voltages:



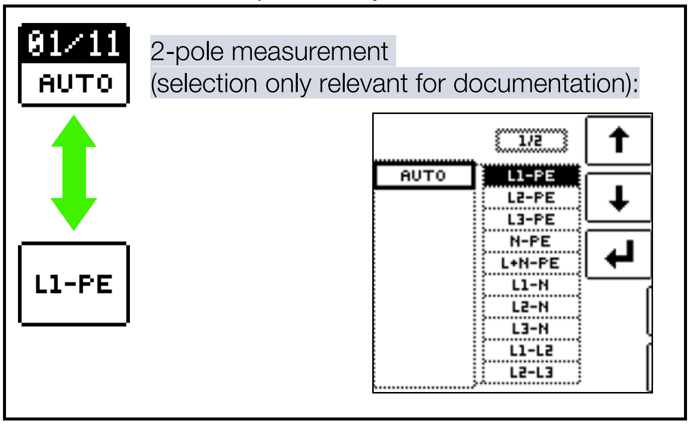
Various preset parameters are available for setting test voltage. The list can be extended with the help of the editing function. This function is made available as soon as the cursor is located in the parameter selection column (see also chap. 10.4). This list makes it possible to select a test voltage which deviates from nominal voltage, and is usually lower, for measurements at sensitive components, as well as systems with voltage limiting devices.

Limits – Limit Values for Insulation Resistance:



Setting a limit value for insulation resistance makes it possible to indicate that a minimum value has been fallen short of. If the measured value for R_{ISO} is below this limit, the **UL/RL** LED lights up red. Various fixed parameters or an editable value can be selected.
The limit value is displayed above the measured value.

Conductor Relationship – Polarity:



The specification of conductor relationship points makes it possible to allocate measured values and measuring points to each other. Corresponding report generation is possible after measurement has been completed by pressing the save key (softkey).

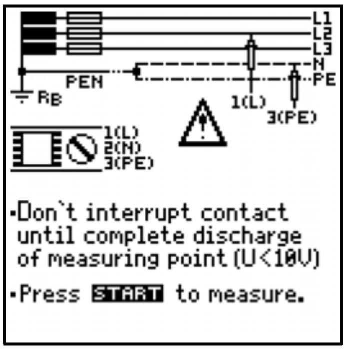
Selection can be made between manual setting and the **AUTO** function. With the help of the **AUTO** function, the user can switch through the various conductor relationships, one after the other, by pressing the **IΔN** key (see also chapter "2-Pole Measurement with Fast or Semiautomatic Polarity Reversal" ⇨60).

13.1.2 R_{ISO} MEASUREMENT

Connection

Probe 1(L)

Probe 3(PE)



DANGER

Dangerous Voltage!

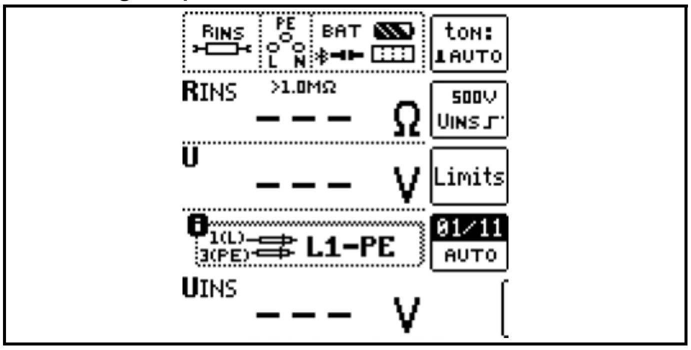
Risk of electric shock.

- Only measure insulation resistance on de-energized objects.
- Never touch the test probe tips.
- Capacitive devices under test are charged during this measurement. Incorrect discharging results in a life-threatening situation.
  For this reason, interrupt the connection between the measuring/test instrument and the DUT if momentary test probe voltage is < 10 V.

Note

N and PE must be interrupted for systems without RCD.

Measuring Sequence



Note

High cable capacitance extends measuring time.

The duration of the measurement can be increased by pressing and holding the **ON/START** key – due to the fact that the battery is subjected to a heavy load during this measurement, it should be kept as short as possible.

1. Checking Measurement Cables Before Measurements: Before measuring insulation resistance, briefly connect the measurement cables to the test probes to determine whether or not the measuring/test instrument indicates < 1 kΩ.
   In this way, incorrect connection can be avoided and interrupted measurement cables can be detected.
2. Connect the probes.
3. Set the parameters.
4. Start the measurement by pressing the **ON/START** key.

↳ Constant test voltage is applied.

↳ Measured values are displayed when the measured value for R_{ISO} is stable or test time has elapsed.

The following measured values are displayed:

- R_{ISO}: insulation resistance
- U: momentary voltage at the test probes
- U_{ISO}: voltage at the moment insulation resistance was acquired

5. Measurement is ended as soon as U is less than 10 V.

Continuous measurement:
Press and hold **ON/START** with **ton AUTO** setting.

Quick polarity reversal if parameter is set to **AUTO**:
01/11 … 11/11: L1-PE … L1-L3

Measurement can be aborted by pressing **ON/START** or **ESC**.

13.2 R_{ISO} RAMP ◢ – INSULATION MEASUREMENT WITH RISING TEST VOLTAGE

13.2.1 GENERAL

Select Measuring Function

General

Insulation and semiconductor junction quality can be determined with the R_{ISO} Ramp measuring function. This function is used for the following applications:

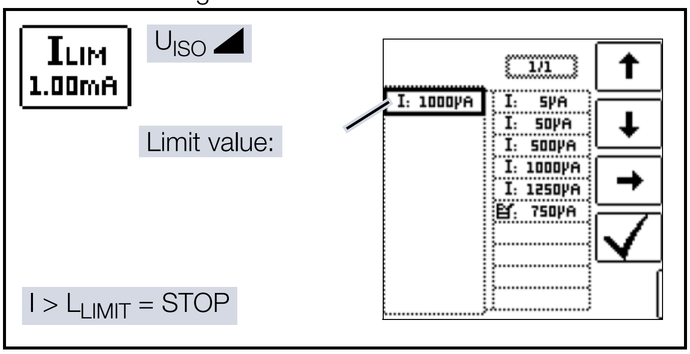
- Detection of weak points in the insulation
- Testing voltage-limiting components for correct function
- Determining sparkover voltage for spark gaps

Measuring Method

Insulation testing is conducted by applying a rising test voltage ramp which is increased continuously up to selected maximum test voltage U. If a voltage drop occurs or if maximum leakage current is exceeded, measurement is aborted and sparkover or breakdown voltage U_{ISO} is displayed.

Parameter

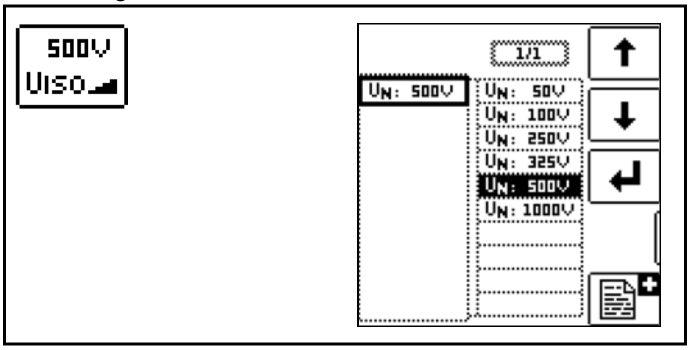
Breakdown voltage limit values:



Limit value I_{LIM} can be set for the purpose of current monitoring. Measurement is aborted if the limit value is exceeded. Various fixed parameters or an editable value can be selected.

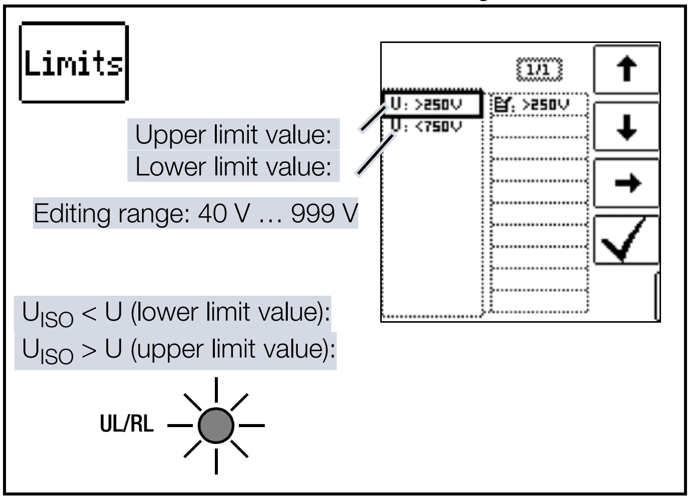
> **Note**
>
> In order to suppress the influence of parallel capacitances on the DUT when measurement is started, shutdown upon reaching selected breakdown current I_{LIM} does not occur until a minimum voltage of 5 V is exceeded.

Test voltage:



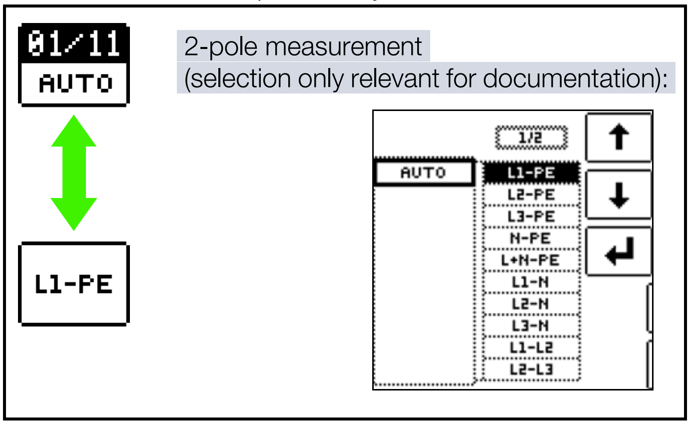
Various preset parameters are available for setting test voltage. The list can be extended with the help of the ⊞ editing function. This function is made available as soon as the cursor is located in the parameter selection column. See chapter "Freely Selectable Parameter Settings or Limit Values" ➪ 59.

Limits – Limit Values for Breakdown Voltage:



A target range can be defined by setting upper and lower limit values for insulation voltage UISO. If the measured value is not within this range, the **UL/RL** LED lights up red. An editable value is available for the adjustment of each limit value.

Conductor Relationship – Polarity:



The specification of conductor relationship points makes it possible to allocate measured values and measuring points to each other. Corresponding report generation is possible after measurement has been completed by pressing the save key (softkey).

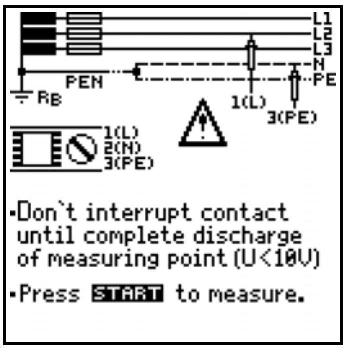
Selection can be made between manual setting and the **AUTO** function. With the help of the **AUTO** function, the user can switch through the various conductor relationships, one after the other, by pressing the **IΔN** key (see also chap. 10.5).

13.3 R_{ISO} RAMP MEASUREMENT

Connection

Probe 1(L)

Probe 3(PE)



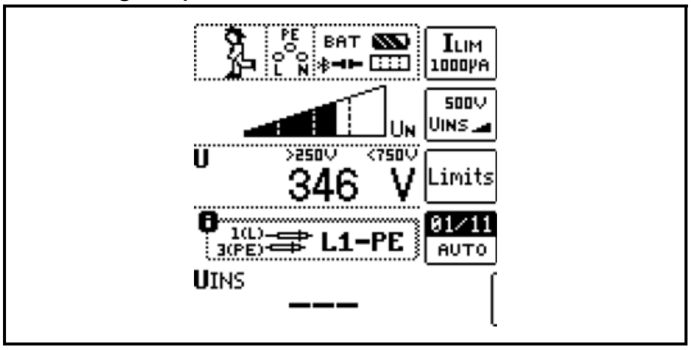
DANGER

Dangerous Voltage!

Risk of electric shock.

- Only measure insulation resistance on de-energized objects.
- Never touch the test probe tips.
- Capacitive devices under test are charged during this measurement. Incorrect discharging results in a life-threatening situation.
  For this reason, interrupt the connection between the measuring/test instrument and the DUT if momentary test probe voltage is < 10 V.

Measuring Sequence



1. Connect the probes.
2. Set the parameters.
3. Start the measurement by pressing the **ON/START** key.

   ↳ Rising test voltage is applied.
   ↳ The measured values are displayed as soon as:
   - Breakdown occurs in the form of arc-over or a voltage drop
     or
   - Nominal test voltage is reached
     or
   - Current flows at the selected amperage

   The following measured values are displayed:
   - U: momentary test probe voltage
   - U_{ISO}: either breakdown or nominal voltage depending on the test sequence
4. Measurement is ended as soon as U is less than 10 V.

Quick polarity reversal if parameter is set to AUTO:
01/11 … 11/11: L1-PE … L1-L3

After pressing the **ON/START** key, test voltage is continuously increased until specified nominal voltage U_N is reached. U is the voltage which is measured at the test probes during and after testing. Test voltage is continuously increased until one of the following events occurs:

- Nominal voltage (selected test voltage U_N) is reached
- Breakdown in the form of arc-over or a voltage drop
- Current flows at the selected amperage
- Measurement can be aborted by pressing **ON/START** or **ESC**

Test voltage drops to a value of less than 10 V after measurement.

Notes on Measurement with the Ramp Function

Insulation measurement with ramp function serves the following purposes:

- Detect weak points in the test object's insulation
- Determine tripping voltage of voltage limiting components and test them for correct functioning These components may include, for example, varistors, overvoltage limiters (e.g. DEHNguard® from Dehn+Söhne) and spark gaps.

The measuring/test instrument uses continuously rising test voltage for this measuring function, up to the maximum selected voltage limit. The measuring procedure is started by pressing the **ON/START** key and runs automatically until one of the following events occurs:

- The selected voltage limit is reached
- The selected current limit is reached
  or
- Sparkover occurs (spark gaps)

Differentiation is made amongst the following three procedures for insulation measurement with ramp function:

- Testing overvoltage limiters or varistors and determining their tripping voltage:
  - Select maximum voltage such that the anticipated breakdown voltage of the device under test is roughly one third of this value (observe manufacturer's data sheet if applicable).
  - Select the current limit value in accordance with actual requirements or the manufacturer's data sheet (characteristic curve of the device under test).
- Determining tripping voltage for spark gaps:
  - Select maximum voltage such that the anticipated breakdown voltage of the device under test is roughly one third of this value (observe manufacturer's data sheet if applicable).

  - Select the current limit value in accordance with actual requirements within a range of 5 to 10 µA (response characteristics are too unstable with larger current limit values, which may result in faulty measurement results).
- Detecting weak points in the insulation:
  - Select maximum voltage such that it does not exceed the test object's permissible insulation voltage; it can be assumed that an insulation fault will occur even with a significantly lower voltage if an accordingly lower maximum voltage value is selected (nevertheless at least greater than anticipated breakdown voltage) – the ramp is less steep as a result (increased measuring accuracy).
  - Select the current limit value in accordance with actual requirements within a range of 5 to 10 µA (see also settings for spark gaps).

13.3.1 EVALUATING MEASURED VALUES

Measuring/test instrument measuring error must be taken into consideration in order to assure that the limit values set forth in DIN VDE regulations are not fallen short of. The required minimum display values for insulation resistance can be determined with the help of the tables in ⇨🗎154. These values take maximum device error into consideration (under nominal conditions of use). Intermediate values can be interpolated.

14 RCD – TESTING OF RESIDUAL CURRENT DEVICES

14.1 GENERAL

Residual current devices (RCDs) are used for protection by means of automatic shutdown of supply power in the event of indirect contact. The effectiveness of this measure must be examined by means of visual inspection and measurement. It must be verified that shutdown takes place no later than upon reaching rated differential current $I_{\Delta N}$, and the agreed upon limit value for permissible touch voltage must not be exceeded.

The measuring/test instrument offers the opportunity of testing RCDs which are sensitive to alternating, pulsed and direct current with non-delayed (general type), short-time delayed (type G) or time delayed tripping (type $\boxed{S}$). The following table provides an overview of the response characteristics of various types of RCDs.

Types of Residual Current

	AC	A	F	F – Audio	F – EV	B/B+	A – EV	B/B+ MI
Sinusoidal	X	X	X	X	X	X	X	X
Half-wave	–	X	X	X	X	X	X	X
DC	–	–	–	–	–	X	–	X
+ 6 mA DC	–	–	–	–	X	–	X	X

Measuring Functions

Selection is possible from amongst the following measuring functions:

- $U_{I\Delta N}$: touch voltage measurement
- RCD I_F: tripping current with rising test current
- RCD $I_{\Delta N}$: time to trip measurement with constant test current
- RCD $I_{F\angle}+I_{\Delta N}$: simultaneous measurement of time to trip and tripping current with increasing test current

Observe characteristic values and technical data when selecting the measuring function ➪🗎12.

Information regarding status information can be found in chapter "Appendix" ➪🗎154.

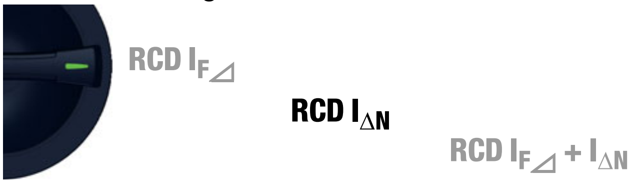
Test Probes

Generation of DC residual current:
All three probes are required in this case: (1)L, (2)N, (3)PE. 2 probes, namely 1(L), 3(PE), suffice when generating AC current or half-wave current.

14.2 MEASUREMENT OF TOUCH VOLTAGE AND TIME TO TRIP WITH NOMINAL RESIDUAL CURRENT

14.2.1 GENERAL

Select Measuring Function



Each of the 3 tripping tests described in the following pages begins with a touch voltage measurement for safety reasons before the actual tripping test is started. Respective maximum touch voltage U_L must be specified here under limits, which must not be exceeded. If prevailing touch voltage $U_{I\Delta N}$ is greater than limit value U_L, safety shutdown ensues.

Measuring Method

The measuring/test instrument uses a measuring current of only ⅓ nominal residual current for the determination of touch voltage $U_{I\Delta N}$ which occurs at nominal residual current. This prevents tripping of the RCCB.

This measuring method is especially advantageous, because touch voltage can be measured quickly and easily at any electrical outlet without tripping the RCCB.

The usual, complex measuring method involving testing for the proper functioning of the RCD at a given point, and subsequent substantiation that all other systems components requiring protection are reliably connected at low resistance values to the selected measuring point via the PE conductor, is rendered unnecessary.

ATTENTION

Tripping of RCCBs for Data Processing Systems

Data loss in data processing systems.

- Back up your data before measurement.
- Switch all consumers off.

Help Function

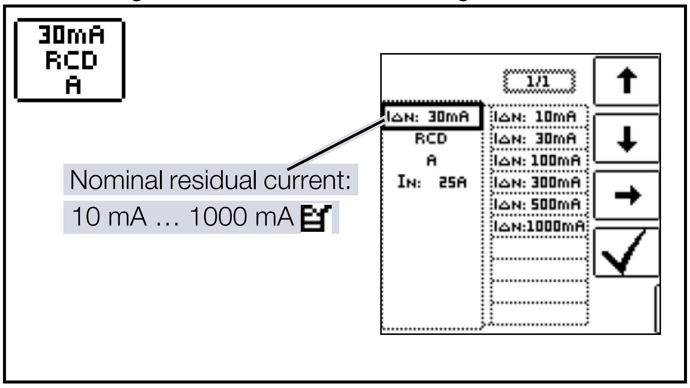
Illustrations and measurement instructions can be displayed by pressing the **HELP** key.

The help function is exited by pressing the **ESC** key.

Parameter

Nominal residual current:

Nominal residual current parameter $I_{\Delta N}$, which is relevant for touch voltage, can be set in the following submenu:

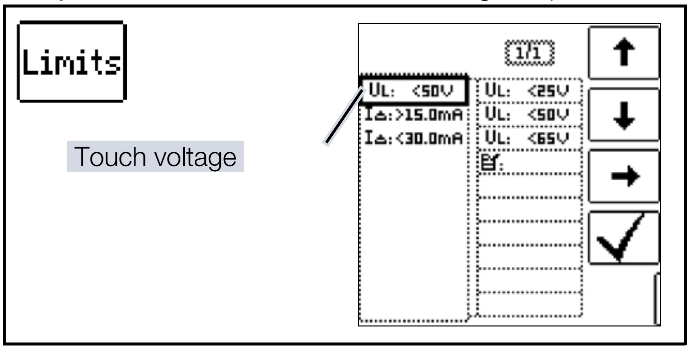


Limits – setting the limit value:

The measuring/test instrument offers the option of a display in the event that maximum permissible touch voltage U_L is exceeded.

U_L can be configured to this end.

If prevailing touch voltage UIΔN is greater than limit valueU_L, safety shutdown ensues. The **UL/RL** LED lights up red.



14.2.2 RCD $I_{\Delta N}$ – MEASUREMENT OF TIME TO TRIP WITH NOMINAL CURRENT

Measuring Connections

Measurement with full and half-wave:

Probe 1(L)

Probe 3(PE)

Measurement with direct current:

Probe 1(L)

Probe 2(N)

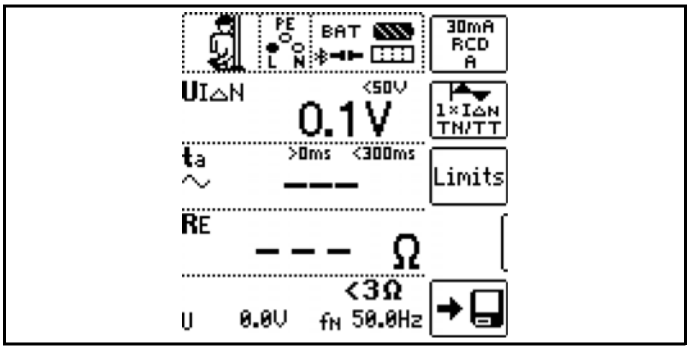
Probe 3(PE)

Measuring Sequence

Note

Battery operation: Incorrect measurement results when the battery is low!

Only perform the measurement with DC test current if the battery charge level is ≥ 50%.



Refer to the notes in chapter "Notes Concerning Measurement" ➪94 when performing the measurement.

1. Set the parameters.
2. Start touch voltage measurement:
   Press the **ON/START** key.

   ↳ Measured values display: $U_I\Delta_N$, R_E, U, f.
3. Start touch voltage measurement and tripping test:
   Press the **IΔN key.**

   ↳ Test current is applied.
4. End of measurement: when the RCD is tripped or the final value is reached.

↳ Measured values display: $U_I\Delta_N$, ta, R_E, U, f.

Measurement can be aborted by pressing **ON/START**, $I_{\Delta N}$ or **ESC**.

Explanation of displayed measured values:

- $U_I\Delta_N$: touch voltage relative to nominal residual current
- t_a: time to trip
- R_E: earth loop resistance

- U: voltage at the test probes before stating the tripping test – U_n is displayed if voltage value U_{max} deviates from nominal voltage by 10%.
- f: frequency of the voltage at the test probes before starting the tripping test – f_N is displayed if frequency f_{max} deviates from nominal frequency by 1%.

Tripping Test with Nominal Residual Current

The tripping test need only be performed at one measuring point for each RCCB.

If touch voltage
$U_{I\Delta N} > U_I$ exceeds U_I during the measuring sequence, safety shutdown occurs.

Unintentional Tripping of the RCD due to Bias Current within the System

If bias currents should occur, they can be measured with the help of a current clamp transformer as described in ➪ "IL/AMP – Current and Apparent Power Measurement with Current Clamp Sensor" 🗎111. The RCCB may be tripped during the testing of touch voltage if extremely large bias currents are present within the system, or if a test current was selected which is too great for the RCCB.

After touch voltage has been measured, testing can be performed with the measuring/test instrument to determine whether or not the RCCB is tripped within the selected limit values at nominal residual current.

Unintentional Tripping of the RCD due to Leakage Current in the Measuring Circuit

Measurement of touch voltage with 30% nominal residual current does not normally trip an RCCB. However, the tripping limit may be exceeded as a result of leakage current in the measuring circuit, for example due to interconnected consumers with EMC circuit, e.g. frequency converters or PCs.

Limit Values for Permissible, Continuous Touch Voltage

The limit for permissible, continuous touch voltage is equal to U_L = 50 V for alternating voltages (international agreement). Lower values have been established for special applications (e.g. medical applications: U_L = 25 V).

WARNING

Defective System
(touch voltage too high or RCCB doesn't trip)

Injuries or damage to the system.

Repair the system.

3-Phase Connections

For proper RCD testing at three-phase connections, the tripping test must be conducted for one of the three phase conductors (L1, L2 and L3).

Inductive Power Consumers

Voltage peaks may occur within the measuring circuit if inductive consumers are shut down during an RCCB tripping test. If this is the case, the measuring/test instrument might not display any measured value (– – –). If this message appears, switch all consumers off before performing the tripping test. In extreme cases, one of the fuses in the measuring/test instrument may blow, and/or the instrument may be damaged.

14.3 RCD $I_{F\triangle}$ – TESTING RESIDUAL CURRENT DEVICES BY MEASURING TRIPPING CURRENT WITH RISING TEST CURRENT

14.3.1 GENERAL

Select Measuring Function

RCD $I_{F\triangle}$

This measuring/test instrument offers the option of testing type B RCDs with smooth direct current.

DIN EN 61557-6 requires testing of these RCDs in both current flow directions.

Other RCDs can be selected under the DUT parameter, and other waveforms can be selected under the test parameter.

Measuring Method

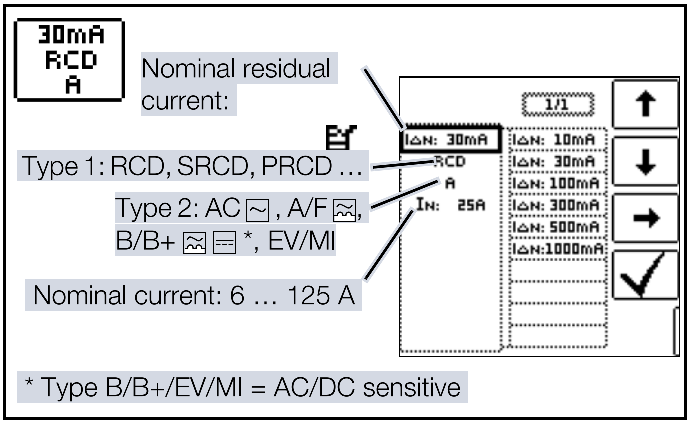
The tripping current of RCDs is measured by supplying a rising test current.

Parameter

The measurement parameters can be set in the submenus which are described below.

The following parameters can be configured for the device under test:

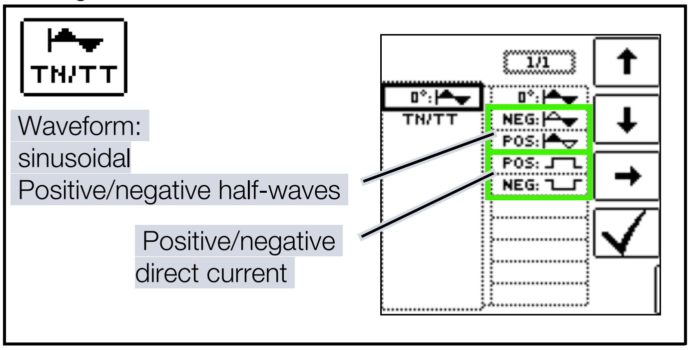
- $I_{\Delta N}$: nominal residual current
- Type of device, e.g. RCD, RCD-S
- Characteristic, e.g. type AC, type B
- I_N: nominal current



The following parameters can be configured for the test:

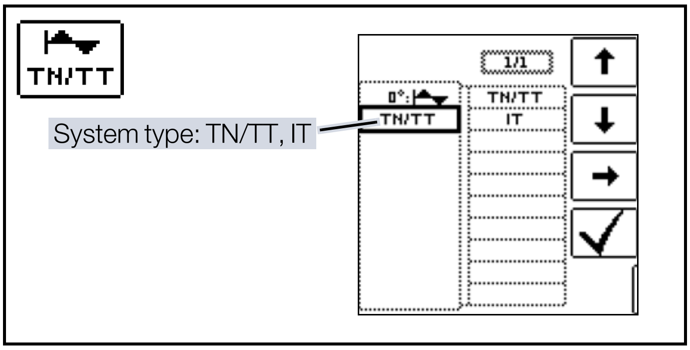
The type of test current can be selected. The function's starting and final values are dictated by this setting (see also chapter "Characteristic Values" ⇨31). Selection is possible from the following options:

- Full-wave, 0°
- Positive half-wave
- Negative half-wave
- Positive direct current
- Negative direct current



The type of electrical system can be selected for report generation:

- TN/TT
- IT

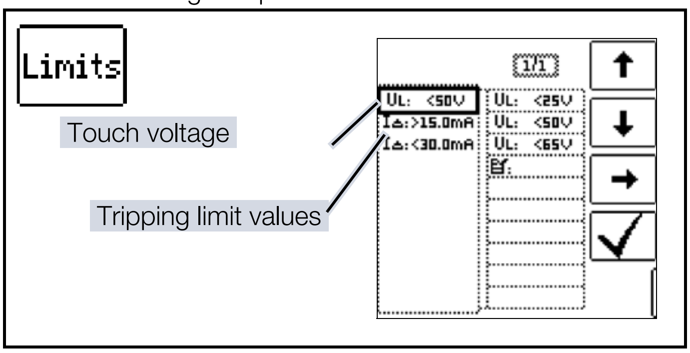


Limit values:

The measuring/test instrument offers the option of displaying limit value violations. The following limit values can be configured:

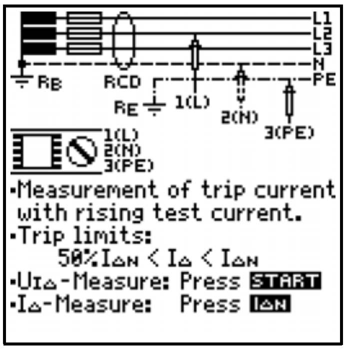
- **U_L**: maximum permissible touch voltage
- **I_Δ>**: minimum tripping current
- **I_Δ<**: maximum tripping current

If touch voltage $I_{I\Delta N}$ is greater than limit value U_l, safety shutdown ensues. The **UL/RL** LED lights up red. If the measured value for tripping current ID is not within the specified limits, the **RCD FI** LED lights up red.



14.3.2 RCD I_F MEASUREMENT ⊿

Connection



Measurement with full and half-wave:

Probe 1(L)

Probe 3(PE)

Measurement with direct current:

Probe 1(L)

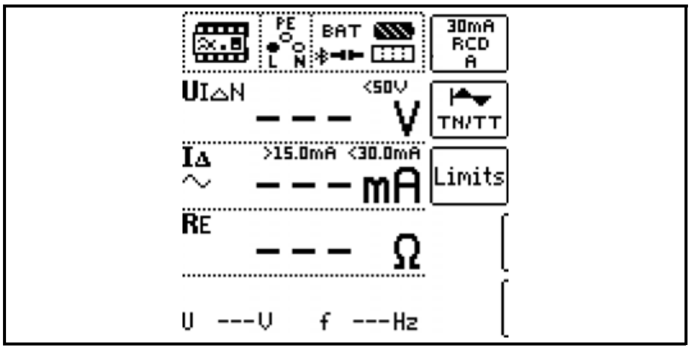
Probe 2(N)

Probe 3(PE)

> **Note**
>
> Half-wave test:
>
> Testing is conducted with rising test current with up to 1.4 × $I_{\Delta N}$. Setting the tripping current factor has no effect.

Measuring Sequence

> **Note**
>
> Battery operation: Incorrect measurement results when the battery is low!
>
> Only perform the measurement with DC test current if the battery charge level is ≥ 50%.



Refer to the notes in chapter "Notes Concerning Measurement" ➩🗎94 when performing the measurement.

1. Set the parameters.
2. Start touch voltage measurement:
   Press the **ON/START** key.

   ↳ Measured values display: $U_{I\Delta N}$, R_E, U, f.
3. Start touch voltage measurement and tripping test: Press the **IΔN** key.

   ↳ Test current is applied.
4. End of measurement: when the RCD is tripped or the final value is reached
   ↳ Measured values display: $U_{I\Delta N}$, I_D, R_E, U, f.

Measurement can be aborted by pressing **ON/START**, **IΔN** or **ESC**.

Explanation of displayed measured values:

- $U_{I\Delta N}$: touch voltage relative to nominal residual current
- I_Δ: residual tripping current
- R_E: earth loop resistance
- U: voltage at the test probes before starting the tripping test.
  UN is displayed if voltage U_{max} deviates from nominal voltage by 10%.
- f: frequency of the applied voltage.
  f_N is displayed if frequency f_{max} deviates from nominal frequency by 1%.

14.4 RCD $I_{\Delta N}$ – TESTING RCDS BY MEASURING TIME TO TRIP WITH CONSTANT TEST CURRENT

14.4.1 GENERAL

This measuring function makes it possible to test RCDs with sinusoidal test current in accordance with DIN EN 61557-6.

Other waveforms can be selected under the test parameter.

Select Measuring Function

RCD $I_{\Delta N}$

Measuring Method

Very high constant test current is applied and time to trip, or holding time in the event that tripping does not occur, is measured.

Help Function

Illustrations and measurement instructions can be displayed by pressing the **HELP** key.

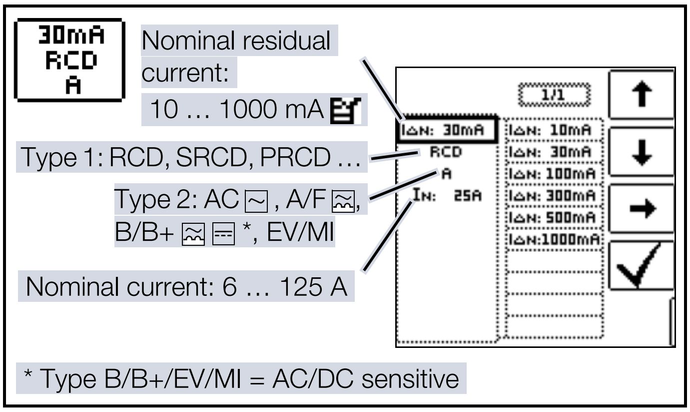
The help function is exited by pressing the **ESC** key.

Parameter

The measurement parameters can be set in the submenus which are described below:

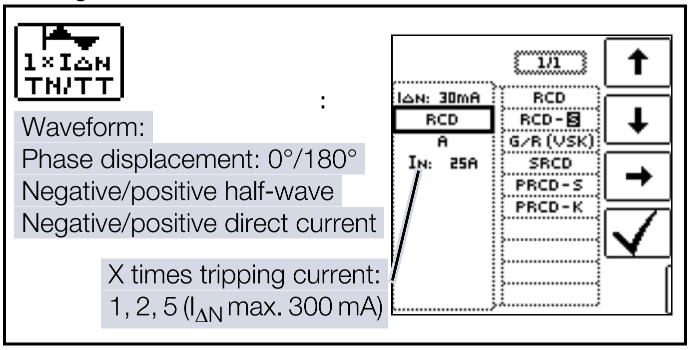
The following parameters can be configured for the device under test:

- $I_{\Delta N}$: nominal residual current
- Type of device, e.g. RCD, RCD-S
- Characteristic, e.g. type AC, type B
- I_N: nominal current



One of the following waveforms can be selected for the test current to be applied:

- Full-wave, 0°
- Full-wave, 180°
- Positive half-wave
- Negative half-wave
- Positive direct current
- Negative direct current

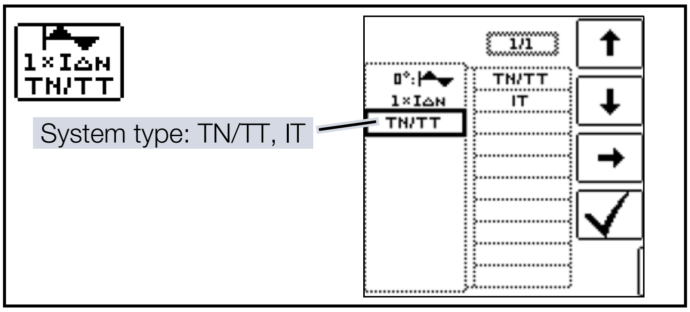


Selection options for the tripping current factor:

- 0.5 × $I_{\Delta N}$ + 1 × $I_{\Delta N}$: no-trip test with half nominal residual current (duration: 1 s) with subsequent tripping test using nominal residual current
- 1 × $I_{\Delta N}$: tripping test with nominal residual current
- 2 × $I_{\Delta N}$: tripping test with 2 times nominal residual current
- 5 × $I_{\Delta N}$: tripping test with 5 times nominal residual current

The type of electrical system can be selected for report generation:

- TN/TT
- IT



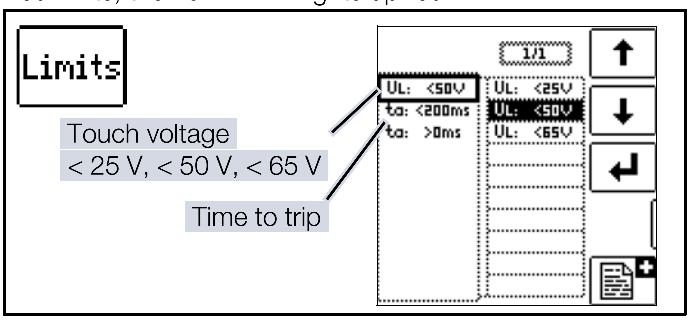
Limit values:

The measuring/test instrument offers the option of displaying limit value violations. The following limit values can be configured:

- U_L: maximum permissible touch voltage
- **ta>**: minimum time to trip
- **ta<**: maximum time to trip

If touch voltage $U_{I\Delta N}$ is greater than limit value Ul, safety shutdown ensues. The **UL/RL** LED lights up red.

If the measured value for time to trip ta is not within the specified limits, the **RCD FI** LED lights up red.



14.4.2 RCD $I_{\Delta N}$ MEASUREMENT

Connection

Measurement with full and half-wave:

Probe 1(L)

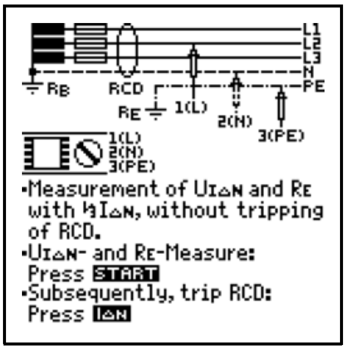
Probe 3(PE)

Measurement with direct current:

Probe 1(L)

Probe 2(N)

Probe 3(PE)

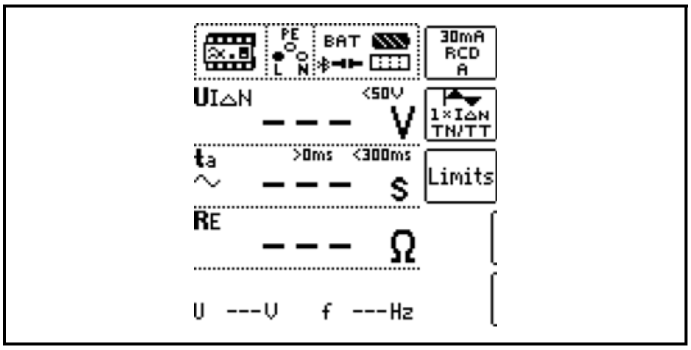


Measuring Sequence

Note

Battery operation: Incorrect measurement results when the battery is low!

Only perform the measurement with DC test current if the battery charge level is ≥ 50%.



Refer to the notes in chapter "Notes Concerning Measurement" ➪🗎94 when performing the measurement.

1. Set the parameters.
2. Start touch voltage measurement:
   Press the **ON/START** key.

   ↳ Measured values display: $U_I\Delta_N$, R_E, U, f.
3. Start touch voltage measurement and tripping test: Press the **IΔN** key.

   ↳ Test current is applied.
4. End of measurement: when the RCD is tripped or the final value is reached.

↳ Measured values display: $U_I\Delta_N$, ta, R_E, U, f.

Measurement can be aborted by pressing **ON/START**, **IΔN** or **ESC**.

Explanation of displayed measured values:

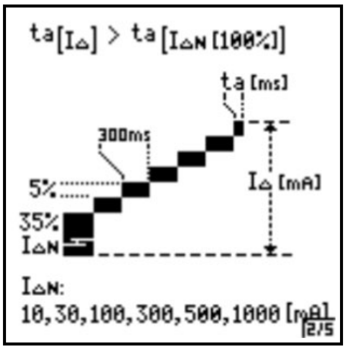
- $U_I\Delta_N$: touch voltage relative to nominal residual current
- t_a: Time to trip
- R_E: earth loop resistance
- U: voltage at the test probes before starting the tripping test.
  U_N is displayed if voltage U_{max} deviates from nominal voltage by 10%.
- f: frequency of the applied voltage.
  f_N is displayed if frequency f_{max} deviates from nominal frequency by 1%.

14.5 RCD $I_{F\triangle} + I_{\Delta N}$ – TESTING RCDS BY SIMULTANEOUSLY MEASURING TRIPPING CURRENT AND TIME TO TRIP WITH RISING TEST CURRENT

14.5.1 GENERAL

The advantage of this measuring function in contrast to individual measurement of $I_{\Delta N}$ and t_a is the simultaneous measurement of breaking time and breaking current by means of a test current which is increased in steps, during which the RCD is tripped only once.

The intelligent ramp is subdivided into time segments of 300 ms each between the initial current value (35% $I_{\Delta N}$) and the final current value (130% $I_{\Delta N}$). This results in a gradation for which each step corresponds to a constant test current which is applied for no longer than 300 ms, assuming that tripping does not occur.



Note

Slow-blow RCDs:
Erroneous measurements at tripping times t_a > 300 ms

At longer tripping times, the displayed measurement is lower because each stage of the ramp is only 300 ms long. The measurement is unable to distinguish whether

- tripping occurred in the previous stage and the RCD is simply very slow
  or
- tripping occurred in the current stage and the RCD is fast.

And thus both tripping current and tripping time are measured and displayed.

Select Measuring Function

RCD $I_{F\triangle} + I_{\Delta N}$

Measuring Method

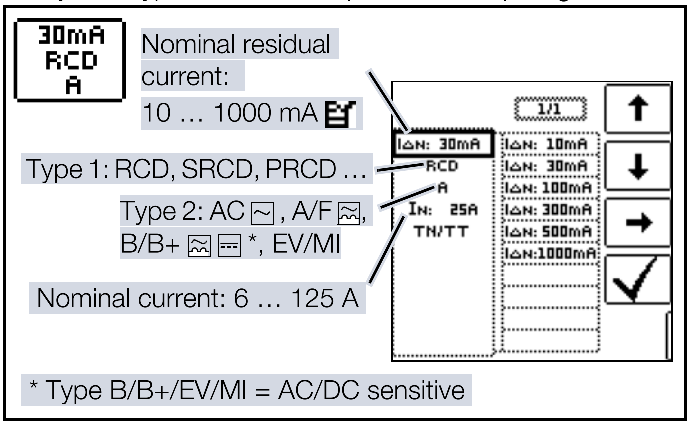
A test current which is increased in steps is applied within a range of 0.35 … 1.3 × $I_{\Delta N}$. Time to trip and tripping current are measured simultaneously.

Parameter

The measurement parameters can be set in the submenus which are described below.

The following parameters can be configured for the device under test:

- $I_{\Delta N}$: nominal residual current
- Type of device, e.g. RCD, RCD-S
- Characteristic, e.g. type AC, type B
- I_N: nominal current
- System type: TN/TT, IT – specified for report generation

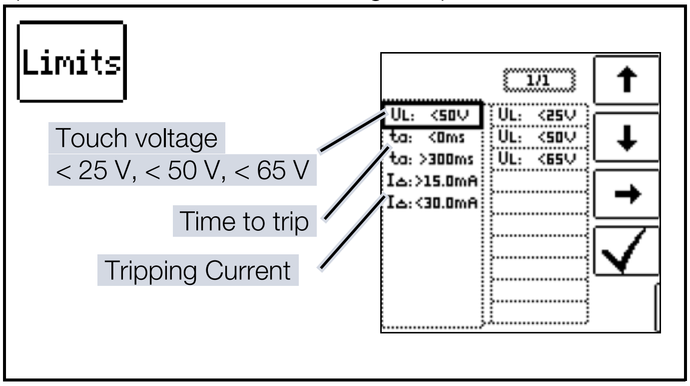


The measuring/test instrument offers the option of displaying limit value violations. The following limit values can be configured:

- U_L: maximum permissible touch voltage
- t_a>: minimum time to trip
- t_a<: maximum time to trip
- IΔ>: minimum tripping current
- IΔ<: maximum tripping current

If prevailing touch voltage $U_{I\Delta N}$ is greater than limit value U_L, safety shutdown ensues. The **UL/RL** LED lights up red.

If the time to trip t_a and/or tripping current I_D is not within the specified limits, the **RCD FI** LED lights up red.



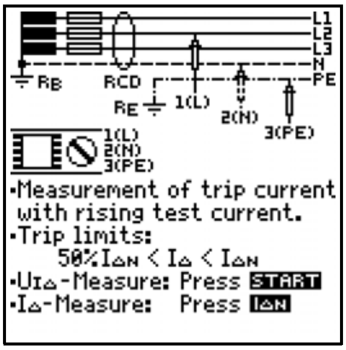
14.5.2 RCD $I_{F\Delta}$ + $I_{\Delta N}$ MEASUREMENT

Refer to the notes in chapter "Notes Concerning Measurement" ➩94 when performing the measurement.

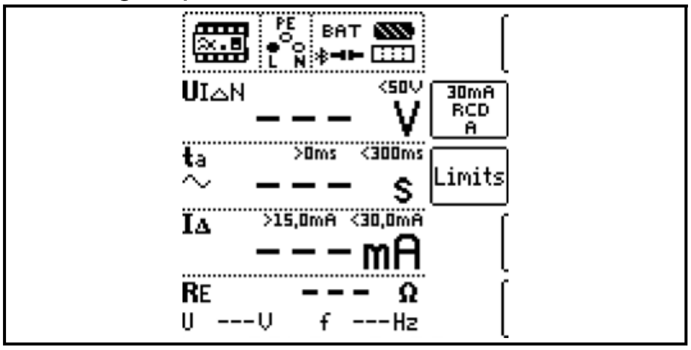
Connection

Probe 1(L)

Probe 3(PE)



Measuring Sequence



1. Set the parameters.
2. Start touch voltage measurement:
   Press the **ON/START** key.

   ↳ Measured values display: $U_{I\Delta N}$, R_E, U, f.
3. Start touch voltage measurement and tripping test: Press the **IΔN** key.

   ↳ Test current is applied.
4. End of measurement: when the RCD is tripped or the final value is reached.
5. Measured values display: $U_{I\Delta N}$, t_a, I_Δ, R_E, U, f.

Measurement can be aborted by pressing **ON/START**, **IΔN** or **ESC**.

Explanation of displayed measured values:

- $U_{I\Delta N}$: touch voltage relative to nominal residual current
- t_a: time to trip
- I_Δ: tripping current
- R_E: earth loop resistance
- U: voltage at the test probes before starting the tripping test.
  U_N is displayed if voltage U_{max} deviates from nominal voltage by 10%.
- f: frequency of the applied voltage.
  f_N is displayed if frequency f_{max} deviates from nominal frequency by 1%.

14.6 SPECIAL TESTS FOR SYSTEMS AND RCDS

14.6.1 TESTING SYSTEMS AND RCCBS WITH RISING FAULT CURRENT (DC) FOR TYPE B/B+ AND EV/MI RCDS

Select Measuring Function

RCD $I_{\Delta N}$

General

In accordance with VDE 0413-6, it must be substantiated that, with smooth direct current, residual operating current is no more than twice the value of rated residual current $I_{\Delta N}$. A continuously rising direct current, beginning with 0.2 times rated residual current $I_{\Delta N}$, must be applied to this end. If current rise is linear, rising current may not exceed twice the value of $I_{\Delta N}$ within a period of 5 seconds.

Testing with smoothed direct current must be possible in both test current directions.

14.6.2 TESTING RCCBS WITH 5 × $I_{\Delta N}$

Measurement of time to trip is performed here with 5 times nominal residual current.

Note

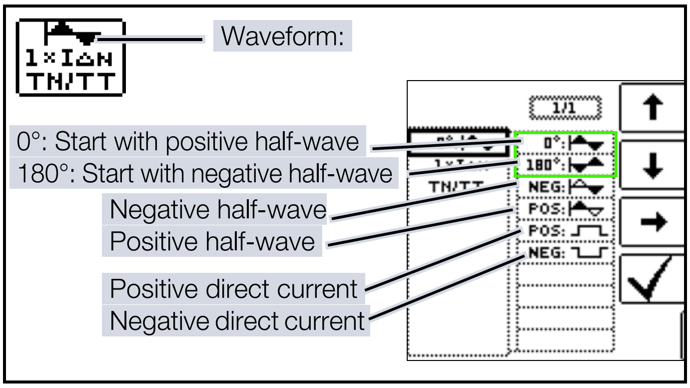
Measurements performed with 5 times nominal fault current are required for testing type **S** and **G** RCCBs in the manufacturing process. They're used for personal safety as well.

Measurement can be started with the **positive half-wave 0°** or with the **negative half-wave 180°** (**full-wave** setting).

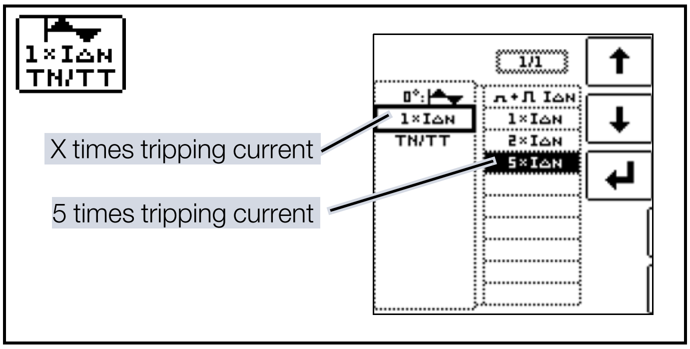
Both measurements must nevertheless be performed. The longer of the two tripping times is decisive regarding the condition of the tested RCCB. Both values must be less than 40 ms.

Parameter Settings

Start with the positive or negative half-wave of the respective full-wave:



5 times nominal residual current:

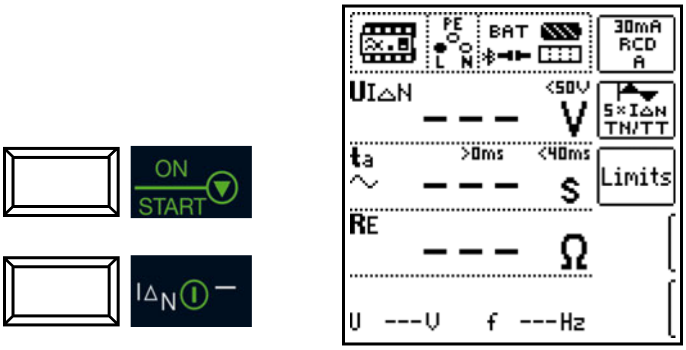


Start Measurement

Note

Battery operation: Incorrect measurement results when the battery is low!

Only perform the measurement with DC test current if the battery charge level is ≥ 50%.



14.6.3 TESTING OF RCCBS WHICH ARE SUITABLE FOR PULSATING RESIDUAL DIRECT CURRENT

Select Measuring Function

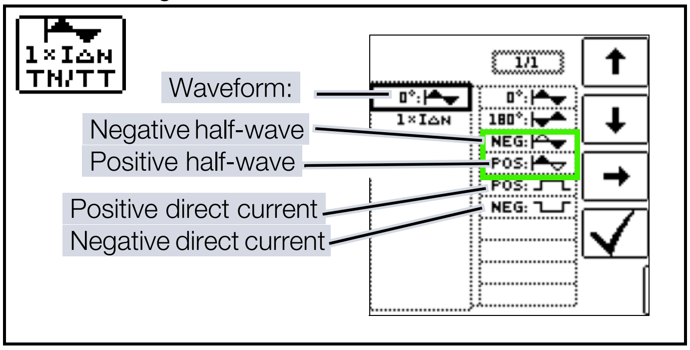
RCD $I_{\Delta N}$

General

In this case, RCCBs can be tested with either positive or negative half-waves. The standard calls for tripping at 1.4 times nominal current.

Parameter Settings

Positive or negative half-waves:

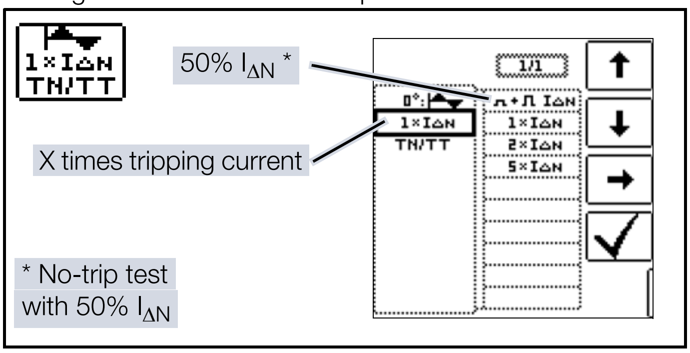


Note

Battery operation: Incorrect measurement results when the battery is low!

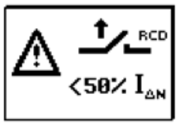
Only perform the measurement with DC test current if the battery charge level is ≥ 50%.

Testing with and without “no-trip test”:



No-Trip Test:

If, during the no-trip test which lasts for 1 second, the RCD trips too early at 50% $I_{\Delta N}$, i.e. before the actual tripping test starts, the pop-up window shown at the right appears.



Note

According to DIN EN 50178 (VDE 160), only type B RCCBs (AC-DC sensitive) can be used for equipment with > 4 kVA, which is capable of generating smooth DC residual current (e.g. frequency converters).

Tests with pulsating DC fault current only are not suitable for these RCCBs. Testing must also be conducted with smooth DC residual current in this case.

Note

Measurement is performed with positive and negative half-waves for testing RCCBs during manufacturing. If a circuit is charged with pulsating direct current, the function of the RCCB can be executed with this test in order to assure that the RCCB is not saturated by the pulsating direct current so that it no longer trips.

14.6.4 SYSTEMS WITH TYPE RCD-S SELECTIVE RCCBS

Selective RCDs are used in systems which include two series connected RCCBs that are not tripped simultaneously in the event of a fault. These selective RCDs demonstrate delayed response characteristics and are identified with the [S] symbol.

Select Measuring Function

RCD $I_{F\triangle}$ or **RCD $I_{\Delta N}$**

Measuring Method

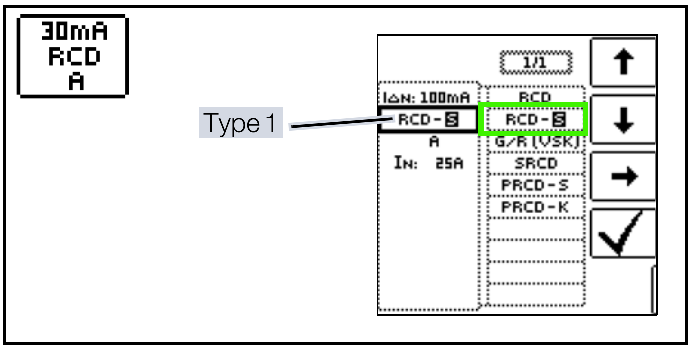
The same measuring method is used as for standard RCCBs (see chapter "RCD IF – Testing Residual Current Devices by Measuring Tripping Current with Rising Test Current" ➪82 and chapter "RCD IΔn – Testing RCDs by Measuring Time to Trip with Constant Test Current" ➪84).

If selective RCDs are used, earthing resistance may not exceed half of the value for standard RCCBs.

For this reason, the measuring/test instrument displays twice the measured value for touch voltage.

Parameter Settings

Selective:

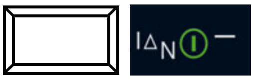


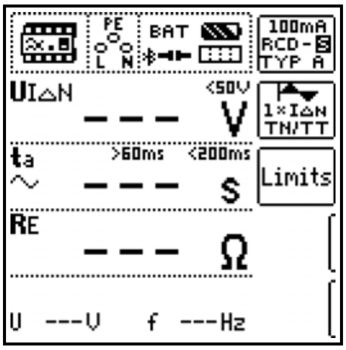
Start Measurement

Note

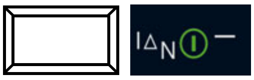
Battery operation: Incorrect measurement results when the battery is low!

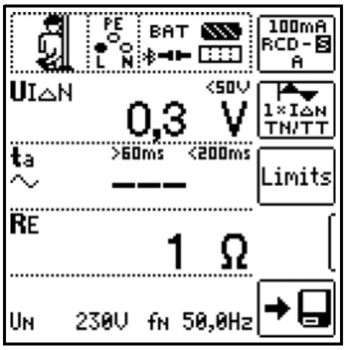
Only perform the measurement with DC test current if the battery charge level is ≥ 50%.





Tripping test:
Press the **IΔN** key.





The RCCB is tripped. Blinking bars appear at the display panel, after which time to trip t_a and earthing resistance R_E are displayed.

The tripping test only needs to be performed at one measuring point for each RCCB.

Note

Selective RCDs demonstrate delayed response characteristics Tripping performance is briefly influenced (up to 30 s) due to pre-loading during measurement of touch voltage. In order to eliminate pre-charging caused by the measurement of touch voltage, a waiting period must be observed prior to the tripping test. After the measuring sequence has been started (tripping test), blinking bars are displayed for approximately 30 seconds. Tripping times of up to 1000 ms are permissible. The tripping test is executed immediately after once again pressing the **IΔN** key.

14.6.5 PRCDS WITH NON-LINEAR TYPE PRCD-K ELEMENTS

General

The PRCD-K is a portable RCD with electronic residual current evaluation laid out as an inline device which switches all poles (L, N and PE). Undervoltage tripping and protective conductor monitoring are additionally integrated into the PRCD-K.

The PRCD-K is equipped with undervoltage tripping, for which reason it has to be operated with line voltage, and measurements may only be performed in the on state (PRCD-K switches all poles).

Terminology (from DIN VDE 0661)

Portable protective devices are circuit breakers which can be connected between power consuming devices and permanently installed electrical outlets by means of standardized plug-and-socket devices.
A reusable, portable protective device is a protective device which is designed such that it can be connected to movable cables.

Please be aware that a non-linear element is usually integrated into PRCDs, which leads to immediate exceeding of the greatest allowable touch voltage during $U_{I\Delta}$ measurements ($U_{I\Delta}$ greater than 50 V).

PRCDs which do not include a non-linear element in the protective conductor must be tested in accordance with section 14.6.6 auf Seite 91.

Objective (from DIN VDE 0661)

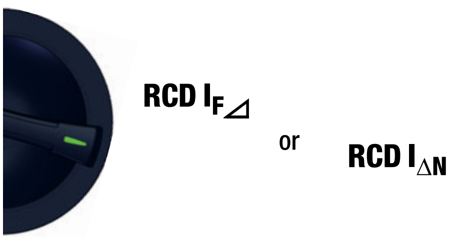
Portable residual current devices (PRCDs) serve to protect persons and property. They allow for the attainment of increased levels of protection as provided by protective measures utilized in electrical systems for the prevention of electrical shock as defined in DIN VDE 0100-410. They must be designed such that they can be installed by means of a plug attached directly to the protective device, or by means of a plug with a short cable.

Measuring Method

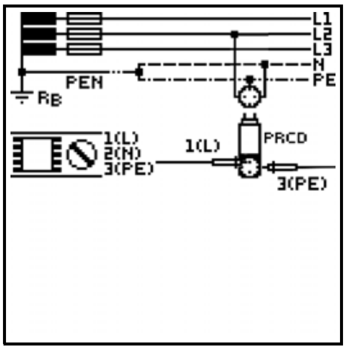
The following can be measured, depending upon the measuring method:

- Time to trip t_A – tripping test with nominal residual current $I_{\Delta N}$
  (the PRCD-K must be tripped at 50% nominal current.)
- Tripping current I_Δ: testing with rising residual current I_F

Select Measuring Function

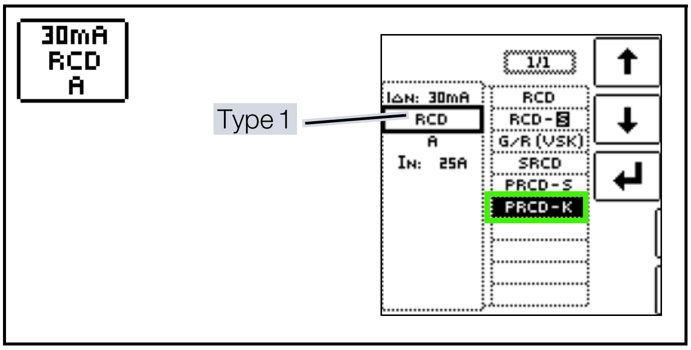


Connection

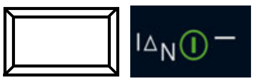


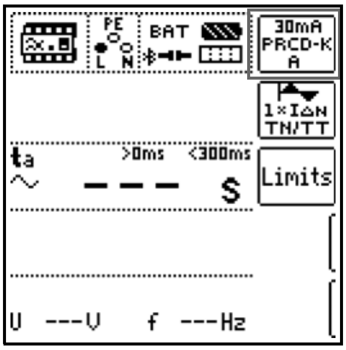
Parameter Settings

PRCD with non-linear elements:



Start Measurement



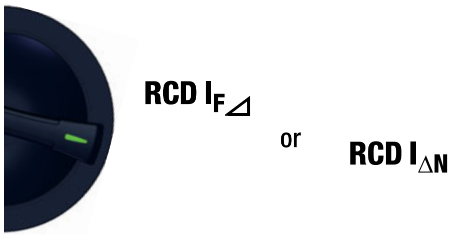


14.6.6 SRCD, PRCD-S (SCHUKOMAT, SIDOS OR COMPARABLE)

RCCBs from the SCHUKOMAT SIDOS series, as well as others which are of identical electrical design, must be tested after selecting the corresponding parameter. Monitoring of the PE conductor is performed for RCDs of this type. The PE conductor is monitored by the summation current transformer. If residual current flows from L to PE, tripping current is cut in half, i.e. the RCCB must be tripped at 50% nominal residual current $I_{\Delta N}$.

Whether or not PRCDs and selective RCDs are of like design can be tested by measuring touch voltage $U_{I\Delta N}$. If a touch voltage $U_{I\Delta N}$ of greater than 70 V is measured at the PRCD of an otherwise error-free system, the PRCD more than likely contains a non-linear element.

Select Measuring Function

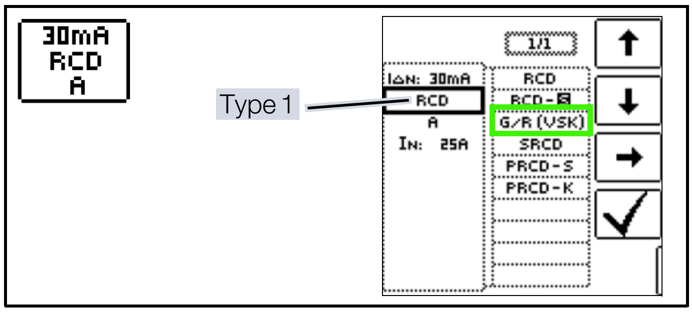


PRCD-S

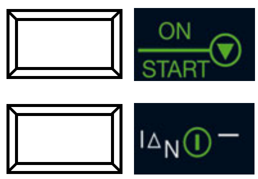
The PRCD-S (portable residual current device – safety) is a special, portable, protective device with protective conductor detection or protective conductor monitoring. The measuring/test instrument serves to protect persons from electrical accidents in the low-voltage range (130 to 1000 V). The PRCD-S must be suitable for commercial use, and is installed like an extension cable between an electrical consumer – as a rule an electrical tool – and the electrical outlet.

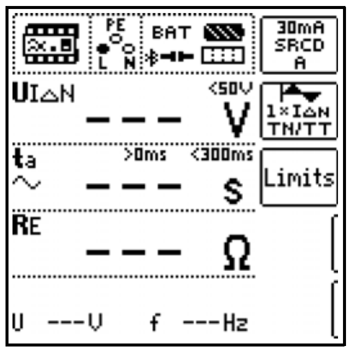
Parameter Settings

SRCD/PRCD



Start Measurement





14.6.7 TYPE G OR R RCCB

In addition to standard RCCBs and selective RCDs, the special characteristics of the type G RCCB can also be tested with the measuring/test instrument.

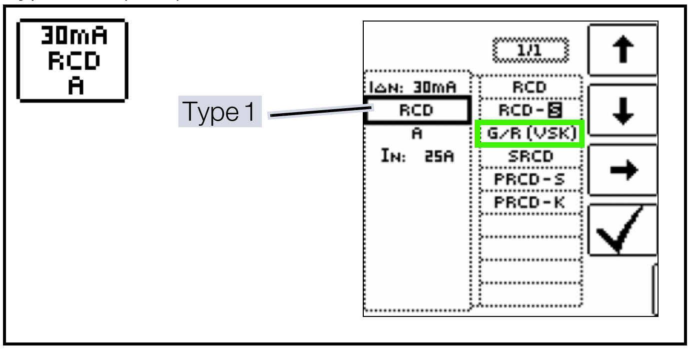
The type G RCCB is an Austrian specialty which complies with device standard ÖVE/ÖNORM E 8601. Erroneous tripping is minimized thanks to its greater current carrying capacity and short-term delay.

Select Measuring Function

RCD $I_{\Delta N}$

Parameter Settings

Type G/R (VSK):



Touch voltage and time to trip can be tested using the **RCD – G/R** setting.

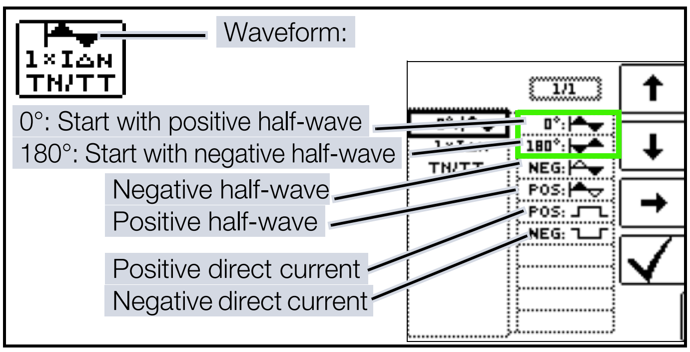
Note

It must be observed that time to trip for type G RCCBs may be as long as 1000 ms when measurement is made at nominal residual current. Set the limit value correspondingly.

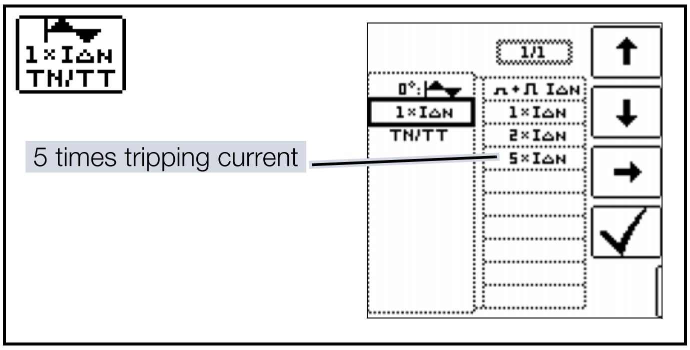
Then select 5 × $I_{\Delta N}$ in the menu (this is selected automatically for the G/R setting) and repeat the tripping test beginning with the positive half-wave at 0° and the negative half-wave at 180° (full-wave setting). The longer of the two tripping times is decisive regarding the condition of the tested RCCB.

Parameter Settings

Start with the positive or negative half-wave of the respective full-wave:



5 times nominal residual current:



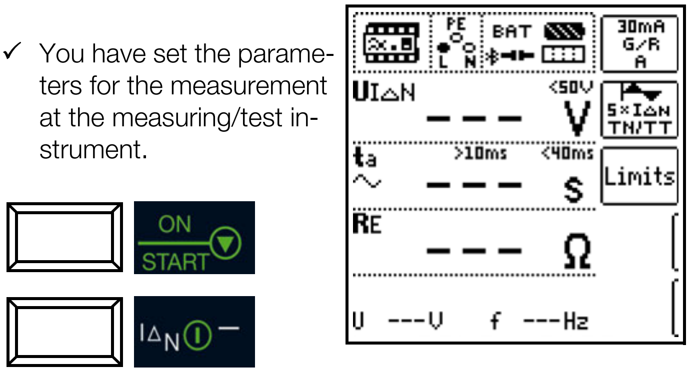
Start Measurement

Note

Battery operation: Incorrect measurement results when the battery is low!

Only perform the measurement with DC test current if the battery charge level is ≥ 50%.

✓ You have set the parameters for the measurement at the measuring/test instrument.



In both cases tripping time must be between 10 and 40 ms (10 ms = minimum delay time for type G RCCBs!).

Type G RCCBs with other nominal residual current values must be tested with the corresponding parameter setting under menu item $I_{\Delta N}$. In this case as well, the limit value must be appropriately adjusted.

Note

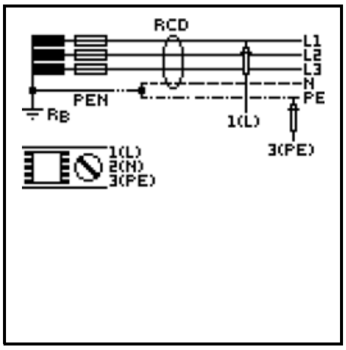
The RCD S parameter setting for selective RCCBs is not suitable for type G RCCBs.

14.6.8 TESTING RESIDUAL CURRENT CIRCUIT BREAKERS IN TN-S SYSTEMS

RCCBs can only be used in TN-S systems (PE and N laid separately). An RCCB would not work in a TN-C system because PE is directly connected to the neutral conductor in the outlet (it does not bypass the RCCB). This means that residual current would be returned via the RCCB and would not generate any residual current, which is required in order to trip the RCCB.

As a rule, the display for touch voltage is also 0.1 V, because the nominal residual current of 30 mA together with minimal loop resistance result in a very small voltage value:
$U_{I\Delta N} = R_E \times I_{\Delta N} = 1\ \Omega \times 30\ \text{mA} = 30\ \text{mV} = 0.03\ \text{V}$

Connection



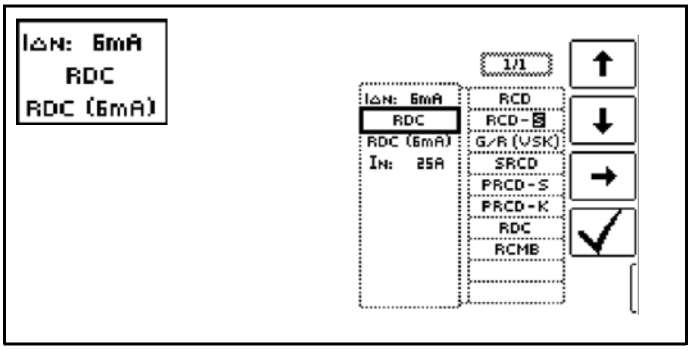
14.7 TESTING 6 MA RESIDUAL CURRENT DEVICES RDC-DD / RCMB

DIN VDE 0100-722 (Requirements for special installations or locations – Supplies for electric vehicles) specifies that all outlets for charging electric vehicles must be protected by a separate residual current device (RCD).
Furthermore, additional protection is required for multiphase charging with smooth DC fault current. Either a type B RCD, an RDC-DD (residual direct current detecting device) or an RCMB (residual current monitoring module) can be used to this end.

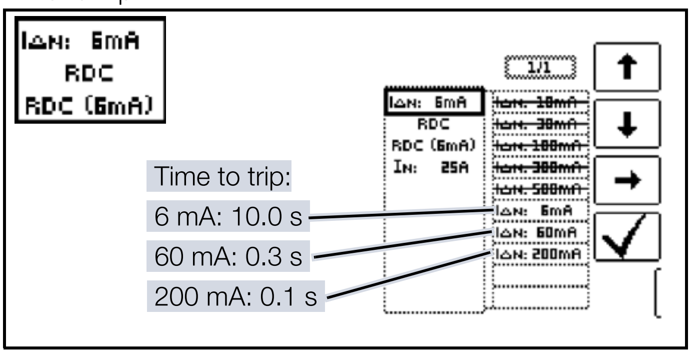
Select Measuring Function

Parameter Settings – Type RDC

RDC:



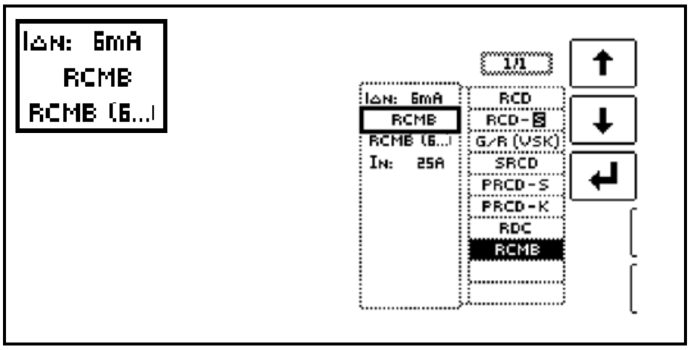
Time to trip:



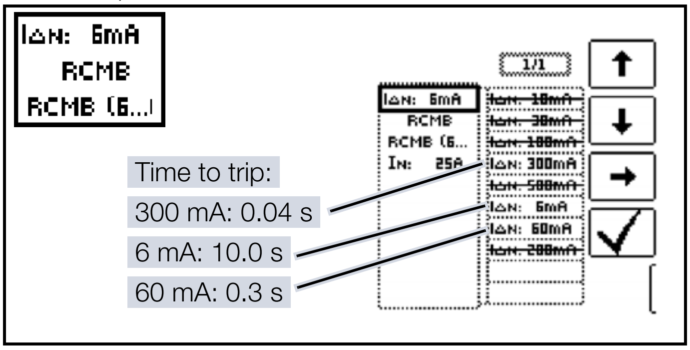
Note
The RDC-DD is tested with nominal residual currents of 6 to 200 mA.

Set Parameter – Type RCMB

RCMB:



Time to trip:

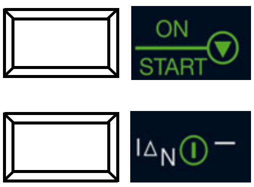


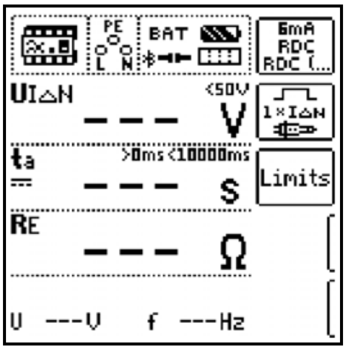
Note

The RCMB is tested with nominal residual currents of 6 to 300 mA.

Start Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.





14.8 NOTES CONCERNING MEASUREMENT

14.8.1 GENERAL

- TN system: due to low protective conductor resistance, measured values for touch voltage $U_{I}\Delta_{N}$ are very low.
- Leakage current downstream from the RCD can influence measurement results and may lead to erroneous tripping.
- If the neutral conductor is used as a probe, the connection between the neutral point and ground must be checked in advance. Any voltage between the neutral conductor and ground can influence the measurement.
- Earth resistance must not exceed the manufacturer's specification.
- Measurement may be influenced by other earthing devices.
- Operating equipment downstream from the RCD, for example rotating machines, may significantly increase time to trip.
- Observe the limit values for touch voltage which are stipulated in your country. These may vary depending on the application.
- If inductive power consumers are shut down during the tripping test, resulting voltage peaks may make measurement impossible: measured value display **---**. They may also cause the fuses in the measuring/test instrument to blow and result in damage to the instrument.
- Observe shutdown times which depend on the system type during measurement of time to trip as well. The preset limit values are based on valid manufacturing standards for RCDs.

14.8.2 RCDS OF SPECIAL DESIGN

Special conditions must be taken into consideration for RCDs of special design:

Selective RCDs (identification S)

In order to assure correct testing of tripping performance, waiting time is required while preloading resulting from the measurement of touch voltage $U_{I}\Delta_{N}$ is allowed to decay. This is indicated by a 30-second display of blinking bars in the t_a field during the **RCD IΔN** time to trip measurement. This waiting time can be circumvented by repeatedly pressing the **IΔN** key.

PRCD-K

Touch voltage measurement is not possible when this type has been selected. Measured values $U_{I}\Delta_{N}$ and R_E are thus not displayed.

Furthermore, PRCD-Ks have an inversely wired protective conductor. Consequently, tripping is already possible as of 0.25 × $I_{\Delta N}$.

RCBO

The **RCBO** function makes it possible to test RCCBs with overcurrent protection.

14.8.3 PRESETTINGS

Time to trip limits, RCD $I_{\Delta N}$, RCD $I_F + I_{\Delta N}$:

Waveform	$I_{\Delta N}$ Factor	General		Briefly Delayed		Selective	
		t_a >	t_a <	t_a >	t_a <	t_a >	t_a <
Sinusoidal	0.5	0 ms	300 ms	10 ms	300 ms	130 ms	500 ms
	1	0 ms	300 ms	10 ms	300 ms	130 ms	500 ms
	2	0 ms	150 ms	10 ms	150 ms	60 ms	200 ms
	5	0 ms	40 ms	10 ms	40 ms	50 ms	150 ms
Half-wave	0.5	0 ms	300 ms	10 ms	300 ms	130 ms	500 ms
	1	0 ms	300 ms	10 ms	300 ms	130 ms	500 ms
DC	1	0 ms	300 ms	10 ms [1)]	300 ms [2)]	130 ms	500 ms

1) Disabled at the measuring/test instrument

2) Disabled at the measuring/test instrument

Tripping current limits, RCD RCD I_F, RCD $I_F + I_{\Delta N}$

	IΔ >	IΔ <
Sinusoidal	½ × $I_{\Delta N}$ [1)]	1 × $I_{\Delta N}$ [2)]
Half-wave	0.35 × $I_{\Delta N}$ [3)]	1.4 × $I_{\Delta N}$ [4)]
DC	½ × $I_{\Delta N}$	2 × $I_{\Delta N}$
Type EV, MI DC	3 mA	6 mA

1) PRCD-K and SRCD: Half of the respective value of the specified factor is set as the limit value for the no-trip test and the tripping test.

2) PRCD-K and SRCD: Half of the respective value of the specified factor is set as the limit value for the no-trip test and the tripping test.

3) PRCD-K and SRCD: Half of the respective value of the specified factor is set as the limit value for the no-trip test and the tripping test.

4) PRCD-K and SRCD: Half of the respective value of the specified factor is set as the limit value for the no-trip test and the tripping test.

15 Z_{LOOP} – TESTING OF BREAKING REQUIREMENTS FOR OVERCURRENT PROTECTIVE DEVICES, MEASUREMENT OF LINE OR LOOP IMPEDANCE AND DETERMINATION OF SHORT-CIRCUIT CURRENT

15.1 GENERAL

Testing of overcurrent protective devices includes visual inspection and measurement. Use the measuring/test instrument to perform measurements.

15.1.1 MEASURING METHOD

Depending on the utilized type of contacting, the measuring/test instrument permits measurement of line impedance Z_{L-N} or loop impedance Z_{L-PE}.

Loop impedance Z is measured and short-circuit current I_K is ascertained in order to determine whether or not the breaking requirements for protective devices have been fulfilled.

Loop impedance is the resistance within the current loop (utility station – phase conductor – protective conductor) when a short-circuit to an exposed conductive part occurs (conductive connection between phase conductor and protective conductor). Short-circuit current magnitude is determined by the loop impedance value. Short-circuit current I_K may not fall below a predetermined value set forth by DIN VDE 0100, so that reliable breaking of the protective device (fuse, automatic circuit breaker) is assured.

For this reason, the measured loop impedance value must be less than the maximum allowable value.

Tables containing allowable display values for loop impedance and minimum short-circuit current display values for ampere ratings for various fuses and circuit breakers can be found in the help texts and in chapter "Appendix" ➩🗎154. Maximum measuring/test instrument error in accordance with VDE 0413 has been taken into consideration in these tables. See also evaluation of the measured values in the following chapters.

At a line voltage of:

120V (-0%)

230V (-0%)

400V (-0%)

690V (-0%)

test current is ≥ 10 $A_{AC/DC}$.

If dangerous touch voltage occurs during measurement (> U_L), safety shutdown occurs.

The measuring/test instrument calculates short-circuit current I_K based on measured loop impedance Z_{LOOP} and line voltage. Short-circuit current calculation is made with reference to nominal line voltage for line voltages which lie within the nominal ranges for 120 V, 230 V, 400 V or 690 V systems. If line voltage does not lie within these nominal ranges, the measuring/test instrument calculates short-circuit current I_K based upon prevailing line voltage and measured loop resistance Z_{LOOP}.

> **Note**
> Loop impedance should be measured for each electrical circuit at the farthest point, in order to ascertain maximum loop impedance for the system.

> **Note**
> Observe national regulations, e.g. the necessity of conducting measurements beyond RCCBs in Austria.

Display of U_{L-N} (U_N / f_N)

If the measured voltage value lies within a range of ± 10% of the respective nominal line voltage of 120 V, 230 V, 400 V or 690 V, the respectively corresponding nominal line voltage is displayed. In the case of measured values outside of the ±10% tolerance, the actual measured value is displayed.

3-Phase Connections

Measurement of loop impedance to earth must be performed at all three phase conductors (L1, L2, and L3) for the testing of overcurrent protective devices at three phase outlets.

15.1.2 MEASUREMENTS WITH SUPPRESSION OF RCD TRIPPING

The measuring/test instrument makes it possible to measure loop impedance in TN systems with type A and F RCCBs (10 mA, 30 mA, 100 mA, 300 mA, 500 mA, 1000 mA nominal residual current).

The measuring/test instrument generates a direct current to this end, which saturates the RCCB’s magnetic circuit. The measuring/test instrument then superimposes a measuring current which only demonstrates half-waves of like polarity. The RCCB is no longer capable of detecting this measuring current and is consequently not tripped during measurement.

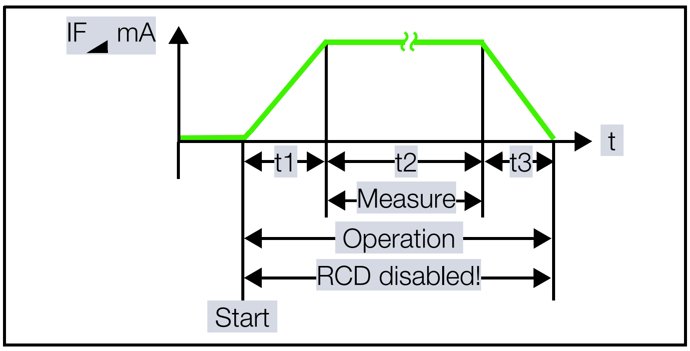


Fig. 6: Suppression of RCD Tripping with Pulsating Current-sensitive RCCBs

Four-wire measurement cables are used between the measuring/test instrument and the probes. Cable and probe resistance is automatically compensated for during measurement and does not affect measurement results.

Note

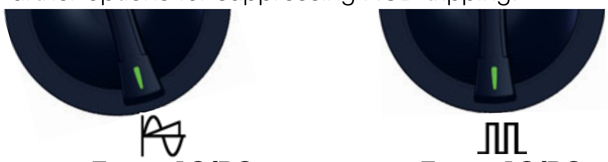
Loop impedance measurement in accordance with the procedure for the suppression of RCCB tripping is only possible with type A and F RCDs.

Note

Bias magnetization:

Use of probes 1(L), 2(N), 3(PE) is required for the measurement of bias magnetization.

Further options for suppressing RCD tripping:



ZLOOP AC/DC ZLOOP AC/DC

ATTENTION

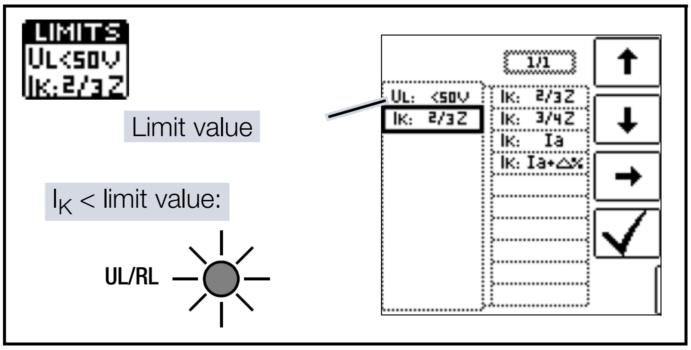
Tripping of Upstream RCDs

Damage to connected consumers.

Data loss.

- Switch off connected consumers before measuring.
- Back up your data before performing the measurement.
- Implement further appropriate safety precautions.

15.1.3 SETTINGS FOR CALCULATING SHORT-CIRCUIT CURRENT – PARAMETER I_K



Short-circuit current I_K is used to test shutdown by means of an overcurrent protective device. In order for an overcurrent protective device to be tripped on time, short-circuit current I_K must be greater than tripping/breaking current I_a (see table ⇨ "RCM Display Values" 160).

The variants which can be selected with the **Limits** key have the following meanings:

- **I_K: I_a**
  The measured value displayed for Z_{LOOP} is used without any correction to calculate I_K.
- **I_K: $I_a + \Delta\%$**
  The measured value displayed for Z_{LOOP} is corrected by an amount equal to the measuring/test instrument's measuring uncertainty in order to calculate I_K.
- **I_K: ⅔ Z**
  In order to calculate I_K, the measured value displayed for Z_{LOOP} is corrected by an amount corresponding to all possible deviations (these are defined in detail by VDE 0100-60 as $Z_{s(m)} \leq ⅔ \times U_0/I_a$).
- **IK: ¾ Z**
  $Z_{s(m)} \leq ¾ \text{ x} \times U_0/I_a$

Key

Z: loop impedance

I_K: short-circuit current

U: voltage at the test probes – U_N is displayed if voltage value U_{max} deviates from nominal voltage by 10%.

f: frequency of the applied voltage

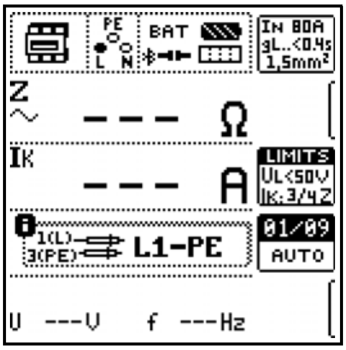
f_N is displayed if frequency f_{max} deviates from nominal frequency by 1%.

Ia: tripping current (see data sheet for circuit breakers / fuses)

D%: inherent error of the measuring/test instrument

15.1.4 SPECIAL CASE: MEASUREMENT WITHOUT LIMIT VALUES

If no limit values are specified, manual evaluation is required.

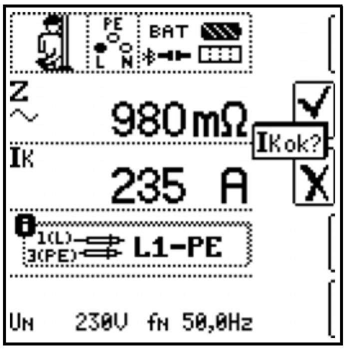


The inspector is prompted to evaluate the measured values himself, and to acknowledge or reject them with the help of the softkeys.

Measurement passed: ☑

Measurement failed: ☒

The measured value can only be saved after it has been evaluated.



15.1.5 EVALUATION OF MEASURED VALUES

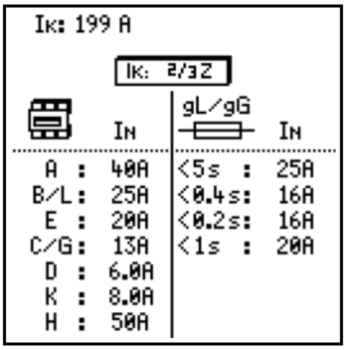
The maximum allowable loop impedance Z_{LOOP} which may be displayed after allowance has been made for maximum measuring error of the measuring/test instrument (under normal measuring conditions) can be determined with the help of the ⇨ "ZLOOP" 🗎159 table. Intermediate values can be interpolated.

The maximum permissible nominal current for the protective device (fuse or circuit breaker) for a line voltage of 230 V after allowance has been made for maximum measuring error of the measuring/test instrument can be determined with the help of the tables ⇨ "RCD Display Values" 🗎156 based on measured short-circuit current (corresponds to DIN VDE 0100-600).

15.1.6 ACCESSING THE TABLE OF "ALLOWABLE FUSES"

After respective measurement has been performed, allowable fuse types can be displayed by pressing the **HELP** key.

The table shows maximum permissible nominal current dependent on fuse type and breaking requirements.



Key:

I_a breaking current

I_K short-circuit current

I_N nominal current

t_a time to trip

15.2 Z_{LOOP} AC/DC – MEASURING LINE/ LOOP IMPEDANCE

Loop Impedance Measurement

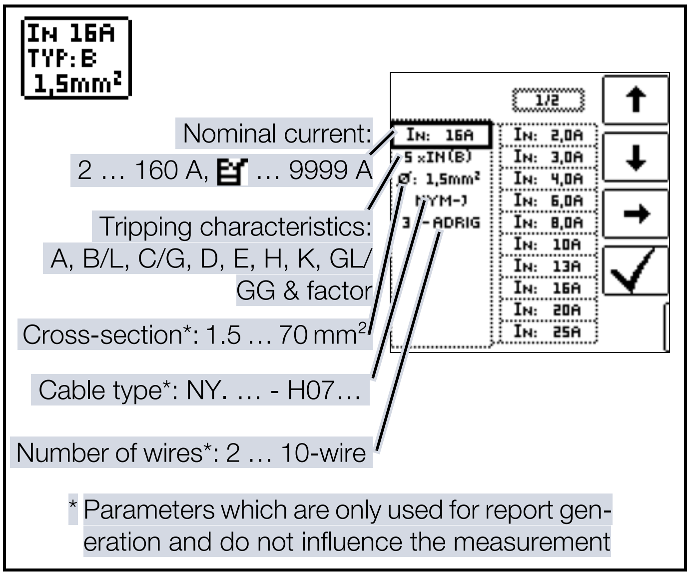
- With full-wave, test current: 10 $A_{AC/DC}$
- In 690 V systems
- In DC systems up to 840 V_{DC}

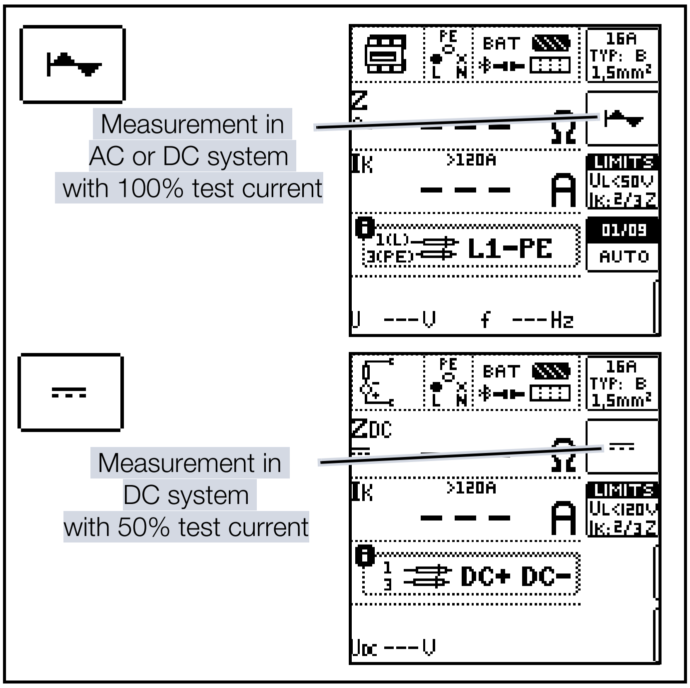
Circuits without RCD

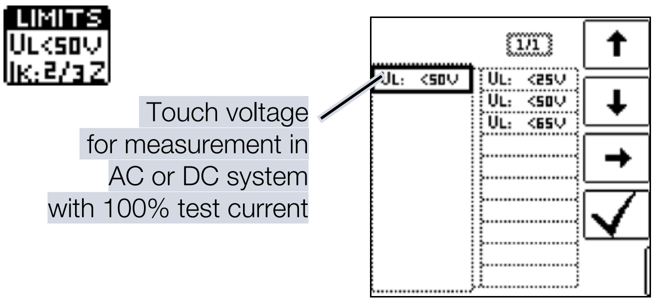
15.2.1 GENERAL

Select Measuring Function

Parameter





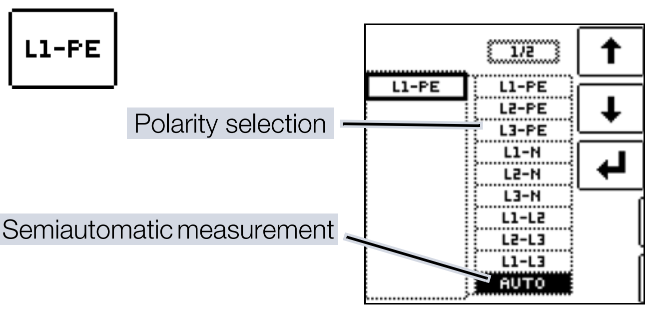


Measurement in the DC system with 50% test current: U_L =120 V (unchangeable)

Sinusoidal (full-wave): setting for circuits without RCD

See chapter "Settings for Calculating Short-Circuit Current – Parameter IK" ➪97 with regard to parameter I_K.

Measurement in AC system only:



15.2.2 Z_{LOOP} AC/DC MEASUREMENT

ATTENTION

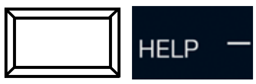
Tripping of Upstream RCDs

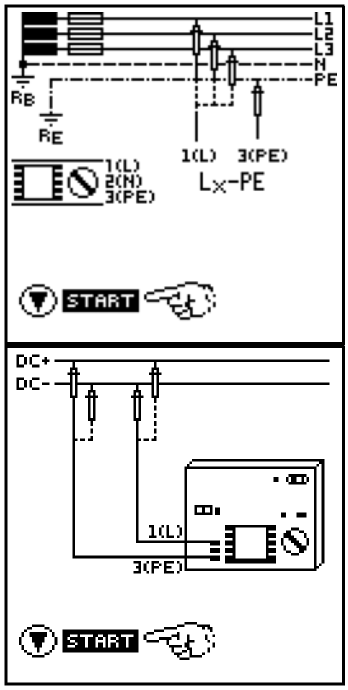
Damage to connected consumers.

Data loss.

- Switch off connected consumers before measuring.
- Back up your data before performing the measurement.
- Implement further appropriate safety precautions.

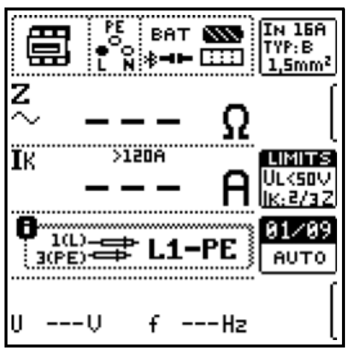
Connection





Start Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.



Saving Measured Values

Evaluating Measured Values

See chapter "Evaluation of Measured Values" ➪🗎98.

Displaying the Fuse Table

See chapter "Accessing the Table of “Allowable Fuses”" ➪🗎98.

15.3 Z_{LOOP} DC+ – MEASURING LINE IMPEDANCE

Measurement of loop impedance without tripping the RCD using the “DC current saturation method”.

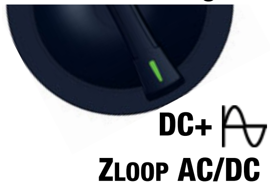
15.3.1 GENERAL

Measurement by means of half-waves plus direct current makes it possible to measure loop impedance in systems which are equipped with RCCBs (only for types A and F).

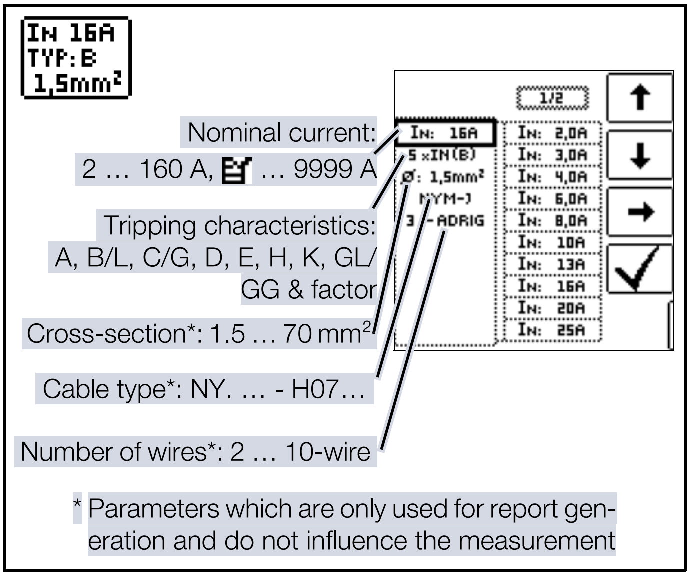
In the case of DC measurement with half-waves, selection can be made from two variants:

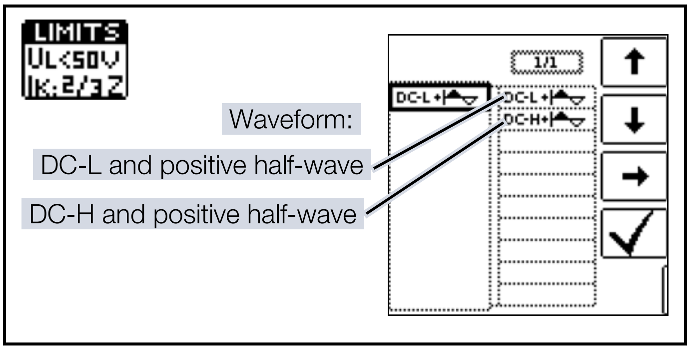
- **DC-L+**: lower bias current, but faster measurement possible
- **DC-H+**: higher bias current providing more reliability with regard to non-tripping of the RCD

Select Measuring Function

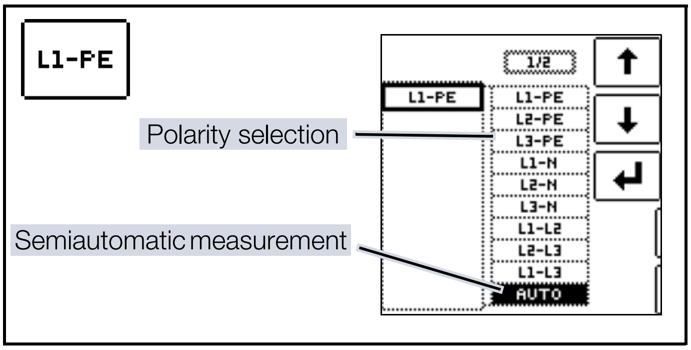


Parameter






See chapter "Settings for Calculating Short-Circuit Current – Parameter IK" ➪🗎97 with regard to parameter I_K.



Note

Selecting the **Lx-PE** reference or **AUTO** is only relevant with regard to report generation.

See also chapter "2-Pole Measurement with Fast or Semiautomatic Polarity Reversal" ➩🗎60 regarding the **AUTO** parameter.

15.3.2 Z_{LOOP} DC+ MEASUREMENT

ATTENTION

Tripping of Upstream RCDs

Damage to connected consumers.

Data loss.

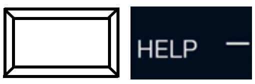
- Switch off connected consumers before measuring.
- Back up your data before performing the measurement.
- Implement further appropriate safety precautions.

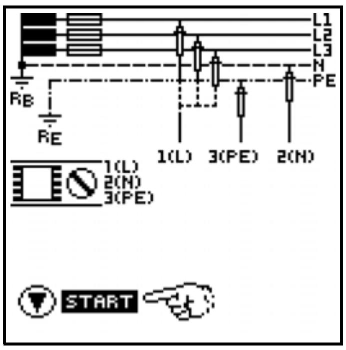
Note

Battery operation: Incorrect measurement results when the battery is low!

Only perform the Z_{LOOP} DC+ (DC-H) measurement with DC test current if the battery charge level is ≥ 50%.

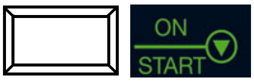
Connection

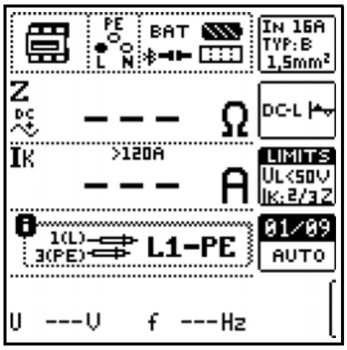




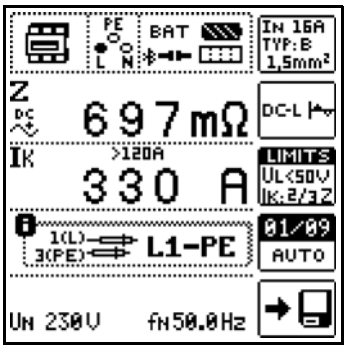
Start Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.





Saving Measured Values



Evaluating Measured Values

See chapter "Evaluation of Measured Values" ➩🗎98.

Displaying the Fuse Table

See chapter "Accessing the Table of “Allowable Fuses”" ➩🗎98.

15.4 Z_{LOOP} $Z+R_{LO}$ – MEASURING LOOP IMPEDANCE

This function permits the measurement of loop impedance Z_{L-PE} without tripping the RCD (types A, F and B) by means of a combined measuring method:

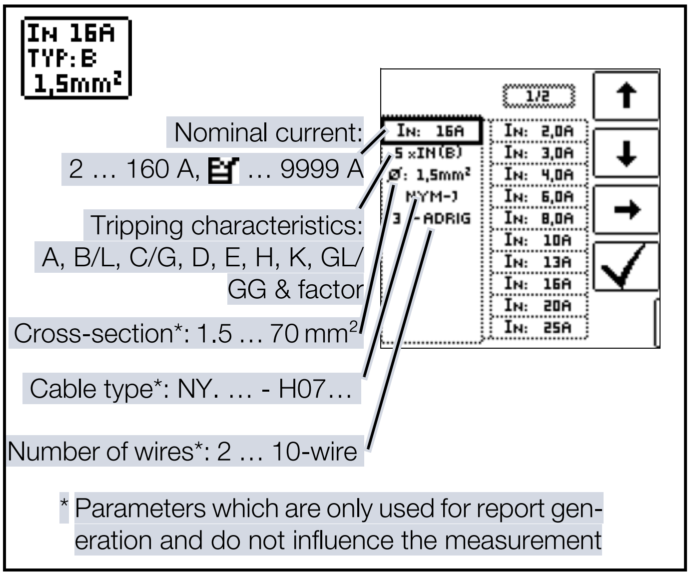
1. Measurement of Z_{L-N} with full test current
2. Measurement of R_{N-PE} with reduced test current

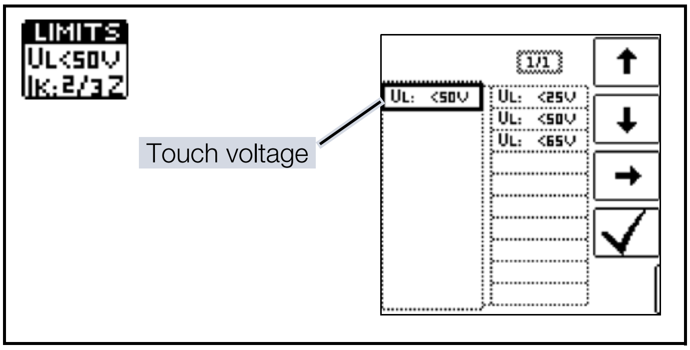
15.4.1 GENERAL

Select Measuring Function

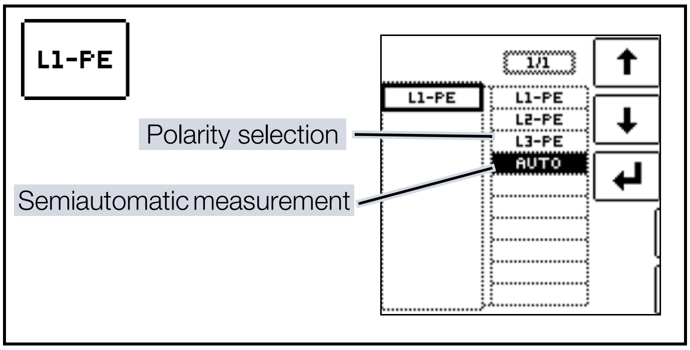
ZLOOP AC/DC

Parameter





See chapter "Settings for Calculating Short-Circuit Current – Parameter IK" ➪97 with regard to parameter I_K.



Note

Selecting the **Lx-PE** reference or **AUTO** is only relevant with regard to report generation.

See also chapter "2-Pole Measurement with Fast or Semiautomatic Polarity Reversal" ➪60 regarding the **AUTO** parameter.

15.4.2 Z_{LOOP} $Z+R_{LO}$ MEASUREMENT

ATTENTION

Tripping of Upstream RCDs

Damage to connected consumers.

Data loss.

- Switch off connected consumers before measuring.
- Back up your data before performing the measurement.
- Implement further appropriate safety precautions.

Note

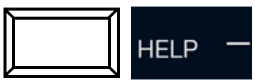
The correct RCD type (above all $I_{\Delta N}$) must be selected before measurement because the RCD will otherwise be tripped during the measuring procedure.

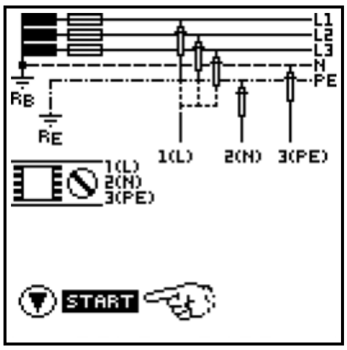
Connection

Probe 1(L) → mains L

Probe 2(N) → mains PE

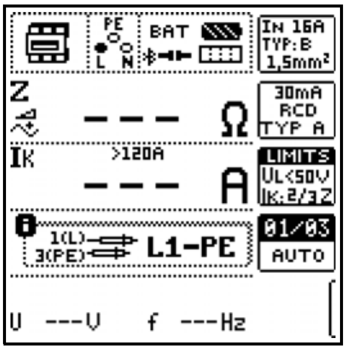
Probe 3(PE) → mains N



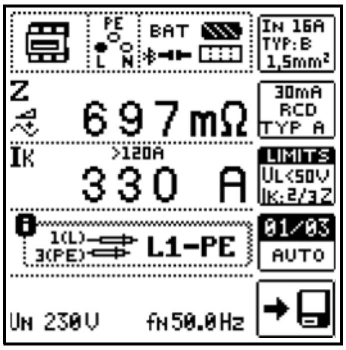


Start Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.



Saving Measured Values



Evaluating Measured Values

See chapter "Evaluation of Measured Values" ➩🗎98.

Displaying the Fuse Table

See chapter "Accessing the Table of “Allowable Fuses”" ➩🗎98.

15.5 Z_{LOOP} ⎍⎍ – MEASURING LOOP IMPEDANCE

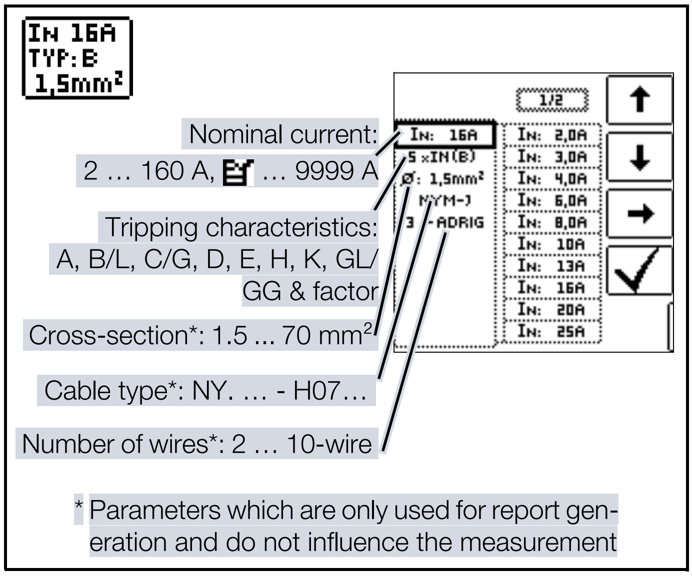
This function permits the measurement of loop impedance $Z_{L\text{-}PE}$ without tripping the RCD (types A and F) by using reduced test current depending on the characteristic data of the installed RCD (15 mA method).

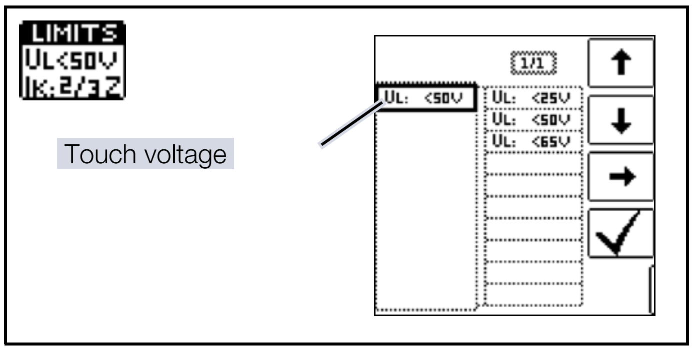
15.5.1 GENERAL

Select Measuring Function

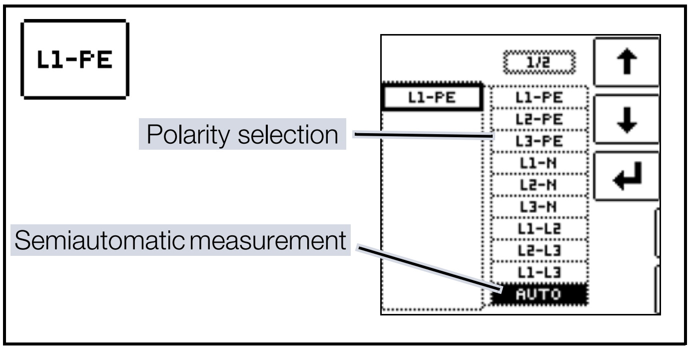
ZLOOP AC/DC

Parameter





See chapter "Settings for Calculating Short-Circuit Current – Parameter IK" ➩🗎97 with regard to parameter I_K.



Note

Selecting the **Lx-PE** reference or **AUTO** is only relevant with regard to report generation.

See also chapter "2-Pole Measurement with Fast or Semiautomatic Polarity Reversal" ➪🗎60 regarding the **AUTO** parameter.

15.5.2 Z_{LOOP} MEASUREMENT

ATTENTION

Tripping of Upstream RCDs

Damage to connected consumers.

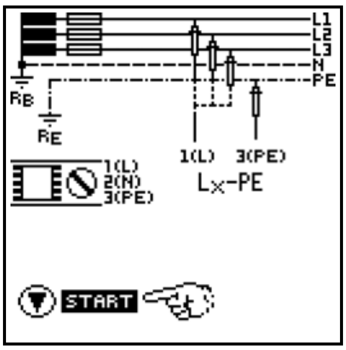
Data loss.

- Switch off connected consumers before measuring.
- Back up your data before performing the measurement.
- Implement further appropriate safety precautions.

Note

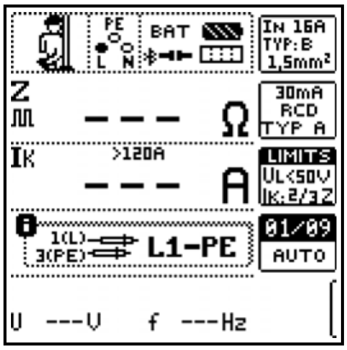
The correct RCD type (above all $I_{\Delta N}$) must be selected before measurement because the RCD will otherwise be tripped during the measuring procedure.

Connection

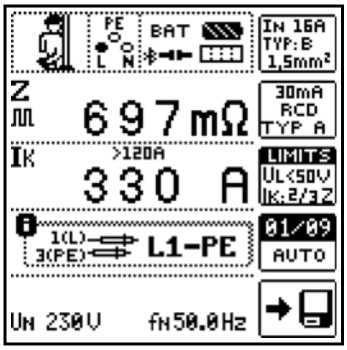


Start Measurement

✓ You have set the parameters for the measurement at the measuring/test instrument.



Saving Measured Values



Evaluating Measured Values

See chapter "Evaluation of Measured Values" ➪🗎98.

Displaying the Fuse Table

See chapter "Accessing the Table of “Allowable Fuses”" ➪🗎98.

16 U_{RES} – RESIDUAL VOLTAGE MEASUREMENT

EN 60204 specifies that after switching supply power off, residual voltage must drop to a value of 60 V or less within 5 seconds at all accessible, active components of a machine to which a voltage of greater than 60 V is applied during operation. Discharge time after exposing conductors is 1 second.

Testing for the absence of voltage is performed as follows with the measuring/test instrument by means of a voltage measurement which involves the measurement of discharge time:
In the case of voltage dips of greater than 5% of momentary line voltage (within 0.7 seconds), the stopwatch is started and momentary undervoltage is displayed as U_{res} after 5 seconds and indicated by the red **UL/RL** LED.

The function is ended after 30 seconds, after which U_{res} and t_u data can be deleted and the function can thus be restarted by pressing the **ESC** key.

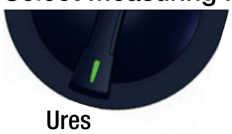
16.1 GENERAL

Measuring Method

Time is measured from shutdown of supply power until a voltage threshold is fallen short of.

Measurement is started in the case of voltage dips of more than 5% within 0.7 s.

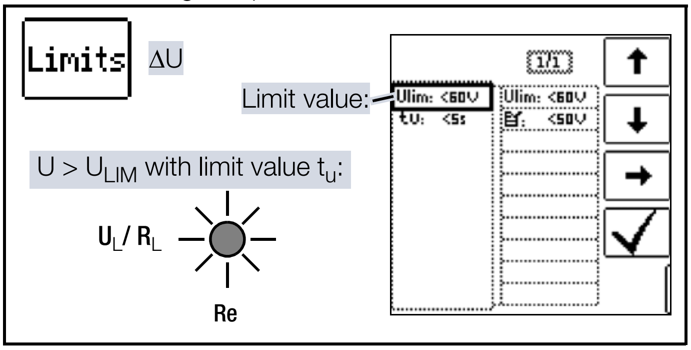
Select Measuring Function



Parameters

Limits – setting the limit values:

The Limits submenu offers the option of configuring the limit values for voltage threshold and discharge time. If the measured voltage value is greater than the selected voltage threshold when the discharge time limit has been reached, the **UL/RL** LED lights up red.

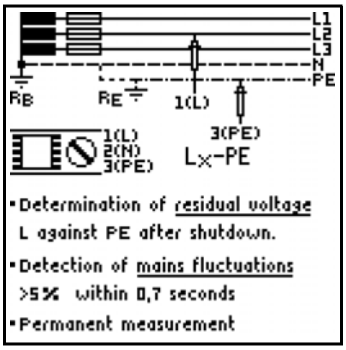


16.2 URES MEASUREMENT

Connection

Probe 1(L)

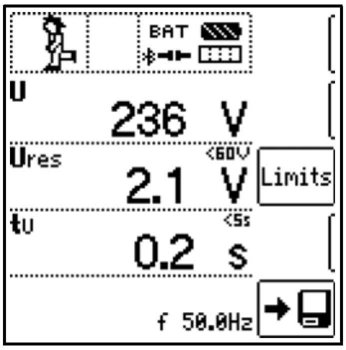
Probe 3(PE)



Measurement is continuously active, i.e. voltage dips are automatically detected without pressing a key.

The following measured values are displayed:

- U: momentary voltage at the test probes
- U_{res}: residual voltage
- t_u: discharge time
- f: frequency of the measured voltage



If the voltage threshold is not fallen short of, residual voltage is measured no later than after the selected time has elapsed.

Measurement is ended after 30 s in the event of an error.

Measured values are reset with subsequent restart and aborting of the measurement takes place after pressing the **ESC** key.

The measured value can be saved via softkey after measurement has been performed.

17 IMDS – TESTING INSULATION MONITORING DEVICES

Insulation monitoring devices (IMDs), insulation fault locators (IFLs) and earth fault detecting systems (EDS) are used in IT systems, for example in the field of e-mobility for DC charging at charging stations in order to monitor insulation resistance. If the required insulation resistance is fallen short of, a message is read out. The measuring/test instrument provides you with the option of testing responsiveness.

17.1 GENERAL

Measuring Method

A single-pole insulation fault is simulated by introducing various resistances between the phase and protective conductors and tripping of the IMD is induced. Time to trip is acquired manually and the response characteristics are evaluated. The test resistors can be set within a range of 15 kΩ to 2.51 MΩ in 65 different steps.

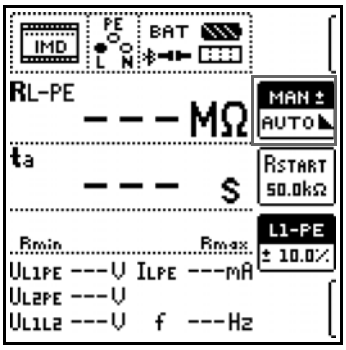
Select Measuring Function

IMD

Parameters

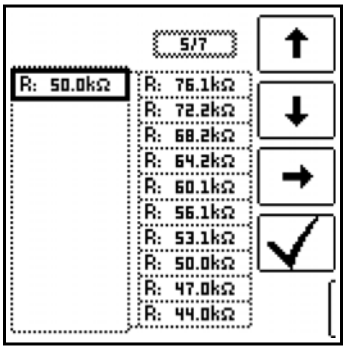
There are two ways to conduct the test:

- **MAN**: Resistance is changed manually by pressing the respective softkeys.
- **AUTO**: Resistance is changed automatically every 2 seconds beginning with $\mathbf{R_{START}}$.



Resistance R_{START}

Numerous parameters are available for setting resistance $\mathbf{R_{START}}$, with which measurement is begun.

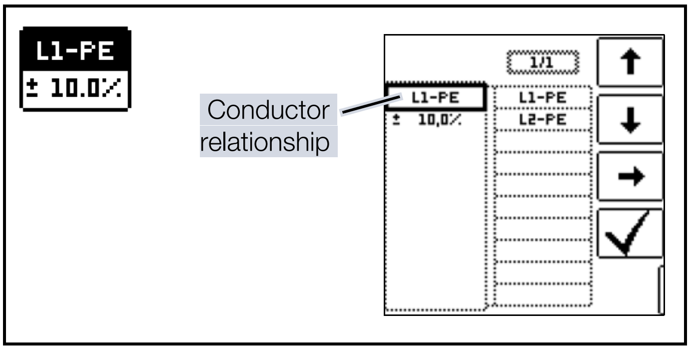


Conductor relationship / resistance range:

- **Conductor relationship**: The corresponding conductor relationship can be selected for documentation of the measuring point.
- **Resistance range**: A range of values can be selected for testing the display of resistance at the IMD.

The parameter is set as a percentage with reference to the resistance momentarily introduced by the measuring/test instrument.

Upper and lower limit values are displayed in the measuring view.



17.2 IMD MEASUREMENT

ATTENTION

Excessive Test Current

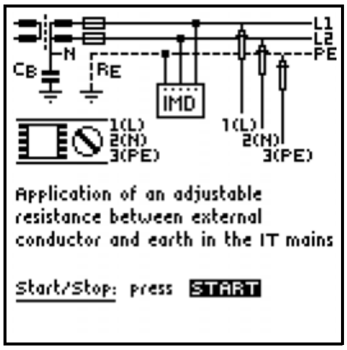
Sensitive system components may be damaged. Select an appropriate test resistance.

Connection

L1: Probe 1(L)

L2: Probe 2(N)

PE: Probe 3(PE)



Measuring Sequence

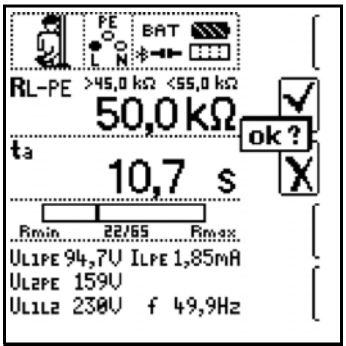
1. Set the parameters ⇨ "General" 🗎106.
2. Start: Press the **ON/START** key.

3. A resistance is introduced between the phase and protective conductors and time measurement is started.
4. **Manual test MAN ±**: press the or softkey to increase or reduce test resistance $R_{L\text{-}PE}$.
   Automatic test **AUTO**: the resistance value is changed automatically.
   ↳ Time to trip t_a is restarted each time resistance is changed.
5. Changing the conductor relationship:
   Press the **IΔN** key.

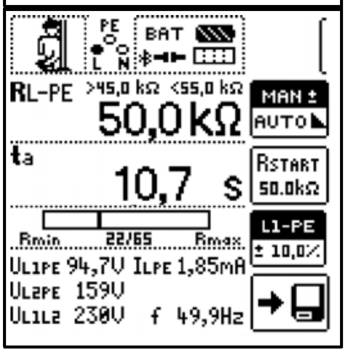
6. End of measurement: In order to end measurement, press the **ON/START** key as soon as the IMD indicates that insulation resistance has been fallen short of.
   ↳ Measured values display
   The following measured values are displayed:
   - $R_{L\text{-}PE}$: active test resistance with upper and lower limit values

- t_a: response time (during which momentary resistance is applied until the measurement is ended)
- R_{min}/R_{max}: status display indicating momentary resistance with reference to the number of possible resistances
- $U_{L1\text{-}PE}$: momentary voltage at the test probes between phase conductor L1 and protective conductor PE
- $U_{L2\text{-}PE}$: momentary voltage at the test probes between phase conductor L2 and protective conductor PE
- $U_{L1\text{-}L2}$: momentary voltage at the test probes between phase conductors L1 and L2
- $I_{L\text{-}PE}$: test current flowing through the active resistance
- f: frequency of the applied voltage

7. After stopping the measurement, the **ok?** evaluation prompt appears and the stopwatch is stopped.
   ☒ = NOK / ☑ = OK
   ↳ Evaluation ☒: the **UL/RL** LED lights up red.



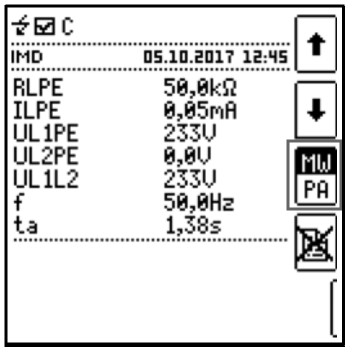
8. Save: press the **Save Value** softkey.



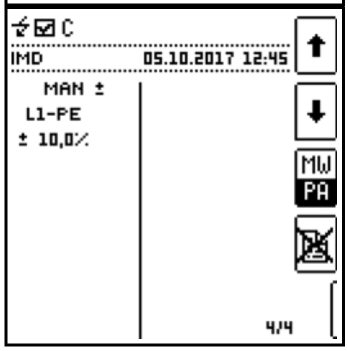
Measurement can be aborted by pressing **ON/START** or **ESC**. The evaluation prompt appears (see above) even after aborting with **ESC**.

17.3 RETRIEVING SAVED MEASURED VALUES

The measured value cannot be saved to memory and included in the test report until it has been evaluated (see also chapter "Saving Measurements/Tests" ➪🗎61).



The setting parameters can be displayed for this measurement with the help of the **MW/PA** key (MW: measured value, PA: parameter).



18 RCM – TESTING OF RESIDUAL CURRENT MONITORING DEVICES

Residual current monitoring devices (RCMs) are used to monitor residual current. They measure and display momentarily flowing current and indicate errors, for example due to defective insulation, in the event that an alarm threshold is fallen short of. As opposed to residual current protective devices, RCMs do not switch off the electrical circuit directly. This is only possible indirectly through the activation of external switchgear. The measuring/test instrument offers the option of testing the response characteristics of RCMs.

18.1 GENERAL

Measuring Method

A test current with constant amperage is applied and the alarm function is checked. When exceeding of the alarm threshold is indicated by the RCM, time measurement for the determination of response time is stopped manually.

Touch voltage is measured by outputting a test current which is below the tripping limit, and by means of subsequent extrapolation up to the nominal residual current value of the RCD.

Response characteristics are then evaluated for report generation.

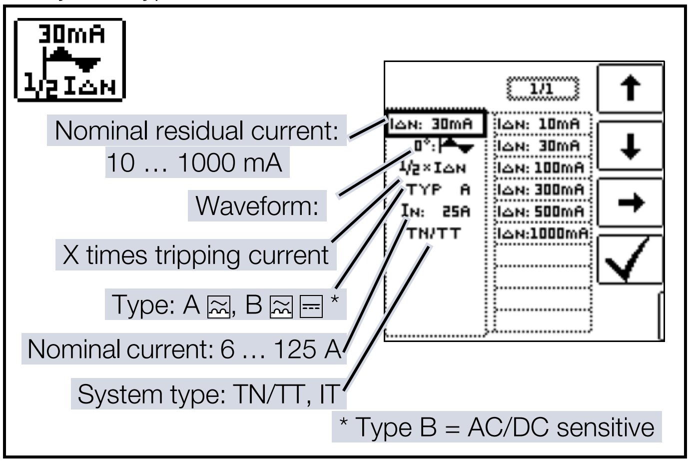
Select Measuring Function

Parameters

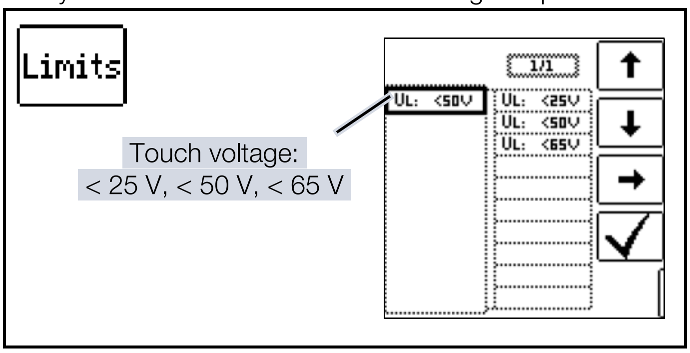
The measurement parameters can be set in the submenus which are described below.

RCM parameter:

- $I_{\Delta N}$: nominal residual current
- Waveform:
  - Full-wave, 0°
  - Full-wave, 180°
  - Positive half-wave
  - Negative half-wave
  - Positive direct current
  - Negative direct current
- Tripping current factor:
  - 0.5 × $I_{\Delta N}$: no-trip test with half nominal residual current (duration: 10 s)
  - 1 × $I_{\Delta N}$: tripping test with nominal residual current (duration: 10 s)
- Characteristic, e.g. type AC, type B
- I_N: nominal current
- System type



Limits – setting the limit value for U_L (maximum permissible touch voltage):
If prevailing touch voltage $U_{I\Delta N}$ is greater than limit value U_L, safety shutdown ensues. The **UL/RL LED** lights up red.



18.2 RCM MEASUREMENT

Connection

Measurement with full and half-wave:

Probe 1(L)

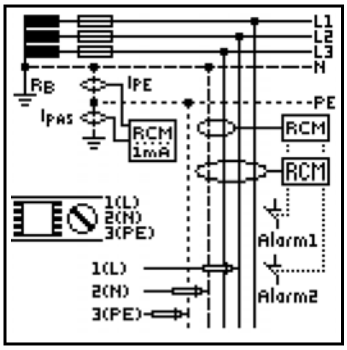
Probe 3(PE)

Measurement with direct current:

Probe 1(L)

Probe 2(N)

Probe 3(PE)



Test methods

1. If only an RCM has been installed – i.e. no RCDs – the test equipment can be connected between mains and ground.
2. Use of an RCM in combination with an RCD:
   a RCD tripping is permissible if the measuring/test instrument is connected between mains and ground.
   b Tripping of the RCD is not permissible if:

- The measuring/test instrument is connected between an upstream conductor and a downstream neutral conductor
- The measuring/test instrument is connected between upstream conductor 1 and downstream conductor 2
- The measuring/test instrument is connected between conductor and ground with downstream RCD
- The measuring/test instrument is only connected to additional conductors via the residual current converter
- The measuring/test instrument is connected for the testing of directionally sensitive RCMs in IT systems Connection must be made at the load side.

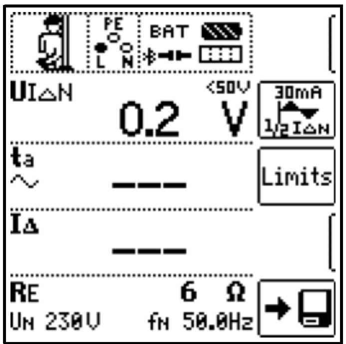
3. If RCMs are used in combination with electronic devices such as frequency converters, converters without electrical isolation etc., it's generally necessary to test the system at several points, for example upstream from the frequency converter, in the frequency converter's intermediate DC circuit and downstream from the frequency converter.

Measuring Sequence

✓ You have set the parameters for the measurement at the measuring/test instrument.

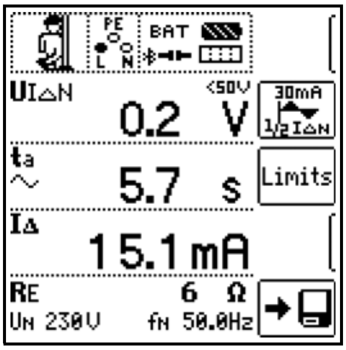
1. In order to start touch voltage measurement:
   Press the **ON/START** key.

   ↳ The following measured values are displayed: $U_{I\Delta N}$, R_E, U, f.



2. Starting the no-trip/tripping test:
   Press the **IΔN** key.

   ↳ Test current is applied.
3. After measurement:
   Press the **IΔN** key as soon as the RCM is tripped.
   ↳ The following measured values are displayed: $U_{I\Delta N}$, t_a, I_Δ, R_E, U, f.



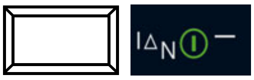
4. After stopping the measurement, the **ok?** evaluation prompt appears and the stopwatch is stopped.
   ☒ = NOK / ☑ = OK
   ↳ Evaluation ☒ (in case of false alarm): the **UL/RL** LED lights up red.
5. Press the corresponding softkey to save your results. (The measured value cannot be saved to memory and included in the test report until it has been evaluated.)

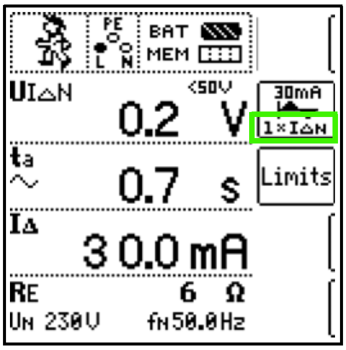
No-trip test with ½ × $I_{\Delta N}$ and 10 s

After 10 seconds have elapsed, no residual current may be indicated. The measurement must then be evaluated. In the event that **NOT OK** is selected, an error is indicated by the **UL/RL** LED which lights up red.

Tripping test with 1 × $I_{\Delta N}$:

- Measurement of signal response time (stopwatch function) with residual current generated by the measuring/test instrument
- Measurement must be stopped manually by pressing **ON/START** or **IΔN** immediately after indication of residual current, in order to document tripping time.





Key:

- $U_{I\Delta N}$: touch voltage relative to nominal residual current
- t_a: response time (= time until the tripping test is stopped manually)
- I_Δ: tripping current
- R_E: earth loop resistance
- U: Momentary voltage at the test probes – U_N is displayed if voltage value U max. deviates from nominal voltage by 10%.
- f: frequency of applied voltage, f_N is displayed if frequency f max. deviates from nominal frequency by 1%.

Notes Concerning Measurement

- Any voltage between the protective conductor and ground can influence the touch voltage measurement.
- Voltage between the neutral and protective conductors can influence the touch voltage measurement. If the neutral conductor is used as a probe, the connection between the distributor neutral point and ground must be checked before measurement is started.
- Leakage current within the electrical circuit downstream from the RCM may influence the measurement.
- Earth electrode resistance must lie within the limits specified by the manufacturer during the touch voltage measurement.
- Potential fields resulting from other earthing devices may influence the ascertainment of touch voltage.
- Within special ranges, reduced touch voltage limit values apply: 25 V_{AC} or 60 V_{DC}.

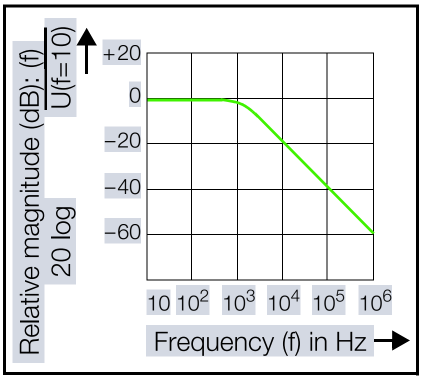
19 I_L – LEAKAGE CURRENT

The IL measurement permits the measurement of, amongst other values, touch current depending on the utilized type of contacting. At exposed conductive parts which are not connected to the protective conductor, the current must be measured which can flow to earth via the user when touched.

19.1 GENERAL

Measuring Method

The I_L measurement is based on the direct measuring method, i.e. current is measured to earth potential via a 2 kΩ resistor. The 3(PE) probe must be connected to the protective conductor system, and the conductive surfaces under test are contacted with the 1(L) probe. TRMS current measurement is performed, and a frequency evaluation is conducted on the basis of a defined frequency response of the measuring setup (see diagram above). A continuous measurement function is used.

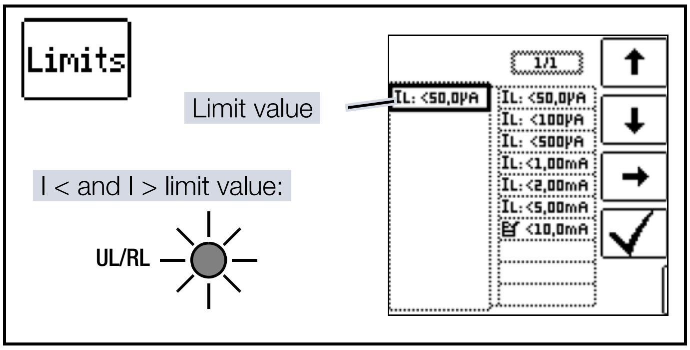


Note
The measuring/test instrument is equipped with safety shutdown in case of interference voltages (see measuring sequence).

Select Measuring Function

Parameters

I_L within a range of 0.01 to 10.0 mA



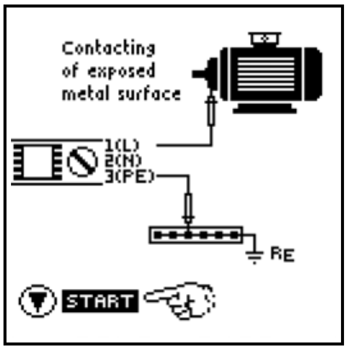
Specifying limit values results in automatic evaluation at the end of the measurement.

19.2 I_L MEASUREMENT

Connection

Probe 1(L)

Probe 3(PE)



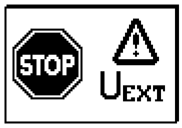
Measuring Sequence

ATTENTION

Interference voltage at the device under test

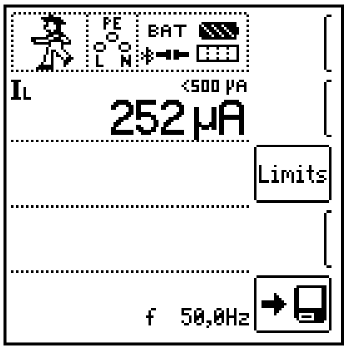
Damage to the device under test.

- The part to be measured must be voltage-free! In case of doubt, test the part to be measured for absence of voltage before starting the I_L measurement.
- The measuring/test instrument is equipped with a protective device: interference voltage detection is active before starting and during current measurement. If interference voltage of greater than 60 V_{TRMS} is detected at probes 1(L) and 3(PE), safety shutdown is triggered. A pop-up appears in the event of safety shutdown.
- Complete the following measuring steps in the order specified in order to assure that interference voltage detection is active when measurement is started.



1. Set the parameters.
2. Connect the probes.
3. In order to start current measurement:
   Press the **ON/START** key.

↳ The measured values are displayed.



Note
Frequency is only displayed as of a level of I_L > 100 µA.

4. Press the corresponding softkey to save your results.

20 $I_{L/AMP}$ – CURRENT AND APPARENT POWER MEASUREMENT WITH CURRENT CLAMP SENSOR

The following can be measured with the help of a current clamp sensor:

- Bias, leakage and equalizing current
- Power (apparent power)
  (simplified – calculation based on the selected voltage and the measured current value)

Note

Please note that apparent power S is an inferred value.

The measured current value must always be used for all safety and quality-relevant tests.

20.1 GENERAL

Current Clamp Sensors

DANGER

High Voltage

Risk of electric shock.

Damage to the measuring/test instrument.

- Use only current clamp sensors which are specified as accessories.
- Observe and comply with the characteristic values of the utilized current clamp sensor, in particular the measurement category.
  Refer to the relevant product documentation for complete information on the current clamp sensor.
- Do not measure any currents which are greater than specified for the measuring range of the respective clamp.
  Input voltage at the measuring/test instrument's function socket may not exceed 1 V.

An overview of compatible current clamp sensors is available in chapter "Optional Accessories" ➪12.

The current clamp sensor is connected via the function socket. See chapter "Instrument Overview" ➪15.

Select Measuring Function

Parameters

Transformation ratio:
The transformation ratio parameter must be correspondingly set at the measuring/test instrument depending on the respectively selected measuring range at the current clamp sensor.

Select the measuring range at the current clamp sensor:

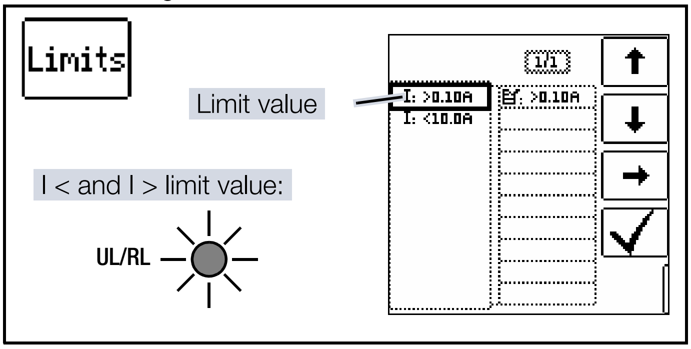
Measuring/ Test Instrument	Clamp Meters				Measuring/ Test Instrument
Transformation Ratio	PROFITEST CLIP	Switch: METRAFLEX P300 [1]	Measuring Range PROFITEST CLIP	Measuring Range METRAFLEX P300	Measuring Range
100:1 1 V / 10 mA	100 mV/mA	—	0.1 mA … 25 mA	—	0.2 mA … 9.99 mA
1:1 1 V/A	—	3 A (1 V/A)	—	3 A	5 mA … 999 mA
01:10 100 mV/A	—	30 A (100 mV/A)	—	30 A	0.05 A … 10 A
1:100 10 mV/A	—	300 A (10 mV/A)	—	300 A	0.5 A … 100 A

1) Can be connected via the Z506J adapter

Measuring/ Test Instrument	Z3512A [1]		Measuring/ Test Instrument
Parameters Transformation Ratio	Switch	Measuring Range	Measuring Range
1:1 1 V / A	1 A / × 1	1 A	5 mA … 999 mA
01:10 100 mV / A	10 A / × 10	10 A	0.05 A … 10 A
1:100 10 mV / A	100 A / 15 100	100 A	0.5 A … 100 A

1) Can be connected via the Z506J adapter

Limits – setting the limit value:



Specifying limit values results in automatic evaluation at the end of the measurement.

Reference voltage:

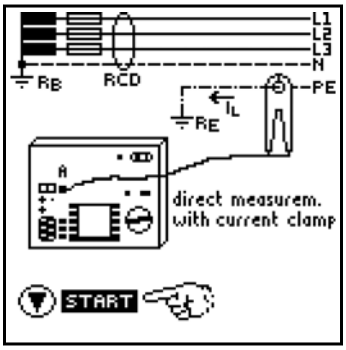
As a standard procedure, power is calculated with a reference voltage of 230 V.

As an alternative, the actual voltage value can be measured first:

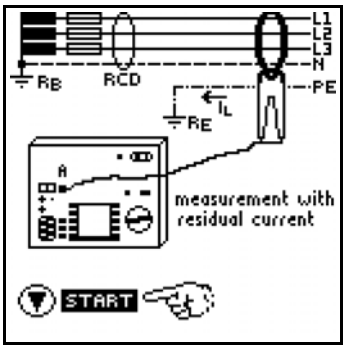
1. Set the rotary switch to the **U** position.
2. Measure voltage U (normally with the 2-pole adapter). See chapter "U – Measuring Voltage and Frequency" ➪🗎64.
3. The measured voltage value is accepted by pressing the **ON/START** key.
   ↳ Two intermittent tones indicate successful acquisition of the value.
4. Set the rotary switch to the ≤ 1V ≅ position.
   ↳ The previously measured voltage value appears at the bottom of the display.
5. Measurement can then be performed as described in this section.

20.2 IL/AMP MEASUREMENT

Connection for Direct Measurement



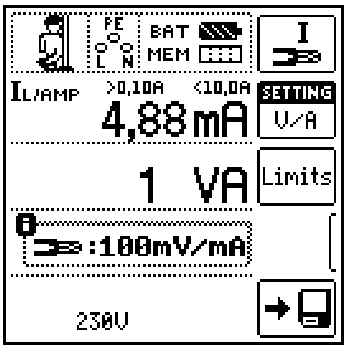
Connection for Differential Method



Measuring Sequence

1. Set the rotary switch to the ≤ 1V ≅ position.
2. Connect the current clamp sensor.
3. Set the parameters.
   In particular the transformation ratio of the connected current clamp sensor.
4. In order to start current clamp measurement:
   Press the **ON/START** key.

   ↳ The measured values are displayed.
5. Press the **ON/START** key to stop the measurement.
6. Press the corresponding softkey to save your results.



21 T %R.H. – MEASUREMENT OF TEMPERATURE AND ATMOSPHERIC HUMIDITY

Temperature and relative atmospheric humidity can be measured using the Z506G accessory sensor with the help of this measuring function.

Fig. 7: T/H sensor Z506G

21.1 GENERAL

Select Measuring Function

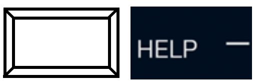
Parameters

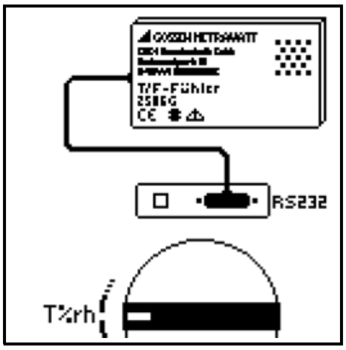
Temperature can be displayed in either °C or °F by pressing the corresponding softkey.

21.2 T % R.H. MEASUREMENT

Connection

The sensor is connected to socket 5: RS 232 port



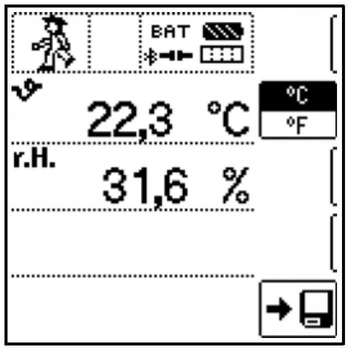


Measuring Sequence

✓ You have set the parameters for the measurement at the measuring/test instrument.

1. Connect the Z506G T/H sensor. See chapter "Instrument Overview" ➪15.
   ↳ The measured values are displayed.
   The following measured values are displayed:
   - **ϑ**: temperature [°C/°F]
   - **r.H.**: relative humidity [%]

2. Press the corresponding softkey to save your results.



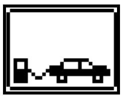
Notes concerning measurement:

- Automatic measuring/test instrument shutdown is not active in this function.
- The RS 232 port is not intended for communication with the PC.
- Monitoring of the probes' measurement inputs is not active for the basic measuring functions (probes for 1(L), 2(N) and 3(PE) or L1, L2 and L3) with this measuring function.
  Simultaneous voltage measurement or checking for the absence of voltage is not possible in this function.

22 EXTRA – SPECIAL FUNCTIONS

- Voltage drop measurement ➩🗎114

- Documentation of charging station tests (checking the operating states of an electric vehicle at charging stations per IEC 61851) ➩🗎117



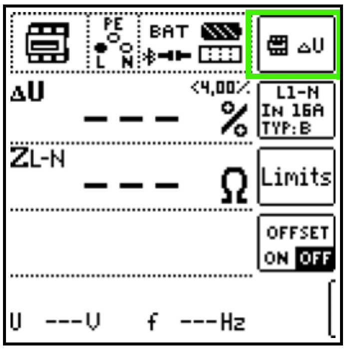
- Documentation of fault simulations at PRCDs with the PROFITEST PRCD adapter ➩🗎119

22.1 GENERAL

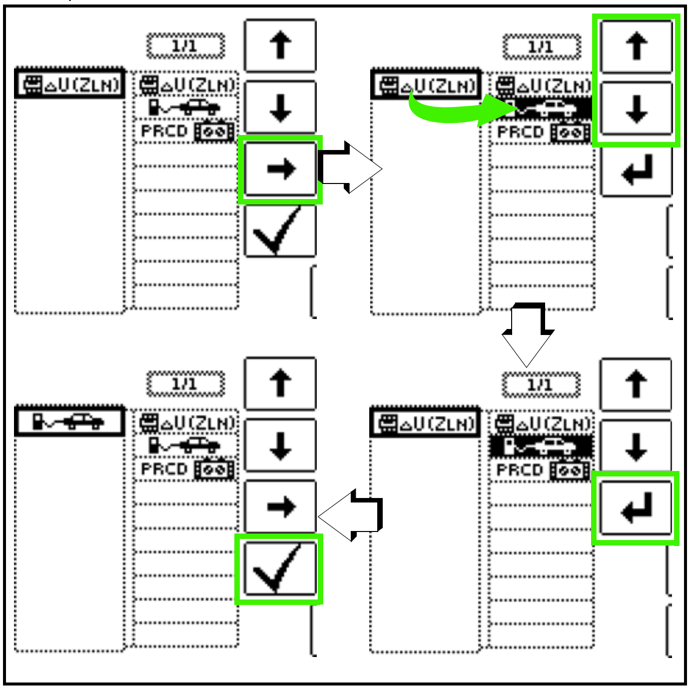
Select the EXTRA switch position.

Selecting Special Functions

The list of special functions is accessed by pressing the uppermost softkey. Select the desired function with the appropriate icon.



Example of further selection, PRCD test:



22.2 ΔU – VOLTAGE DROP MEASUREMENT

22.2.1 GENERAL

In order to assure smooth operation of electrical equipment, it must be assured that an adequately high level of supply voltage is available. Losses in the form of voltage drops at conductors which occur due to prevailing conductor impedances must not be permitted to exceed certain limit values to this end. This makes it necessary to check existing voltage drop from the point of intersection between the distribution network and the power consuming system up to the consumer.

Measuring Method

The system is loaded by introducing a resistance and a voltage dip is generated as a result. This mains voltage reduction and the resulting current are measured in order to determine line impedance.

Absolute voltage drop can then be calculated with the following formula:

$\Delta U_{abs} = (Z - Z_{OFFSET}) \times I_N$, [V]

In order to obtain relative voltage drop, this is related to prevailing nominal voltage:

$\Delta U = 100 \times \Delta U_{abs} / U_N$, [%]

Key:

ΔU_{abs}: absolute voltage drop

Z: Line impedance (phase conductor – neutral conductor, phase conductor – phase conductor)

Z_{OFFSET}: line impedance at the transfer point

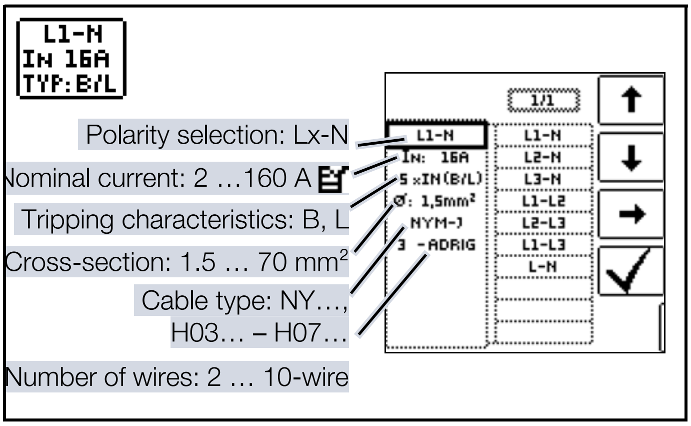
I_N: nominal current of the electrical circuit’s fuse

Parameters

Circuit:

- measuring point, e.g. L1-N
- IN: nominal current of the upstream fuse
- Tripping characteristic, e.g. 5 × I_N (B) (maximum tripping current is additionally specified)
- Cable cross-section
- Type of cable

- Number of wires



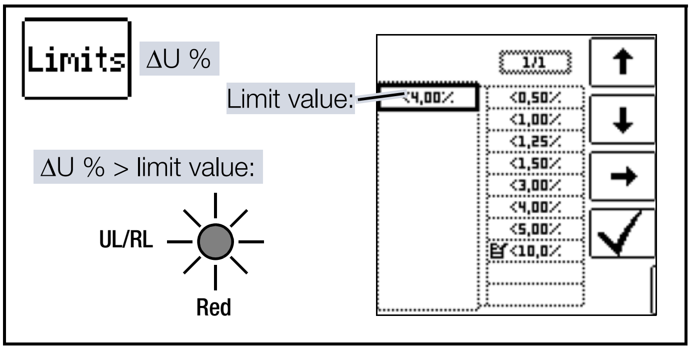
Note

If nominal current I_N is changed by ΔU_{OFFSET}, the offset value is automatically adjusted.

Limits – setting the limit value:

The measuring/test instrument permits the display of exceeded limit values. If measured voltage drop is greater than the selected limit value, the **UL/R** LED lights up red.

Various fixed parameters are available for settings, which are cited with reference to various standards. The list can be extended with the help of the editing function. This function is made available as soon as the cursor is located in the parameter selection column.



Note

Limit value per DIN 18015-1:
$\Delta U < 3\%$ between measuring device and consumer

VDE limit value per DIN VDE 0100-520:
$\Delta U \leq 3\%$ for lighting systems
$\Delta U \leq 5\%$ for other electrical appliances
in each case between the distribution network (public supply network) and the consuming device
(adjustable up to 10% in this case)

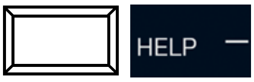
22.2.2 Z_{OFFSET} MEASUREMENT

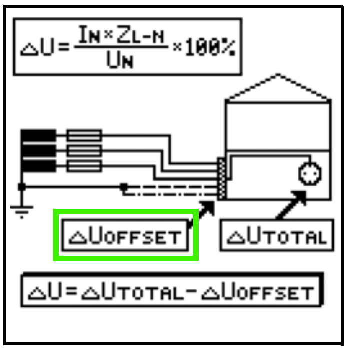
The Z_{OFFSET} function provides the option of saving the line impedance of the transfer point as an offset value and taking it into account for subsequent voltage drop measurements.

Connection

Probe 1(L)

Probe 3(PE)

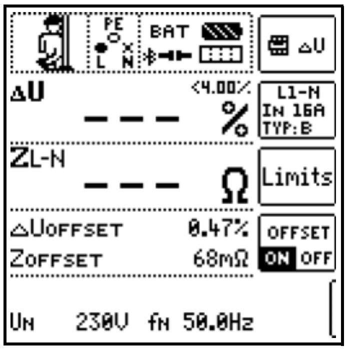




Measuring Sequence

✓ You have set the parameters for the measurement at the measuring/test instrument.

1. Activate the Z_{OFFSET} function by pressing the corresponding softkey .
   ↳ The following values are displayed:
   - ΔU_{OFFSET} 0.00%
   - Z_{OFFSET} 0.00 Ω
2. Connect the test probes to the transfer point (measuring device / meter).
3. Start measurement by pressing the **IΔN** key.
   
   ↳ First of all, an intermittent acoustic warning is generated and a blinking message appears, in order to prevent inadvertent deletion of a previously saved offset value.
   

4. Start offset measurement by pressing the triggering key once again (**IΔN**), or abort offset measurement by pressing the **ON/START** key (in this case **ESC**).
   ↳ Z_{OFFSET} is measured and ΔU_{OFFSET} is calculated.
   The results are displayed.
   

The following points must be observed:

- If nominal current I_N changes, ΔU_{OFFSET} is adjusted automatically.
- The ascertained Z_{OFFSET} value is deleted when the function is deactivated.
- If an error message appears, the last acquired, valid value is retained.

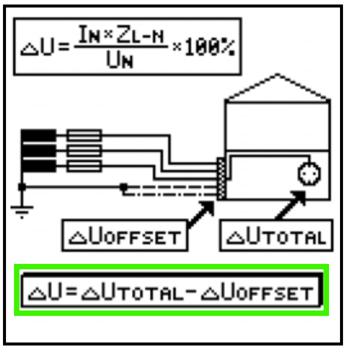
- As a result of the utilized 4-wire technology, resistance of the probe cables does not have to be calculated into the measurement results.

22.2.3 ΔU MEASUREMENT

Connection

Probe 1(L)

Probe 3(PE)



Measuring Sequence

1. Connect the test probes.
2. Set the parameters.
3. In order to start the voltage drop measurement:
   Press the **ON/START** key.

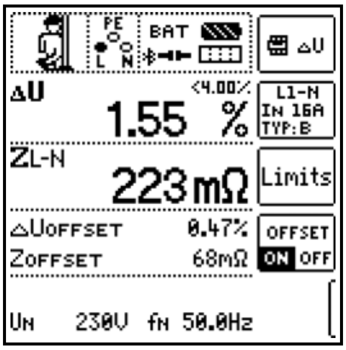
↳ Measurement is performed.

↳ The measured values are displayed:

- ΔU, Z, U, f

With activated Z_{OFFSET} function:

- ΔU_{OFFSET}: relative voltage drop at the transfer point
- Z_{OFFSET}: line impedance at the transfer point



4. Press the corresponding softkey to save your results.

If necessary: abort measurement by pressing **ON/START** or **ESC**

Key:

- ΔU: relative voltage drop
- Z: line impedance
- U: momentary voltage at the test probes –
  U_N is displayed if voltage U_{max} deviates from nominal voltage by 10%.
- f: frequency of the applied voltage
  f_N is displayed if frequency f_{max} deviates from nominal frequency by 1%.
- ΔU_{OFFSET}: relative voltage drop at the transfer point
- Z_{OFFSET}: line impedance at the transfer point

22.3 E-MOBILITY

In the field of e-mobility, various tests can be performed with the measuring/test instrument in combination with optional adapters.

- METRALINE PRO-TYP EM II ⇨117
  Single and 3-phase test adapter for testing electric charging points
- PROFITEST H+E EXPERT CHECK ⇨117
  Test adapter for testing e-charging points with visualization of the PWM signal
- PROFITEST EMOBILITY ⇨117
  Adapter for standards-compliant testing of mode 2 and 3, single and 3-phase charging cables
- Documentation of testing with
  - MENNEKES adapter ⇨117
  - WALTHER adapter ⇨117
  - HENSEL adapter ⇨117

  (documentation of visual inspection only / no measurements or tests)

22.3.1 METRALINE PRO-TYP EM II – SINGLE AND 3-PHASE TEST ADAPTER FOR TESTING ELECTRIC CHARGING POINTS

The METRALINE PRO-TYPE EM II is a test adapter for performing VDE tests at charging stations in accordance with IEC 61851 in combination with a compatible measuring/test instrument, for example the PROFITEST PRIME / PROFITEST PRIME AC.

The METRALINE PRO-TYP EM II is connected to the charging point to this end. By simulating an electric vehicle, it triggers a charging cycle which causes the flow of electric current to the charging station's socket. All relevant tests can then be carried out with the PROFITEST PRIME / PROFITEST PRIME AC via the test sockets (PE, N, L1, L2, L3).

Refer to the respective product documentation for complete information on the METRALINE PRO-TYP EM.

22.3.2 PROFITEST H+E EXPERT CHECK – TEST ADAPTER FOR TESTING E-CHARGING POINTS WITH VISUALIZATION OF THE PWM SIGNAL

The PROFITEST H+E EXPERT CHECK is a tester for checking AC charging points in accordance with DIN EN/ IEC 61851-1 (VDE 0122-1). The tester can be used to check the performance of AC charging points. The tester provides function tests, fault simulations and visualization of the PWM signal for this purpose.

In combination with a compatible measuring/test instrument such as the PROFITEST PRIME / PROFITEST PRIME AC, the effectiveness of protective measures at the AC charging point can be verified.

The PROFITEST H+E EXPERT CHECK is connected to the charging point to this end. By simulating an electric vehicle, it triggers a charging cycle which causes the flow of electric current to the charging station's socket. All relevant tests can then be carried out with the PROFITEST PRIME / PROFITEST PRIME AC via the test sockets (PE, N, L1, L2, L3).

Refer to the respective product documentation for complete information on the PROFITEST H+E EXPERT CHECK.

22.3.3 PROFITEST EMOBILITY – ADAPTER FOR STANDARDS-COMPLIANT TESTING OF MODE 2 AND 3, SINGLE AND 3-PHASE CHARGING CABLES

The PROFITEST EMOBILITY is an adapter for standards-compliant testing of single and 3-phase, mode 2 and 3 charging cables with simulation of faults in accordance with DIN EN 50678, VDE 0701 / DIN EN 50699, VDE 0702 and the manufacturer's specifications.

Some measurements/tests can be performed alone with the adapter, while others require a compatible test instrument, such as the PROFITEST PRIME / PROFITEST PRIME AC, and significantly expand the range of functions of the PROFITEST EMOBILITY.

Complete information regarding the PROFITEST EMOBILITY and its use in combination with the PROFITEST PRIME / PROFITEST PRIME AC can be found in the product documentation for the PROFITEST EMOBILITY.

22.3.4 DOCUMENTATION OF TESTS PERFORMED WITH ADAPTERS FROM MENNEKES, WALTHER AND HENSEL

When you perform tests with a

- MENNEKES adapter
- WALTHER adapter
- HENSEL adapter

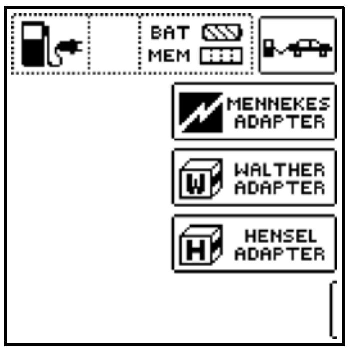
you can easily document them with the measuring/test instrument.

A guided test sequence is started at the measuring/test instrument to this end, or a specific vehicle operating state (e.g. status A) is manually selected, which is simulated accordingly with the respective adapter. The results are saved to the PROFITEST PRIME / PROFITEST PRIME AC as a visual inspection. They can then be documented in IZYTRONIQ software.

Procedure

This document only describes the procedure used for the PROFITEST PRIME / PROFITEST PRIME AC.
Refer to the product documentation for the respective adapter for information on how it's used.

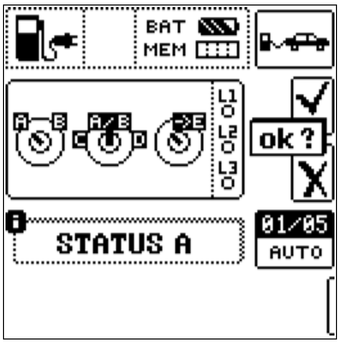
1. Select the adapter:
   After selecting charging station in the **EXTRA** menu (see chapter "General" ⇨114), the utilized adapter can be chosen by pressing the charging station symbol in the upper right-hand corner.



↳ The first test step is displayed immediately.

> **Tip**
> The **EXTRA** selection menu is accessed by pressing the charging station symbol in the upper right-hand corner once again.

2. The test sequence is selected by default, i.e. the **AUTO** parameter is active.
   Switching to manual status change (**SELECT STATUS** parameter), by means of which the operating state (status) to be tested can be selected individually, is accomplished by pressing this parameter key.



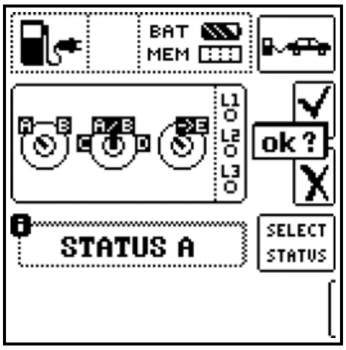
3. Simulate the vehicle state shown in the respective test step with the adapter.
   - Note the result as a visual inspection at the PROFITEST PRIME / PROFITEST PRIME AC.
     After responding to the visual inspection prompt and saving the results during the test sequence, automatic switching to the next status ensues – the 01/05 key display corresponds to A/E (01 = A, 02 = B, 03 = C, 04 = D, 05 = E).
     Status variants can be skipped by pressing the **IΔN** key.
4. Continue until all test steps have been documented.

Example: MENNEKES Adapter

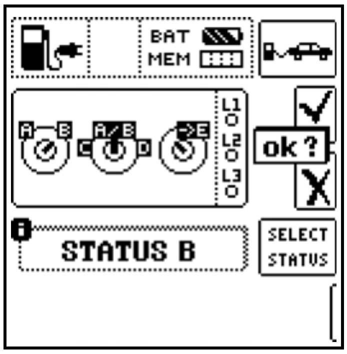
Simulation of operating states in accordance with IEC 61851 and manual selection of the vehicle state.

WALTHER and HENSEL adapters are handled analogously.

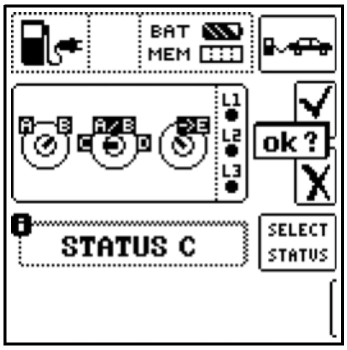
- Status A – charging cable connected to charging point only:
  - CP signal is activated.
  - Voltage between PE and CP is 12 V.



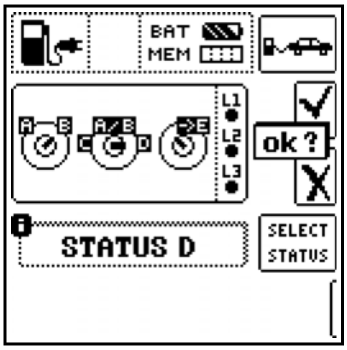
- Status B – charging cable connected to charging point and vehicle:
  - Charging cable is locked into place at the charging point and the vehicle.
  - Vehicle is not yet ready for charging.
  - Voltage between PE and CP: +9 V / -12 V



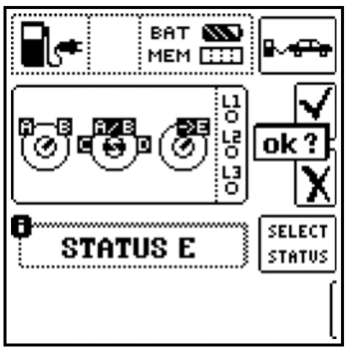
- Status C – non-gassing vehicle detected:
  - Vehicle is ready for charging / power is connected
  - Voltage between PE and CP is +6 V / -12 V.



- Status D – gassing vehicle detected:
  - Vehicle is ready for charging / power is connected
  - Voltage between PE and CP: +3 V / -12 V



- Status E – charging cable damaged:
  - Short-circuit between PE and CP
  - Charging cable is unlocked at the charging point.
  - Voltage between PE and CP is +0 V.



22.4 PRCD – TEST SEQUENCES FOR DOCUMENTING FAULT SIMULATIONS AT PRCDS WITH THE PROFITEST PRCD-ADAPTER

The following functions are possible after connecting the measuring/test instrument to the PROFITEST PRCD test adapter:

There are three preset test sequences:

- PRCD-S (single-phase / 3-pole)
- PRCD-S (3-phase / 5-pole)
- PRCD-K (single-phase / 3-pole)

The measuring/test instrument runs through all test steps semi-automatically:

- Single-phase PRCDs:
  - PRCD-S: 11 test steps
  - PRCD-K: 4 test steps
- 3-phase PRCDs:
  - PRCD-S: 18 test steps

Each test step is evaluated and assessed by the user (**OK**/**not OK**) for later documentation.

The PRCD's protective conductor resistance is measured by means of the measuring/test instrument's R_{LO} function.

Note

Please note that the protective conductor measurement is a modified R_{LO} measurement with ramp sequence for PRCDs ➪ "RLO 0.2A Measurement at PRCDs" 🗎69.

The PRCD's insulation resistance is measured by means of the measuring/test instrument's R_{ISO} function ➪ "RISO – Insulation Resistance Measurement" 🗎74.

The tripping test with nominal residual current is conducted by means of the measuring/test instrument's I_F ◢ function ➪ "RCD IF – Testing Residual Current Devices by Measuring Tripping Current with Rising Test Current" 🗎82.

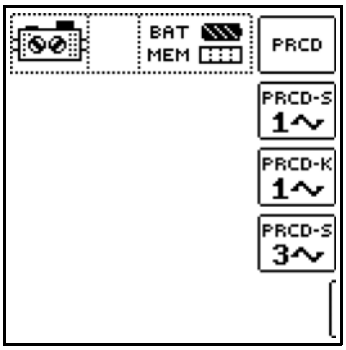
Time to trip is measured by means of the measuring/test instrument's $I_{\Delta N}$ function ➪ "RCD IΔn – Testing RCDs by Measuring Time to Trip with Constant Test Current" 🗎84.

The varistor test for PRCD-Ks is executed by means of a measurement conducted via an ISO ramp ➪ "RISO Ramp – Insulation Measurement with Rising Test Voltage" 🗎76.

22.4.1 SETTINGS

Selecting the PRCD to be Tested

After selecting PRCD in the **EXTRA** menu (➪ "General" 🗎114), the desired PRCD type can be chosen via the adapter symbol in the upper right-hand area. The **EXTRA** selection menu is accessed by pressing this key once again.



22.4.2 PARAMETERS

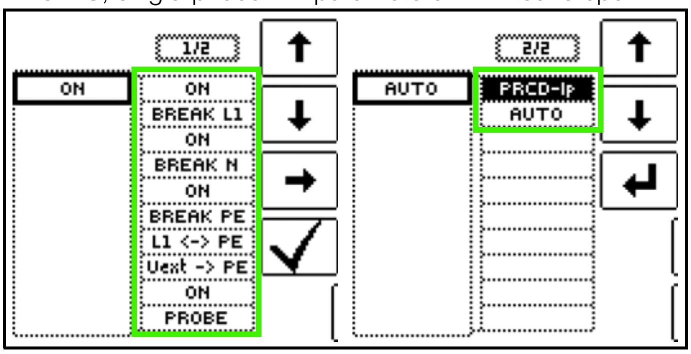
Meanings of symbols for the respective fault simulations:

Switch Position PROFITEST PRCD	Symbol at Measuring/Test Instrument: Parameter Setting	Symbol at Measuring/Test Instrument: Menu Display	Meanings of Symbols
	ON	1~ON	Single-phase PRCD activated
	ON	3~ON	3-phase PRCD activated
	BREAK Lx		Interrupted phase
	Lx←→PE Lx←→ N		Wires reversed between phase conductor and PE or neutral conductor
PE-U_{EXT}	U_{ext} → PE	PE-UEXT	PE to phase
	PROBE	ON	Contact **ON** key on PRCD with probe
	PRCD-I_p	ON	Protective conductor current measurement with current clamp transformer
—	AUTO	AUTO	Semi-automatic change of fault simulations

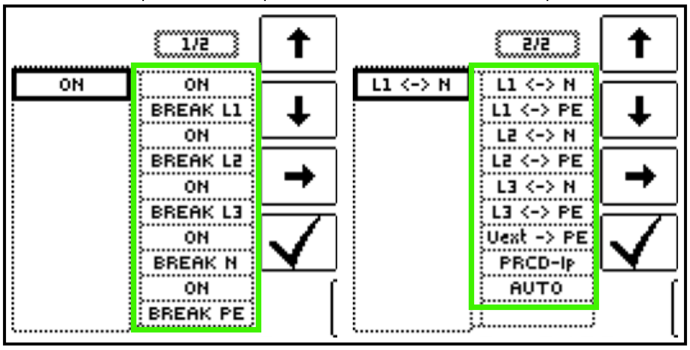
Together with the required intermediate steps for PRCD activation (= ON) the parameters for fault simulations represent the test steps:

- Interruption (BREAK …)
- Reversed conductors (L1 ←→ PE)
- PE to phase (U_{ext} → PE)
- Contact with the ON key
- Protective conductor current measurement (PRCD-I_p)

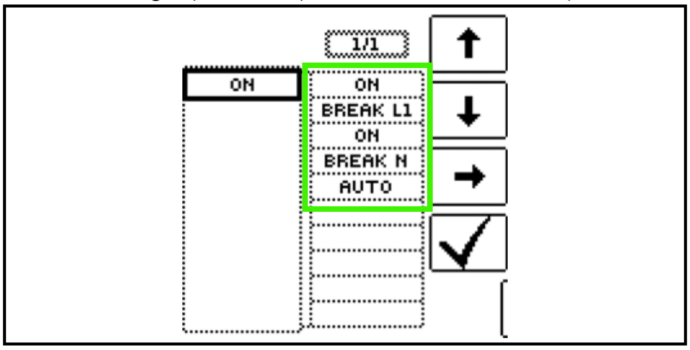
PRCD-S, single-phase: 11 parameters = 11 test steps



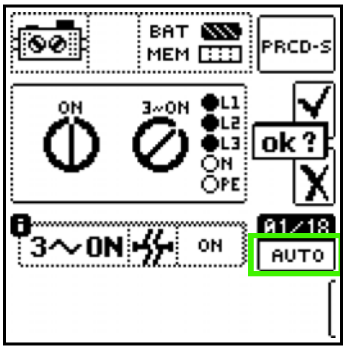
PRCD-S, 3-phase: 18 parameters = 18 test steps



PRCD-K, single-phase: 4 parameters = 4 test steps



Semi-Automatic Changing of Fault Simulations/Statuses



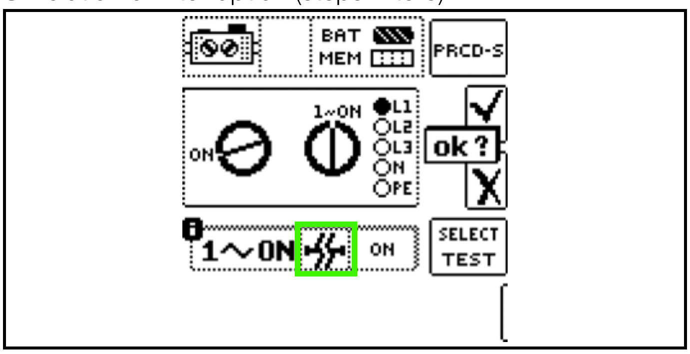
As an alternative to manual status changing via the parameters menu at the measuring/test instrument, quick and convenient switching amongst the fault simulations is also possible.

The **AUTO** status parameter has to be selected to this end. After responding to the visual inspection prompt and saving the results, automatic switching to the next fault simulation ensues. Fault simulations can be skipped by pressing the **IΔN** key.

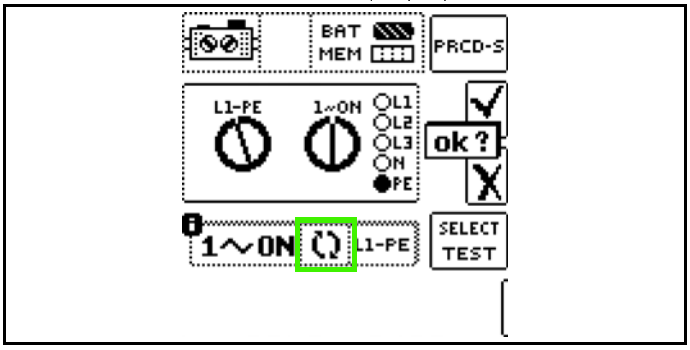
22.4.3 PRCD-S TEST SEQUENCE (SINGLE-PHASE) – 11 TEST STEPS

Selection Examples

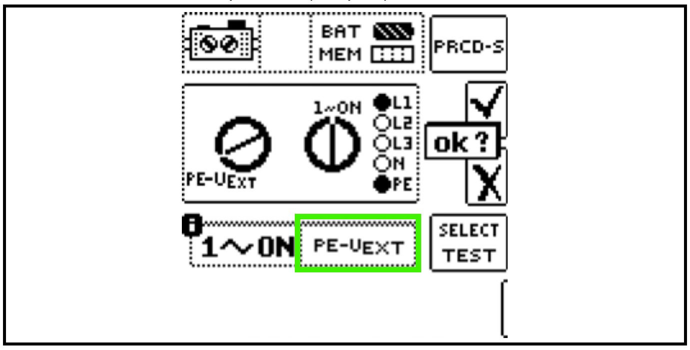
Simulation of interruption (steps 1 to 6):



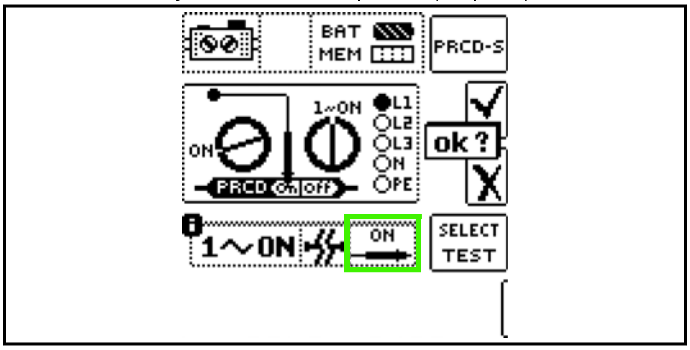
Reversed conductor simulation (step 7):



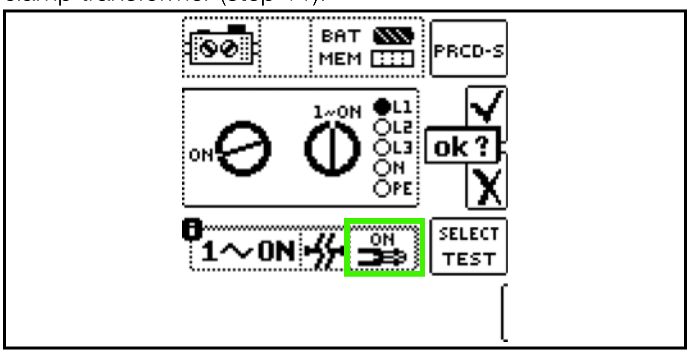
Simulation of PE to phase (step 8):



Contact ON key at PRCD with probe (step 10):



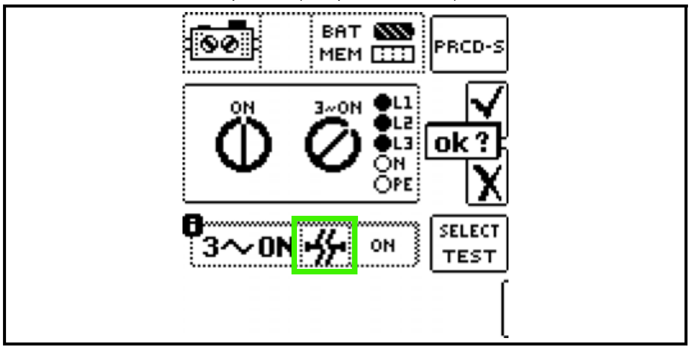
Measurement of protective conductor current with a current clamp transformer (step 11):



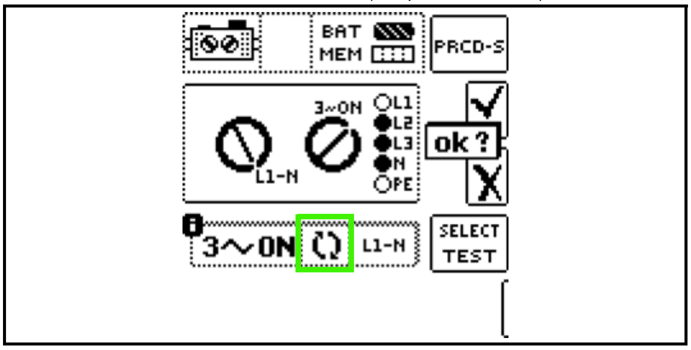
22.4.4 PRCD-S TEST SEQUENCE (3-PHASE) – 18 TEST STEPS

Selection Examples

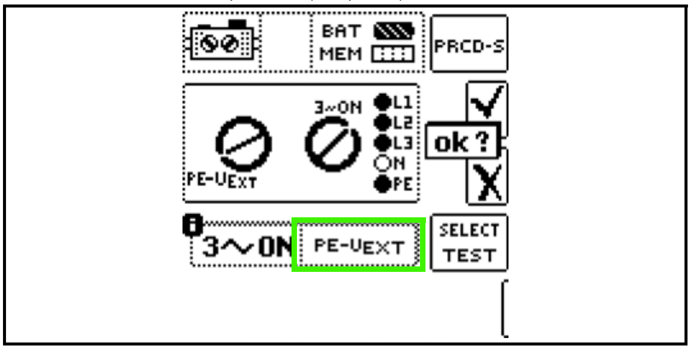
Simulation of interruption (steps 1 to 10):



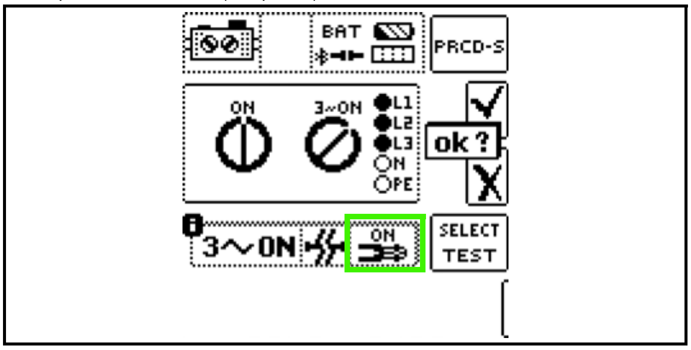
Reversed conductor simulation (steps 11 to 16):



Simulation of PE to phase (step 17):



Measurement of protective conductor current with a current clamp transformer (step 18):



23 HV – TESTING FOR DIELECTRIC STRENGTH,(PROFITEST PRIME AC ONLY)

The high-voltage module for the PROFITEST PRIME AC is intended for quick and safe performance of testing for dielectric strength at electrical and electronic equipment and systems in machines in accordance with DIN VDE 0113/ EN 60204-1.

All of the values required for approval reports can be measured with this measuring/test instrument.

23.1 SPECIAL SAFETY REQUIREMENTS AND INSTRUCTIONS FOR VOLTAGE TESTS

General

- Please read and comply with the safety information included in this section.
- Observe and comply with the general safety regulations as well ➪🗎6. Read them again!
- Observe and comply with the checklist for voltage tests ➪🗎122.
- Observe and comply with the stipulations set forth in DIN EN 50191/VDE 0104, “Erection and operation of electrical test equipment”.

Measuring/Test Instrument

- The measuring/test instrument itself must not be used as a device under test for voltage testing.
- Implement measures for the prevention of unauthorized use:
  - Make sure that the high-voltage module cannot be operated by unauthorized persons.
  - Grant access to the key switch to authorized persons only.
  - After testing has been completed, turn the key to the “closed padlock symbol” position and remove it.
- Electrically isolate test voltage from the mains.
  This prevents current from flowing from the high-voltage pistol to earth.
- Current limiting in the event of arc-over:
  If the current limit value entered as a device parameter is exceeded due to arc-over, the momentary measurement is automatically aborted and the measuring/test instrument switches back to the “ready for HV measurement” state.
- Power failure:
  When mains voltage is restored, the momentary measurement is aborted and the measuring/test instrument switches back to the “ready for HV measurement” state.

Test Area

- Before initializing any tests, and before enabling the test equipment, make sure that all means of access to the danger zone are closed, and that all persons have exited the danger zone.
- Use external signal lamps to indicate the operating state of the measuring/test instrument’s high-voltage module. Signal lamps may fail (e.g. damage to lamp elements or connection cable). For this reason, the inspector must always ensure that no other persons are present in the potential danger area of the test to be executed or in the potential danger area of the device under test (e.g. by means of cordoning off).
- Do not leave the measuring/test instrument unattended while the key switch is in the “open padlock symbol” position.

Operating Conditions

- Life endangering! Do not perform measurements in damp environments, in the presence of condensation or in areas where explosive gases may be present.

23.2 CHECKLIST FOR VOLTAGE TESTS

General

- ☐ You have read all of the safety precautions (➪🗎6 and ➪🗎122).

Personal Safety Measures

- ☐ The five safety rules in accordance with DIN VDE 0105-100“ “Operation of electrical installations – Part 100: General requirements” have been implemented. The system/ machine/installation is
  - ☐ 1) Completely shut down
  - ☐ 2) Secured against restart
  - ☐ 3) Deenergized at all poles
  - ☐ 4) Grounded and short-circuited.
  - ☐ 5) Neighboring live components have been covered or rendered inaccessible
- ☐ Warning devices have been set up:
  - ☐ Barriers are in place.
  - ☐ Warning signs are clearly visible.
  - ☐ Warning beacons are clearly visible.
  - ☐ The emergency off switch is connected, clearly visible and easy to reach.
- ☐ All points of access to the danger zone are blocked.
- ☐ All persons except for the inspectors have left the danger zone.
- ☐ People working nearby have been made aware of possible dangers.
- ☐ Each of the two high-voltage pistols can be operated with one of the inspector’s hands (two-hand operation).
- ☐ Protective conductor and insulation resistance measurements have been performed.
- ☐ Upon leaving the test area, the high-voltage module of the measuring/test instrument is secured against unauthorized use.

Safety Measures for the System/Machine/Installation (recommendations)

- ☐ The system/machine/installation is switched off. The power supply has been disconnected and is secured against reconnection (see above: five safety rules in accordance with DIN VDE 0105-100).
- ☐ Each circuit is short-circuited within itself.

- ☐ The neutral conductor (if present) has been disconnected from the mains.
  In TN Systems:
  The protective conductor is connected to the neutral conductor in this case and high-voltage is thus applied between phase conductor and neutral conductor.
  The neutral conductor (if included) must be interrupted if necessary, because it's not disconnected from the mains by means of fuses.
- ☐ Review the circuit diagrams and make a note of all electrical circuits.
- ☐ Control circuits with overvoltage arresters have been disconnected, if the arresters would be triggered by utilized test voltage.
- ☐ Converters have been disconnected.
- ☐ PELV circuits have been disconnected.
  (no HV testing required)
- ☐ Test insulation at each circuit with 1000 V (ISO measurement).
  (If insulation resistance is OK at 1000 V, no failures should occur when testing dielectric strength.)

Miscellaneous

- ☐ Any nearby IT equipment (PCs etc.) is switched off. All data on such equipment has been backed up.
  (Equipment operated in proximity to the test area may “crash” in the event of arc-over, resulting in possible data loss.)

23.3 REQUIRED ACCESSORIES

The following accessories are required in order to fulfill the specified safety precautions:

- Indicator/signal lamp combination ➪🗎123
  SIGNAL PROFITEST PRIME AC (Z506B)
- 2 high-voltage pistols ➪🗎124
  HV-P PROFITEST PRIME AC (Z506V)
- Emergency off switch ➪🗎124
  STOP PROFITEST PRIME AC (Z506D)
- Set of various items used to warn unauthorized persons and for securing large areas, machines or machine components during high-voltage test procedures. Must be compatible with DIN EN 50191 / VDE 0104 and DIN EN 61557-14 / VDE 0413-14.
  Recommendation: CLAIM PROFITEST PRIME AC (Z50G4)
- Key for key switch ➪🗎125
  (included in scope of delivery)

DANGER

Incompatible Accessories

Life endangering.

Use only approved accessories as

- High-voltage pistols
- Indicator/signal lamp combination
- Emergency off switch

(i.e. the products listed above)

Other products may cause electric shocks, incorrect signaling or erroneous emergency shutdowns.

23.3.1 SIGNAL PROFITEST PRIME AC (Z506B) INDICATOR/SIGNAL LAMP COMBINATION

Connection of signal lamps is required by DIN EN 50191/ VDE 0104 and DIN EN 61557-14/VDE 0413-14.

The SIGNAL PROFITEST PRIME AC external signal lamp combination, which is available as an accessory (Z506B), is used to secure the measuring point and must be plainly visible beyond the boundaries of the danger zone.

Connection

The SIGNAL PROFITEST PRIME AC is connected to the function socket identified with the lamp symbol ⨂ in the **HV TEST** connector panel (➪ "Instrument Overview" 🗎15).

Note

If the signal lamp combination has been connected incorrectly or is defective, operation of the high-voltage test module is not possible.

Automatic Signal Lamp Test

Automatic self-testing of the signal lamps is thus performed each time the rotary switch is set to the HV position and the voltage test is started for the first time after a switch position change.

Each time the **HV** position is selected on the rotary switch and the voltage test is started for the first time, automatic testing of the signal lamps is performed.

The green signal lamp flashes again briefly after the red signal lamp has already lit up.

After successful completion of the lamp test, the red signal lamp remains lit and the voltage test can be performed.

In the event of a fault, either the green signal lamp or none of the signal lamps lights up. The high-voltage module is not activated in this case and the voltage test cannot be started.

If this is the case, make sure that all utilized accessories and cables are properly connected.

Further information ⇨ "Testing the Key Switch and the Signal Lamps" 🗎127.

Operation

The SIGNAL PROFITEST PRIME AC indicates two operating states:

- Green: no high voltage,
  display:
- Red: high voltage present, danger!
  display:

Green = voltage test ready for use

(The key switch is in the **"open padlock symbol" position** – see chapter "HV Measurement" ⇨🗎130.)

- Supply power for the signal and control circuits of the high-voltage measuring circuit is switched on.
- Test voltage supply circuits are still switched off, and are still secured against inadvertent activation.

Red = voltage test ready for activation

(You have opened the menu for triggering the dielectric strength test and then pressed the **ON/START** key. See chapter "HV Measurement" ⇨🗎130.).

- The power supply circuit for the safety test probe is still switched off, assuming the trigger has not been pulled at the high-voltage pistol.
- The test probes are secured against inadvertent contact, as long as the triggers at the high-voltage pistols have not been pulled.

23.3.2 HV-P PROFITEST PRIME AC (Z506V) HIGH-VOLTAGE PISTOLS

DANGER

High voltage of up to 2.5 kV at the test probes and at the device under test!

Life endangering!

Do not touch the test probe or the device under test during the dielectric strength test!

Connection

The two HV-P PROFITEST PRIME AC (Z506V) high-voltage pistols are connected to the HV probe connections (probes 1 and 2) in the **HV TEST** connector panel (⇨ "Instrument Overview" 🗎15).

The connector plugs are coded differently in order to prevent connection of the wrong probes.

The high-voltage pistols are only functional as long as the respective key switch is set to the "open padlock symbol" position.

If a fault is detected, the high-voltage module is not activated and the voltage test cannot be started.

Two-Hand Operation – Precaution for the Prevention of Inadvertent Startup

Two-hand operation is mandatory for the inspector when performing voltage tests with high voltage.

If the triggers at the high-voltage pistols are pulled to the first point of mechanical resistance, the test probes are exposed.

High-voltage is not applied to the test probes until the triggers are pulled beyond this point, assuming the high-voltage module is in the ready-for-activation state (red signal lamp is lit).

23.3.3 PROFITEST PRIME AC (Z506D) EMERGENCY OFF SWITCH

Connection of an emergency off switch is required by DIN EN 50191/ VDE 0104 and DIN EN 61557-14/ VDE 0413-14.

The STOP PROFITEST PRIME AC external emergency off switch, which is available as an accessory (Z506D), is used to secure the measuring point in the event of danger due to interruption of high-voltage to the high-voltage pistols.

It must be clearly visible and positioned outside of the danger zone.

Connection

The STOP PROFITEST PRIME AC is connected to the function socket identified with the emergency off symbol in the **HV TEST** connector panel (⇨ "Instrument Overview" 🗎15).

Note

If the emergency off switch has been connected incorrectly or is defective, operation of the high-voltage testing module is not possible.

23.3.4 KEY FOR KEY SWITCH

The key switch prevents unauthorized activation of the high-voltage measuring circuit.

DANGER

High Voltage!

Unauthorized access to the high-voltage measuring function is life endangering to untrained persons.

- Keep the key in a safe place which is only accessible to authorized personnel.
- Each time testing has been completed, turn the key to the “closed padlock symbol” position and remove it.

The key is included in the scope of delivery.

Note

If you require a replacement key, a KEY PROFITEST PRIME blank (Z506E) must first be ordered from us.

The corresponding key number can be found in the lid of your PROFITEST PRIME AC.

With the key blank and key number, a locksmith can cut a matching key.

Before supply voltage (auxiliary power) can be connected to the test instrument’s high-voltage test module, the key switch must be unlocked and the emergency off switch must not be pressed.

23.4 GENERAL

The electrical equipment of the machine under test must withstand a test voltage of twice its own rated voltage value or 1000 V~ (whichever is greater) applied between the conductors of all circuits and the protective conductor system for a period of at least 1 second. The test voltage must have the same frequency as the electrical supply network, and must be generated by a transformer with a minimum power rating of 500 VA. The standard sequence, continuous operation and pulse control modes are available for various testing tasks.

Symbols in the User Interface for High-Voltage Measurement

High-voltage module is ready for activation, high-voltage pistols can be triggered.

Life endangering high-voltage of up to 2.5 kV is present at the HV test probes.

Measuring Method

Testing for dielectric strength is conducted by outputting an alternating voltage of 200 V to 2.5 kV at line frequency (primarily sinusoidal oscillation with a frequency of 45 to 65 Hz).

In accordance with DIN EN 61439-1, test current is at least 100 mA, and short-circuit current which must be supplied by the high-voltage transformer (at least 500 VA nominal power) is 200 mA.

In order to protect the device under test, current limiting and rise time until the selected test voltage is reached can be selected.

In the event of short-circuiting or breakdown due to an insulation defect at the device under test, measurement is stopped when the selected shutdown current has been reached and achieved test voltage is displayed.

Operating Modes (measurement types)

The following operating modes can be selected:

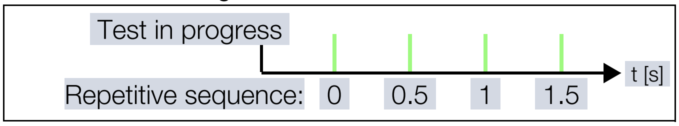
- Standard sequence for standards-compliant testing of dielectric strength
- Continuous operation for long-term testing and troubleshooting
- Pulse control mode for troubleshooting

Indicators

Optical – HV TEST LED:
When lit up, the red caution LED above the key switch indicates that the **HV** switch position has been selected and that the **HV TEST** connector panel is active.
It also indicates when HV test voltage is applied to the sockets for the high-voltage pistols.

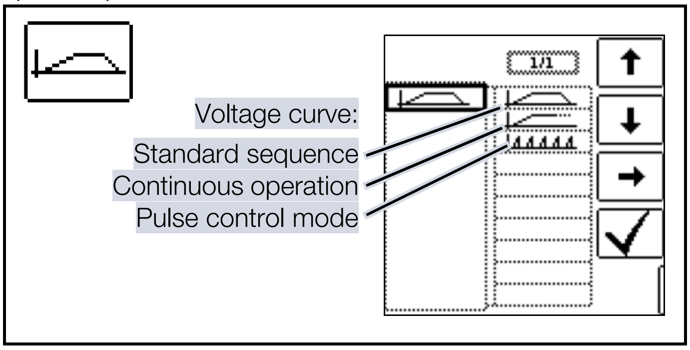
- Continuous illumination: ready for operation and for activation
- Blinking: active testing, high-voltage is present

Acoustic – periodic acoustic warning:
Acoustic signaling takes place during the test sequence – when high-voltage is present. The repetitive acoustic sequence is higher pitched in the pulse control mode than for the other two voltage curves.



Parameters

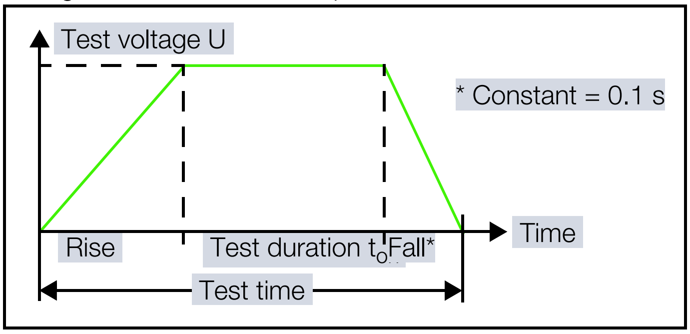
The desired voltage curve is entered first, followed by the respective parameters.



Tip

A list of all entry limits and default values is included in chapter "Characteristic Values" ➩ 31.

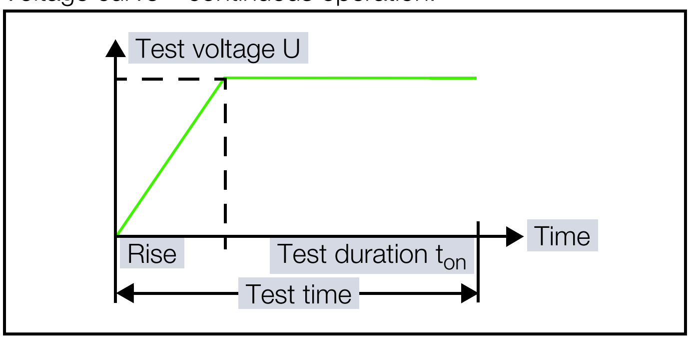
Voltage curve – standard sequence:



After selected rise time t◢ has elapsed, specified U is applied until the selected test duration t_{on} has elapsed.

Shutdown current I_{LIM} can be adjusted within a range of 1 to 200 mA. If this value is exceeded, test voltage is switched off within 0.5 ms.

Voltage curve – continuous operation:

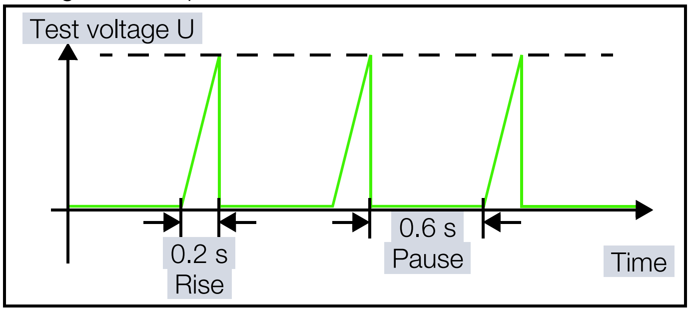


After selected rise time t◢ has elapsed, specified U is applied until the triggers at the high-voltage pistols are released.

Continuous operation >>> is set as test duration t_{on}.

Shutdown current I_{LIM} can be adjusted within a range of 1 to 200 mA. If this value is exceeded, test voltage is switched off within 0.5 ms.

Voltage curve – pulse control mode:

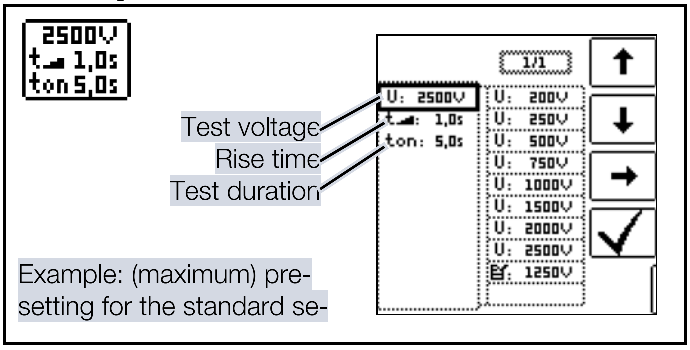


We recommend selecting the pulse control mode for troubleshooting purposes (arc-over location).

Continuous operation >>> is set as test duration t_{on}.

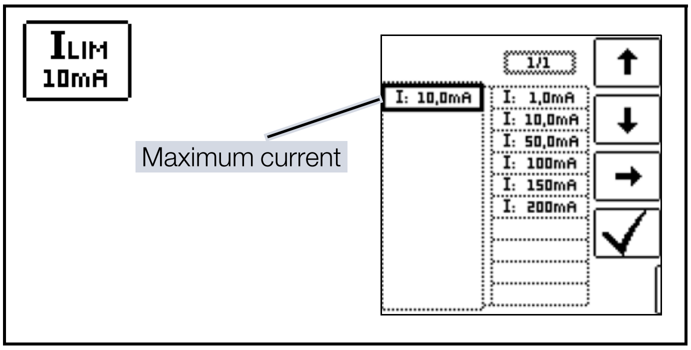
Shutdown current
I_{LIM} is permanently set to roughly 125 mA in the pulse control mode. If this value is exceeded, test voltage is switched off within 0.5 ms. After approximately 0.6 seconds, test voltage is cyclically increased from 0 V to the selected final value within a period of t◢ = 0.2 s, or is switched back when shutdown current is reached.

Test voltage:



- Test voltage **U**: test voltage level (200 V … 2500 V).
- Rise time **t◢**: time during which test voltage is increased to the selected value (0.1 s … 99.9 s).
  (0.2 s is permanently set for pulse control mode.)
- Test duration **t_{on}**: time during which test voltage is applied (1 s … 20 s)
  In the case of continuous operation or pulse control mode, continuous measurement **t_{on}** >>> is always selected.)

Maximum current:



I_{LIM}: maximum current which may flow before high-voltage is shut down (1 to 200 mA).
(Does not apply to pulse control mode.)

If, during testing, I_{LIM} is reached before the selected test voltage (see above), test voltage U measured at this point in time and current I_{LIM} appear at the display and are saved as measurement results.

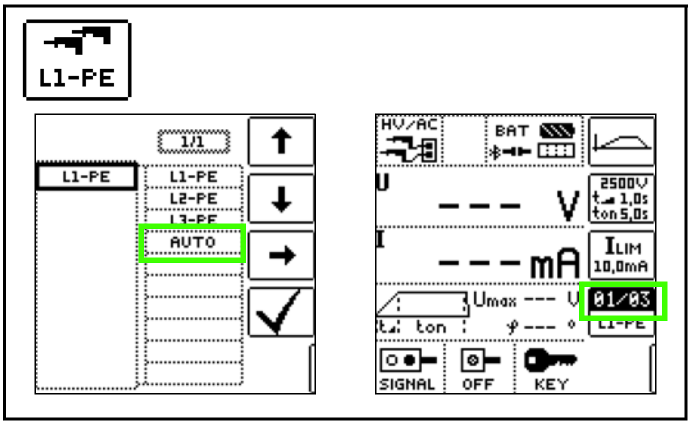
Setting ranges of parameters and standard values for t_{on}, U, I_{LIM} and t◢ in accordance with DIN VDE:

Parameters	Lower Limit	Standard Value	Upper Limit	Special Setting
Test duration t_{on}	0.5 s	1 s	120 s	Continuous measurement
Test voltage U	200 V	1 kV or 2 × U_N [1)]	2.5 kV	
Breaking current I_{LIM}	0.2 mA	—	200 mA	Pulse control mode
Rise time t◢	100 ms	1 s [2)]	99.9 s	

1) The respectively larger value must be used.

2) Recommended

2-pole measurement with fast or semiautomatic polarity reversal:



See chapter "2-Pole Measurement with Fast or Semiautomatic Polarity Reversal" ➪🗎60 regarding fast or semi-automatic polarity reversal in memory mode.

23.5 PREPARING A MEASUREMENT – PERFORMING FUNCTION TESTS

Execute the following function tests in the specified order.

Prerequisites:

✓ The measuring/test instrument is connected to mains power.

✓ Supply power (auxiliary power) complies with the specifications ➪ "Technical Data" 🗎29.

✓ The mains switch is set to **ON**.

(Testing for dielectric strength is not possible during battery operation.)

DANGER

Non-functional test instrument / HV TEST LED doesn't light up

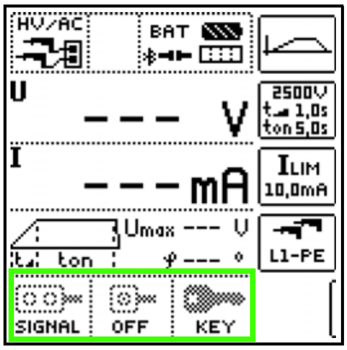
Life endangering.

Damage to the measuring/test instrument and/or surrounding areas.

1. Do not perform any more measurements.
2. Remove the measuring/test instrument from service and secure it against inadvertent restart.
3. Contact our service department ➪🗎150.

23.5.1 TESTING THE KEY SWITCH AND THE SIGNAL LAMPS

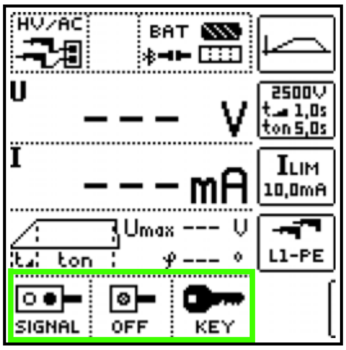
1. Set the key switch to the **open padlock symbol** position.
2. Turn the rotary selector switch to the **HV** position.
   ↳ The **HV TEST** LED lights up if the rotary selector switch is in the HV position and the high-voltage module is active.
3. Set the key switch to the **closed padlock symbol** position.
   ↳ Neither the green nor the red signal lamp should light up.
   ↳ The symbols **SIGNAL** (for the signal lamp combination), **OFF** (for the emergency off switch) and **KEY** (for the key switch) are grayed out in the display's footer.



4. Set the key switch to the **open padlock symbol** position.
   ↳ The **HV TEST** LED lights up if the rotary selector switch is in the **HV** position and the high-voltage module is active.

↳ The green signal lamp must light up and  appears at the display.

↳ The symbols **SIGNAL** (for the signal lamp combination), **OFF** (for the emergency off switch) and **KEY** (for the key switch) must appear fully black in the display's footer.



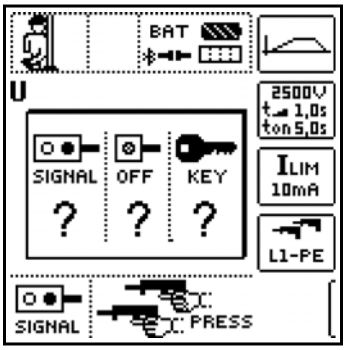
Error:

In the event that one of the symbols is grayed out, the signal lamp combination or the emergency off switch is not connected, the emergency off switch is activated or the key switch is not set to the **open padlock symbol** position.

A defective signal lamp combination or emergency off switch, or faulty mains power supply also cause graying out of the respective symbol.

In this case the measuring/test instrument is not ready for activation.

If the **ON/START** key is pressed in this case, the following error message appears:



> **Note**
>
> The emergency off switch, the signal lamps and mains power are also continuously monitored during operation.
>
> Activation of the emergency off switch, defective safety devices or faulty mains power result in immediate shutdown of the high-voltage module or prevent the test from being started.
>
> Further internal protective measures (e.g. temperature monitoring) continuously ensure the safety of the user as well, and protect the measuring/test instrument against damage.

23.5.2 TEST RUN FOR THE VOLTAGE TEST

DANGER

High Voltage!

Life endangering due to electric shock.

Do not start the voltage test unless you have implemented all safety precautions and are complying with all safety regulations.

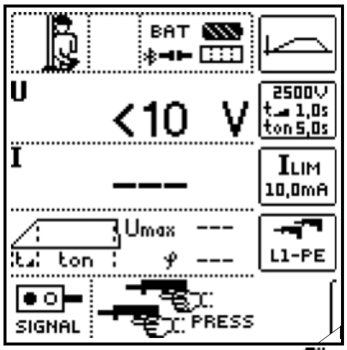
1. Set the key switch to the **open padlock symbol** position.
2. Turn the rotary selector switch to the **HV** position.
   ↳ The high-voltage module is activated.
3. Make sure that
   - The **HV TEST** LED and the signal lamp light up green.
   - The symbols **SIGNAL** (for the signal lamp combination), **OFF** (for the emergency off switch) and **KEY** (for the key switch) appear fully black in the display's footer.

   (See chapter "Testing the Key Switch and the Signal Lamps" ➪ 127.)

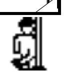
   ↳ The measuring/test instrument's high-voltage module is now ready for operation.
4. Start the test run by pressing the **ON/START** key.

↳ The signal lamp must light up red and  appears at the display.

↳ The high-voltage pistols appear at the display and the **PRESS** message prompts the user to activate them.



↳ The symbol shown at the right is flipped from left to right and back again until the measurement is finally started by activating the high-voltage pistols.



DANGER

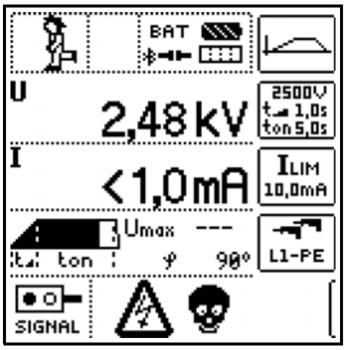
High Voltage!

Life endangering due to electric shock.

Life endangering high-voltage of up to 2.5 kV is present at the test probes of the high-voltage pistols.

Do not touch the test probe or the device under test during the dielectric strength test.

5. Pull the triggers of the high-voltage pistols to the limit stop and hold.
   ↳ The voltage test is started.
   - The **RUN** symbol  is continuously active.
     - The **HV TEST** LED blinks.
     - The two high-voltage warning symbols appear at the display and alternate back and forth between normal and inverse.
     - A periodic acoustic warning accompanies the measurement.
     - Momentary test voltage **U** is displayed.
     - The momentary position within the voltage curve is indicated by the filled trapezoid.



6. Release the triggers at the high-voltage pistols.

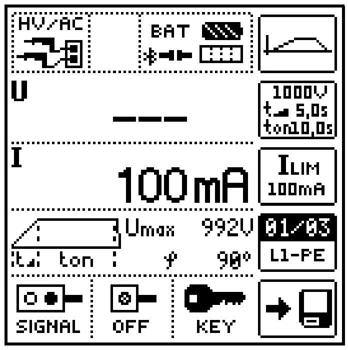
↳ The voltage test is ended.
No later than after selected test duration t_{on}, test voltage is switched off automatically.

23.5.3 TESTING THE SHUTDOWN FUNCTION

The shutdown function is executed during a test run for the voltage test.

1. Set the **standard sequence** to **voltage curve**.
2. Set test voltage **U** to a typical value.
   Recommendation: 1000 V.
3. Set rise time **t** to a typical value.
   Recommendation: 5.0 seconds.
4. Set test duration $\mathbf{t_{on}}$ to a typical value.
   Recommendation: 10.0 seconds.
5. Set maximum current $\mathbf{I_{LIM}}$ to a typical value.
   Recommendation: 100 mA
6. Start the test run for the voltage test. Refer to chapter "Test Run for the Voltage Test" ➪🗎128 up through point 5.
7. Let the ramp run up to the selected nominal voltage.
8. Short circuit the two high-voltage pistols.
   ↳ The measuring/test instrument must shut down immediately.
   ↳ Testing is ended.
   ↳ The green signal lamp must light up.
   The red signal lamp may no longer be lit up.
   ↳ The **FAIL** pop-up appears at the display and a brief, low-pitched acoustic signal is generated.

9. Clear the pop-up by pressing the **ESC key.**
   ↳ The values of the aborted test now appear at the display.
10. Make sure that exactly the same parameter values are displayed as previously set for the test.
    The graphic shown at the right indicates what must be displayed for the recommended parameter values.



DANGER

Failure to Shut Down =
Defective High-Voltage Function or
Defective High-Voltage Pistols

Life endangering due to electric shock.

- Switch the measuring/test instrument off and secure it against inadvertent restart.
- Remove the high-voltage pistols from service and secure them against inadvertent restart.
- Arrange to have the measuring/test instrument and high-voltage pistols checked by our service department ➪🗎150.

23.6 HV MEASUREMENT

Select Measuring Function

DANGER

Interference Voltage May be Present

Risk of electric shock.

Monitoring of the probes' measurement inputs is not active for the basic measuring functions (probes for 1(L), 2(N) and 3(PE) or L1, L2 and L3) in the HV switch position.

Before performing the high-voltage test, make sure that the device under test is voltage-free (see chapter "U – Measuring Voltage and Frequency" ⇨🗎64).

(Simultaneous voltage measurement and checking for the absence of voltage is not possible with the HV function!)

Test Sequence

Test all circuits (conductors) against the protective conductor (all switches in the mains circuit must be turned on, and testing must be performed upstream and downstream from all relays and contactors).

When testing without shorted circuits, all conductors from all circuits must be tested separately against the protective conductor (the machine could be damaged in the event of arc-over).

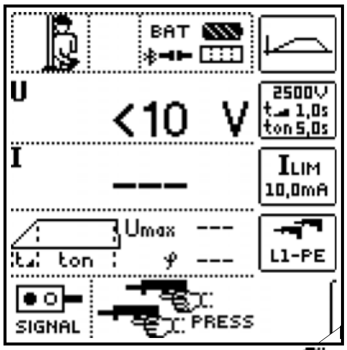
✓ You have completed test preparations ⇨🗎127.
✓ You have determined that the device under test is voltage-free.
✓ You have set the parameters for the measurement at the measuring/test instrument.
✓ The phase conductors of the test circuits are short-circuited within themselves.

1. Set the key switch to the **open padlock symbol** position.
2. Turn the rotary selector switch to the **HV** position.
   ↳ The high-voltage module is activated.
3. Make sure that
   - The **HV TEST** LED and the signal lamp light up green.
   - The symbols **SIGNAL** (for the signal lamp combination), **OFF** (for the emergency off switch) and **KEY** (for the key switch) appear fully black in the display's footer.

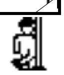
   (See chapter "Testing the Key Switch and the Signal Lamps" ⇨🗎127.)
   ↳ The measuring/test instrument's high-voltage module is now ready for operation.
4. Check the test parameters ⇨🗎125.
5. Start the test by pressing the **ON/START** key.

↳ The signal lamp must light up red and ●○▬ appears at the display.

↳ The high-voltage pistols appear at the display and the **PRESS** message prompts the user to activate them.



↳ The symbol shown at the right is flipped from left to right and back again until the measurement is finally started by activating the high-voltage pistols.



DANGER

High Voltage!

Life endangering due to electric shock.

Life endangering high-voltage of up to 2.5 kV is present at the test probes of the high-voltage pistols.

Do not touch the test probe or the device under test during the dielectric strength test.

6. Bring the high-voltage pistols to the device under test (but do not contact it yet).
7. Pull the triggers of both high-voltage pistols, but only up to the point of mechanical resistance at which the test probes are exposed.
8. Contact the circuits with the high-voltage pistols.
9. Pull the triggers of the high pistols to the limit stop.
   ↳ High-voltage is now switched to the test probes.
   ↳ Testing continues until the selected rise time and the test duration have elapsed, or until the triggers are released in the case of measurement with ramp function.
   Test time (application of high-voltage from rise to drop-off) is indicated acoustically and optically by the blinking LED at the measuring/test instrument.
   ↳ The test result (see below) is displayed with the **PASS** or **FAIL** pop-up.
10. Acknowledge the test result pop-up by pressing the **ESC** key.
    ↳ Measured values U_{max}, I and φ are displayed.

    (Alternative: start another test, see below.)
11. Save the test result.

    After saving, the measuring/test instrument is automatically switched back to the ready-for-activation state – the red signal lamp goes out, the green signal lamp lights up again and ○●▬ appears at the display.
    In order to conduct further testing or a new test, testing has to be started again by pressing the **ON/START** key. If applicable, the parameters must first be adjusted.

Alternative: start another test.

Note

The measured values at the display are overwritten when the next test is executed.

You can start another test when the test result pop-up is displayed (instead of acknowledging the result).

After **PASS** is displayed, proceed as follows:
In the case of successful testing (test passed), the measuring/test instrument remains in the ready-for-activation state – the red signal lamp remains lit up and appears at the display.
The test can be repeated or further testing of dielectric strength can be conducted with the previously selected parameters by once again pulling the triggers of the high-voltage pistols. The pop-up is automatically cleared when the triggers are pulled.
The test is restarted using the same sequence, including the same ramp as before.

Note

Safety shutdown:

If the next test is not started within 30 seconds, the system is switched from ready for activation to the standby mode – the signal lamp combination changes from red to green.

The test must be restarted.

After **FAIL** is displayed, proceed as follows:
If a test is failed, the measuring/test instrument is automatically switched back to the ready-for-activation state – the red signal lamp goes out, the green signal lamp lights up again and appears at the display.
In order to conduct further testing or a new test, testing has to be started again by pressing the **ON/START** key.

Abort Testing

The test can be ended prematurely at any time:

- By pressing the emergency off switch
- By turning the key switch to the **closed padlock symbol** position
- By pressing the **ON/START** key
- By interrupting mains power

Standby Mode

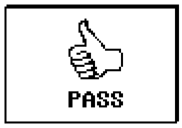
After releasing the trigger(s) at one or both high-voltage pistols – high voltage is no longer present – the high-voltage module switches to the ready-for-activation state.

A further test can be started by pulling the two triggers again. The “ready-for-activation” state remains in effect for 30 seconds (user inactivity timeout). Testing is aborted after 30 seconds if the triggers are not activated during this time.

Test Evaluation

Successful or unsuccessful high-voltage testing is indicated by means of a corresponding pop-up and a brief acoustic signal.

Test passed:



The pop-up shown at the right appears at the display and a brief, high-pitched acoustic signal is generated.

The device under test has withstood testing for dielectric strength in compliance with the selected parameters for nominal test voltage, test duration and maximum current in the standard sequence operating mode.

The device under test fulfills requirements in accordance with DIN EN 60204-1 / VDE 0113-1 / IEC 60204-1.

Test failed:

The device under test has not withstood testing for dielectric strength in compliance with the selected parameters for nominal test voltage, test duration and maximum current in the standard sequence operating mode. The limit value has been violated for at least one of the parameters.
If the test was conducted in the continuous operation mode, maximum current was exceeded or breakdown was detected.

The device under test does not fulfill requirements in accordance with DIN EN 60204-1 / VDE 0113-1 / IEC 60204-1.

The pop-up shown at the right appears at the display and a brief, low-pitched acoustic signal is generated.

Ending the Test for Dielectric Strength

1. Release the trigger(s) at one or both high-voltage pistols. High voltage is no longer present. The high-voltage module is switched to the ready-for-activation state (⇨ "Standby Mode" 131).
2. Then press the **ON/START** key in order to end the test, if it hasn’t already been ended automatically (breakdown or shutdown current reached, green signal lamp already lit up).
   ↳ The display at the signal lamp combination changes from red to green and appear at the display.
3. Set the key switch to the **closed padlock symbol** position.
4. Remove the key.
5. Dismantle the test setup.

ATTENTION

Short Circuits

Damage to the device under test.

Fully dismantle the test setup. In particular, remember to eliminate all short-circuit connections after testing.

6. Start the device under test back up again.

Note

The device under test must be tested for correct functioning after the dielectric strength test – especially with regard to safety functions.

24 AUTO – TEST SEQUENCES (AUTOMATIC TEST SEQUENCES)

If the same sequence of tests will be run frequently (one after the other with subsequent report generation), for example as specified in the standards, it's advisable to make use of test sequences.

Automated test sequences can be compiled from manually created individual measurements with the help of the test sequence function.

DANGER

High Voltage in Test Sequences

Life endangering due to electric shock.

Damage to the measuring/test instrument and/or device under test.

- If possible, run high-voltage tests without a test sequence.
- When using high-voltage test sequences:
  - Observe and comply with all safety-related information. See chapter "HV – Testing for Dielectric Strength,(PROFITEST PRIME AC only)" ➪🗎122.
  - Perform the function tests first. See chapter "Preparing a Measurement – Performing Function Tests" ➪🗎127.

24.1 GENERAL

Layout of the Test Sequences

A test sequence consists of up to 200 individual steps, which are executed one after the other.

Fundamentally, differentiation is made amongst three types of individual steps:

- Visual Inspection:
  A pass/fail evaluation is displayed. Evaluation comments and results are saved to the database.
- User evaluated measurement:
  Same as individual measurements with the measuring/test instrument including storage and parameters configuration.
- Note:
  A note is displayed as a pop-up for the inspector. The test sequence is not continued until after acknowledgment.

Note

Saved visual inspections and pop-ups, as well as information added by barcode scanning, are not displayed at the measuring/test instrument. They only become visible in IZYTRONIQ software.

Creating Test Sequences with IZYTRONIQ

As of firmware version 1.2.0, test sequences are created at a PC with the help of included IZYTRONIQ software, and are then transferred to the measuring/test instrument. Any number of test sequences can be created and stored at the PC in IZYTRONIQ. Up to 10 selected test sequences can be transferred to the measuring/test instrument.

No option for transferring test sequences from the measuring/test instrument back to the PC has been provided for because sequences can only be created, managed and stored at a PC.

Information regarding the creation of test sequences can be found below and in the online help provided with IZYTRONIQ.

Configuring Test Sequence Parameters

As is also the case with the creation of measurements, they're configured at the PC as well. However, parameters can be changed at the measuring/test instrument during the test sequence before the respective measurement is started.

When the test step is started once more, the parameter settings specified in IZYTRONIQ are loaded again.

Note

IZYTRONIQ does not subject the parameters to a plausibility check. As a result, the newly created test sequence should be checked at the measuring/test instrument before it's permanently added to the database.

Limit values are not currently set in IZYTRONIQ, and have to be adjusted during the automatic test sequence.

24.2 CREATING AND TRANSFERRING TEST SEQUENCES WITH IZYTRONIQ (STEP-BY-STEP INSTRUCTIONS)

1. Connect the measuring/test instrument to the PC via USB.
2. Switch the measuring/test instrument on.
3. Start IZYTRONIQ.
4. Log in to IZYTRONIQ.
5. Select **STATIONARY OBJECTS** .
   ↳ The **STATIONARY OBJECTS** menu appears.
6. Select **SEQUENCES** .
   ↳ The **SEQUENCES** menu appears.
7. Select **ADD** .
   ↳ The **CREATE NEW SEQUENCE** dialog is displayed.
8. Enter a **SEQUENCE NAME**, a **TEST TYPE** and a **STANDARD**.
9. Select the currently connected measuring/test instrument from the **FOR INSTRUMENT** list.
10. Acknowledge by clicking **ADD**.
11. Save your settings by clicking the ✓ icon.
12. Select the new entry.

13. Select **Sequence Editor** .
    ↳ The editing menu appears with **STEP SELECTION** and **DESIGN PROGRESS**.
14. Click to expand the measuring/test instrument which is displayed in **STEP SELECTION** ▷.
    ↳ **Visual Inspection**, **User-Evaluated Measurement** and **Note** appear.
15. Create individual steps:
    - **TEST STEP: VISUAL INSPECTION** is opened in the bottom left-hand window by dragging **VISUAL INSPECTION** into the **DESIGN PROGRESS** field.
      Enter the details for the respective visual inspection here.
      Save your settings by clicking the ✓ icon.
    - **TEST STEP: User-evaluated measurement** is opened in the bottom left-hand window by dragging **USER-EVALUATED MEASUREMENT** into the **DESIGN PROGRESS** field.
      Enter a name for the measurement here and specify measurement type and parameters.
      Save your settings by clicking the ✓ icon.
    - **TEST STEP: NOTE** is opened in the bottom left-hand window by dragging **NOTE** into the **DESIGN PROGRESS** field.
      Enter the name and the text for the note here.
      Save your settings by clicking the ✓ icon.
16. Repeat the procedure for creating individual steps (15.) until the test sequence is finished.
17. Save your settings by clicking the ✓ icon.
18. Select **STATIONARY OBJECTS** again.
19. Then select the **EXPORT** function.
    ↳ The export wizard appears.
20. Select the desired measuring/test instrument and insert a checkmark next to **SEQUENCES**.
21. Select **EXPORT**.
    ↳ The **EXPORT SEQUENCES (MAX10)** menu is opened.

ATTENTION

Overwriting Test Sequences

Data loss.

Do not transfer sequences if you have any doubts.

All test sequences available at the measuring/test instrument are deleted during transfer. Only those test sequences transferred during the most recent export operation via IZYTRONIQ are saved at the measuring/test instrument.

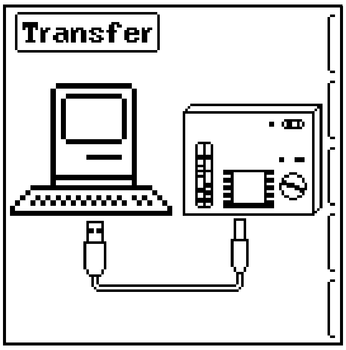
ATTENTION

Data Transfer Not Possible with Selector Switch in U Position

Data transfer is not possible in switch position **U**.

Set the function selector switch to a position other than **U** (the measuring/test instrument must, however, be switched on).

22. Mark the sequences to be exported and click the **EXPORT TO TEST INSTRUMENT** icon.
    ↳ The sequences are transferred.
      For as long as the test sequences are being transferred, a progress display appears at the PC and the illustration shown to the right appears at the measuring/test instrument's display.



      Successful transfer to the measuring/test instrument via IZYTRONIQ is then indicated at the PC.

24.3 AUTOMATIC TEST SEQUENCE

Prerequisite:

✓ You have created at least one test sequence and have transferred it to the measuring/test instrument.

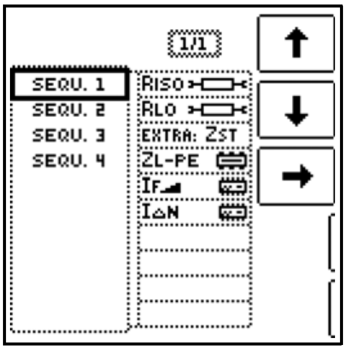
✓ For high-voltage tests: the key switch must be in the **open padlock symbol** position.

Select Measuring Function

Auto

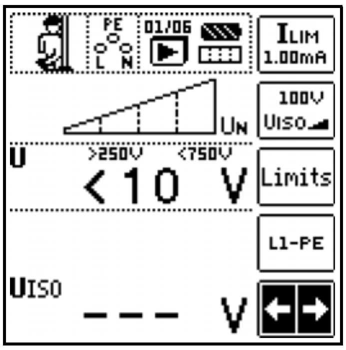
With the rotary switch in the **AUTO** position, all of the test sequences in the measuring/test instrument are displayed.

Selecting and Starting a Test Sequence at the Measuring/Test Instrument



The selected test sequence is started with the **ON/START** key.

When a test step of the measurement type is executed, the same screen layout appears as is also the case for individual measurements.



The current test step number appears in the header instead of the memory and battery icons.

After pressing the **Save** key twice, the next test step is displayed.

Sequence Ended appears after the last test step is completed. The initial menu, **List of Test Sequences**, is once again displayed after acknowledging the prompt.

Setting Parameters and Limit Values

Parameters and limit values can also be changed while a test sequence is running or before the respective measurement is started. The respective change only affects the active test sequence and is not permanently saved for the test sequence.

Skipping Test Steps

Test steps (including individual measurements) can be skipped.

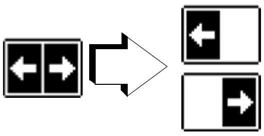
Before starting or starting as of step X:

1. Select the test sequence.
2. Move the cursor to the right-hand test steps column.
3. Select a test step.
4. Press the **ON/START** key.

↳ The test sequence is started.

Within a test sequence:

1. Press the left/right navigation key in order to access the navigation menu.
   ↳ Navigation keys are displayed.
2. Use the navigation keys to jump to the previous or the next test step.



The navigation menu can be exited again and the current test step can be displayed by pressing the **ESC** key.

Aborting a Test Sequence

An active sequence can be aborted by pressing the **ESC** key and then acknowledging.

25 TRANSFERRING AND SAVING DISTRIBUTOR STRUCTURES AND/OR RESULTS (MEASUREMENTS/TESTS)

Distributor structures created in the measuring/test instrument and measurement/test data stored at the measuring/test instrument can be transferred for various purposes.

A PC to which IZYTRONIQ report generating software has been installed is required to this end.

The following scenarios are possible:

- Transfer a distributor structure from the PC (IZYTRONIQ) to the test instrument.
  (as an alternative to creating the distributor structure directly at the measuring/test instrument ⇨ "Internal Database" 🗎54)
- Transfer a distributor structure including measurement/test data from the test instrument to the PC (IZYTRONIQ) for data storage and/or evaluation and report generation.

Data is transferred via USB.

Establishing a USB Connection

Connect the measuring/test instrument and the PC via the supplied USB cable in order to transfer data between them.

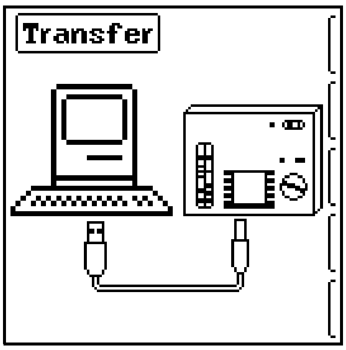
ATTENTION

Data Transfer Not Possible with Selector Switch in U Position

Data transfer is not possible in switch position **U**.

Set the function selector switch to a position other than **U** (the measuring/test instrument must, however, be switched on).

Start IZYTRONIQ software at the PC. Follow the instructions in the online help for IZYTRONIQ in order to transfer data between the measuring/test instrument and the PC/IZYTRONIQ in accordance with the desired scenario.



The image shown to the right appears at the display while structures and data are being transferred.

26 STORAGE AND TRANSPORT

ATTENTION

Improper Storage

Damage to the product and measuring error due to environmental influences.

- Store the measuring/test instrument in a protected location and only within the limits of the specified permissible ambient conditions. The respective ambient conditions (temperature, humidity etc.) can be found in chapter "Technical Data" ⇨🗎29.
- Before closing the test case lid, remove all power, measurement and signal cables from the measuring/test instrument's front panel connector sockets and store them separately to avoid pinching and damaging the cables or scratching the display panel.

ATTENTION

Improper Transport

Damage to the product and measuring error.

- Transport the measuring/test instrument only within the limits of permissible ambient conditions (temperature, humidity etc.) ⇨ "Technical Data" 🗎29.
- Before closing the test case lid, remove all power, measurement and signal cables from the measuring/test instrument's front panel connector sockets and store them separately to avoid pinching and damaging the cables or scratching the display panel.
- Transport accessories separately, e.g. in the PRIME CASE (Z506A)*.
  The inside pocket in the case's lid may not be used for accessories. Considerable damage may otherwise be caused to display's faceplate.
- We recommend using the trolley available as an accessory (Z506F)* for easy transport of the measuring/test instrument.

* Details regarding accessories can be found in the data sheet for the measuring/test instrument.

27 MAINTENANCE

27.1 FIRMWARE/SOFTWARE UPDATE

Measuring/test instrument firmware/software can be updated.

ATTENTION

Data Overwritten During Updating

Test sequences are deleted.

- Back up your test sequences in IZYTRONIQ software. The test sequences can be transferred back to the measuring/test instrument after updating.

The firmware update tool is used to this end. The measuring/test instrument must be connected via USB to the PC on which the firmware update tool is running. The firmware/software is then transferred and installed using the firmware update tool.

The firmware update tool, the corresponding operating instructions and the current firmware/software version are available free of charge from MyGMC on the internet (provided you have registered your measuring/test instrument):

https://www.gossenmetrawatt.de/services/mygmc/

27.2 FUSES

The measuring/test instrument is equipped with fuses. If they're defective, they must be replaced.

WARNING

Electric Shock!

Damage to the Instrument!

Jumpered, missing or defective fuses can cause personal injury and severe damage to the measuring/test instrument.

- Use the measuring/test instrument only with inserted, properly functioning fuses.
- Fuses must comply with the specified technical data 5.7 ➪🗎29.

27.2.1 MAINS CONNECTION FUSES

The mains connection fuses are located in a fuse holder between the inlet socket and the line disconnector.

DANGER

Life Endangering due to Electric Shock!

The measuring/test instrument is powered by electrical current and there's always a risk of electric shock. This can be fatal or cause serious injuries.

- The measuring/test instrument must be voltage-free before and while replacing fuses. Switch the measuring/test instrument off and disconnect it from mains power.
- The measuring/test instrument may not be connected to any measuring circuits before and while replacing fuses.

✓ Replacement fuses which comply with the technical data (➪🗎29) are available.

✓ A flat-head screwdriver is available.

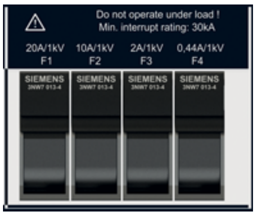
▶ **Fuse Replacement**

1. Disconnect the test/measuring instrument from mains power and all measuring circuits.
2. Pry out the fuse holder with the flat-head screwdriver – simultaneously at top and bottom.
3. Remove the blown fuse or fuses and replace with new fuses.
4. Reinsert the fuse holder with the new fuse. The fuse holder must audibly snap into place.

↳ The fuses have now been replaced.

27.2.2 MEASURING CIRCUIT FUSES

The measuring circuit fuses are located between the mains connection unit and the interface connections.



If a fuse has blown due to overloading, a corresponding message error appears at the display panel. The instrument's voltage measuring ranges are nevertheless still functional.

DANGER

Life Endangering due to Electric Shock!

The measuring/test instrument is powered by electrical current and there's always a risk of electric shock. This can be fatal or cause serious injuries.

- The measuring/test instrument must be voltage-free before and while replacing fuses. Switch the measuring/test instrument off and disconnect it from mains power.
- The measuring/test instrument may not be connected to any measuring circuits before and while replacing fuses.

✓ Replacement fuses which comply with the technical data (⇨29) are available.

Fuse Replacement

1. Determine which fuse(s) might have blown with the help of the error message and the following table.

Measuring Function	Device Fuse			
	F1	F2	F3	F4
Characteristic value	1 kV / 20 A	1 kV / 10 A	1 kV / 2 A	1 kV / 440 mA
Order no.	3-578-319-01	3-578-264-01	3-578-318-01	3-578-317-01
U				
R_{LO} 0.2 A	●	●		●
R_{LO} 25 A	●			
R_{ISO}	●	●		●
R_{ISO}	●	●		●
RCD – IF	●	●	●	
RCD – $I_{\Delta N}$	●	●	●	
RCD – IF+ $I_{\Delta N}$	●	●	●	
Z_{LOOP}	●	●		
Z_{LOOP} DC+	●	●	●	
Z_{LOOP}	●	●	●	
Z_{LOOP}	●	●		
U_{res}				
IMD	●	●		
RCM	●	●		
I_L	●	●		●
≤ 1 V≃				
T, %r.h.				
Extra				
HV				
Auto				
Setup				

Tab. 6: Required Fuses Depending on Measuring Function

Note

The voltage ranges remain functional even if fuses have blown.

1. Eliminate the cause of failure before replacing the respective fuse.
2. Pry out the respective fuse holder to a vertical position.
3. Remove the defective fuse(s).
4. Replace the blown fuse with a new one.
5. Return the fuse holder to the closed position.

↳ The fuse has now been replaced.

27.3 CLEANING

DANGER

Life Endangering due to Electric Shock!

The instrument and its accessories are operated with electrical power, thus resulting in a general risk of electric shock. This can be fatal or cause serious injuries.

- The measuring/test instrument must be voltage-free before and during cleaning. Switch the measuring/test instrument off and disconnect it from mains power.
- The measuring/test instrument may not be connected to any measuring circuits before and during cleaning.
- Never immerse the instrument/accessories in water or other liquids.
- Never touch the instrument/accessories with wet or moist hands.
- No condensation may occur at the measuring/test instrument, the test cables or the device under test, because high-voltage may otherwise cause leakage current at the surfaces. Insulated components may also conduct high-voltage in this case.

ATTENTION

Unsuitable Cleaning Agents

Unsuitable cleaning agents such as aggressive or abrasive cleansers result in damage to the instrument/accessories.

- Use a cloth for cleaning, which has been slightly dampened with water.
- We recommend a moist, lint-free microfiber cloth for cleaning the protective rubber surfaces.
- Avoid the use of cleansers, abrasives or solvents.

Keep the outside surfaces of the instrument and any accessories clean.

27.4 REPLACING LEDS IN THE SIGNAL LAMP COMBINATION (Z506B) FOR THE PROFITEST PRIME AC

You can replace the LEDs in the signal lamp combination.

Required LEDs: Barthelme type 52143015 / LED lamp, 12 V / 3 W, 350 lm, socket: BA15d, 20 x 46 mm.
Please contact our service department in this regard ➪🗎150.

There are two different variants of the signal lamp combination. They're distinguished by different domes: the newer variant has black covers on the colored domes, and the older model doesn't. The procedure for replacing the LED differs depending on variant. Identify your variant and follow the respective replacement instructions.

WARNING

Damage to the Device

Incorrect assembly can cause damage to the device.

The green dome must always be on the side facing the connector cable.

Be sure to screw the dome on correctly.

27.4.1 MODEL WITHOUT BLACK COVERS

1. Disconnect the signal lamp combination from the measuring/test instrument.
2. Unscrew the red or green dome from the base by turning it counterclockwise.
3. Remove the defective LED from the socket: push the LED down and turn it counterclockwise. The LED is disengaged. Remove the LED.
4. Insert a suitable new LED (see above): Insert the LED into the bayonet lock, press the LED down and turn it clockwise.
5. Screw the dome back onto the base: Set the dome onto the base.
6. Tighten the dome by turning it clockwise as far as it will go.

↳ The LED has been replaced.

DANGER

Incorrect High-Voltage Display!

Applied high voltage is not displayed correctly.

- Make sure that the signal lamp combination lights up correctly before using it for a measurement.

27.4.2 MODEL WITH BLACK COVERS

1. Disconnect the signal lamp combination from the measuring/test instrument.
2. Unscrew the red or green dome from the base by turning it counterclockwise.
   The black cover must remain attached to the dome.
3. Remove the defective LED from the dome: push the LED down and turn it counterclockwise. The LED is disengaged. Remove the LED.
4. Insert a suitable new LED (see above): Insert the LED into the bayonet lock, press the LED down and turn it clockwise.
5. Screw the dome back onto the base: Set the dome onto the base. The white marking lines on the base and the dome must line up with each other.
6. Tighten the dome by turning it clockwise as far as it will go.
7. The LED has been replaced.

DANGER

Incorrect High-Voltage Display!

Applied high voltage is not displayed correctly.

- Make sure that the signal lamp combination lights up correctly before using it for a measurement.

27.5 CALIBRATION

Use of the instrument and resultant stressing influence the device and lead to deviation from warranted accuracy values.

In the case of strict measuring accuracy requirements, as well as in the event of severe stressing (e.g. severe climatic or mechanical stress), we recommend a relatively short calibration interval of once per year. If this is not the case, a calibration interval of 2 to 3 years is usually adequate.

Please contact GMC-I Service GmbH for calibration services ⇨ "Contact, Support and Service" 🗎150.

A sticker with an instrument-specific guideline value for the calibration interval and information regarding the service provider is included on the instrument as an aid.

Note

Date on Calibration Certificate / Calibration Interval Begins upon Receipt

Your instrument is furnished with a calibration certificate on which a date appears. This date may be further in the past if your instrument has been stored for some time prior to sale.

Instruments are stored in accordance with the specified ambient conditions. Drift is thus negligible for a duration of one year and longer storage periods are highly unusual.

Consequently, the instrument’s characteristic values lie within the specifications and the first calibration interval can be determined as of the date of receipt.

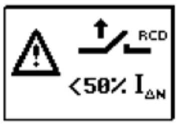
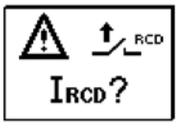
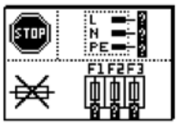
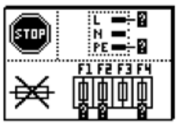
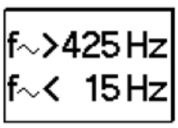
28 TROUBLESHOOTING

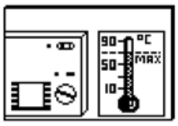
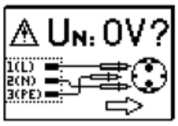
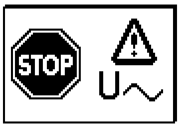
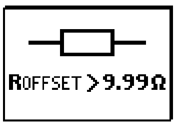
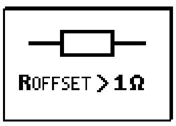
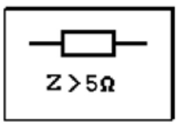
Error messages and instructions are displayed in pop-up windows. These pop-ups and their meanings are explained in the following section (⇨140), along with tips on how to resolve associated issues.

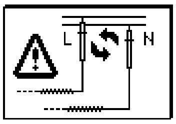
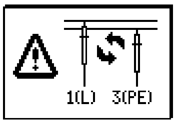
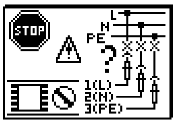
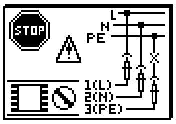
If the error is not eliminated, you can initiate a reset (⇨149) or contact our support department ⇨150.

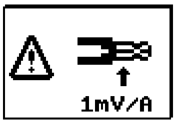
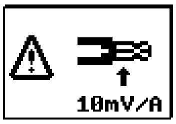
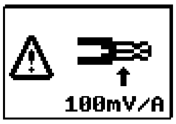
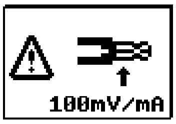
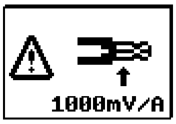
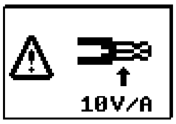
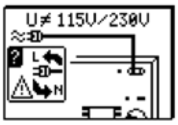
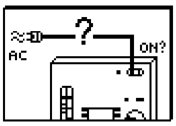
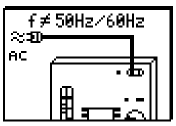
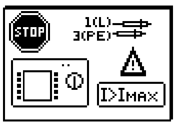
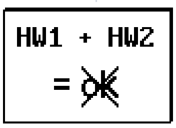
28.1 ERROR MESSAGES

General

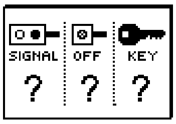
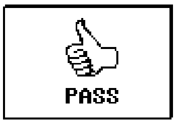
Symbol	Status	Rotary Switch Position	Function/Meaning
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿∿, Z_{LOOP} ⎍⎍,	Voltage to probes 1(L), 2(N), 3(PE) not within the permissible range. Measurement is not possible. Check the mains connection.
		R_{LO} 0.2 A, RCD $I_{\Delta N}$	RCD is tripped too early or is defective. Check the system for bias current.
		Z_{LOOP} ∿, Z_{LOOP} ∿∿, Z_{LOOP} ⎍⎍,	RCD is tripped too early or is defective. Use the Z_{LOOP} DC+∿ measuring function or check the selected nominal test current at the RCD (Z_{LOOP} ∿∿, Z_{LOOP} ⎍⎍).
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	RCD tripped during touch voltage measurement. Check the selected nominal test current at the RCD.
		R_{LO} 0.2 A, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$,	The PRCD has been tripped. Poor contact or defective PRCD.
		R_{LO} 0.2A, R_{LO} 25A, R_{ISO}⎍, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿∿, Z_{LOOP} ⎍⎍, IMD, RCM, Extra, Auto	The measuring path is faulty. Check measurement cables 1(L), 2(N) and 3(PE) for correct connection. Check fuses F1, F2 and F3. Replace defective fuses ⇨136. The voltage ranges remain functional even if the fuses have blown.
		R_{LO} 0.2A, R_{LO} 25A, R_{ISO}⎍, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} ∿, RCM, I_L Extra, Auto	The measuring path is faulty. Check measurement cables 1(L) and 3(PE) for correct connection. Check fuses F1, F2 and F4. Replace defective fuses ⇨136. The voltage ranges remain functional even if the fuses have blown.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿∿, Z_{LOOP} ⎍⎍, IMD, RCM, Extra, Auto	Line frequency at the device under test not within the permissible range. Check mains connection and contacting.

Symbol	Status	Rotary Switch Position	Function/Meaning
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM, Extra, Auto, HV	Excessive temperature inside the measuring/test instrument. Wait for the measuring/test instrument to cool down.
		R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, I_L, $I_{L/AMP}$	Interference voltage at probes 1(L), 2(N) and 3(PE). Ensure absence of voltage at the device under test.
		RISO, RISO⊿	Overvoltage or overload at the internal test voltage generator. Ensure absence of voltage at the device under test.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM	No mains connection detected. Check connection and contacting of probes 1(L), 2(N) and 3(PE) at the device under test.
		Z_{LOOP}	In case of DC measurement: Alternating voltage detected. ■ Check measurement type. ■ Check contacting and system.
		R_{LO} 0.2 A	Waiting time for changing direction of test current flow.
		R_{LO} 0.2 A	When measuring with changing polarity, the results of the individual R_{LO}+ and R_{LO}– measurements deviate from each other by more than 10%: ■ OFFSET measurement is not sensible. ■ Check contacting and system. ■ OFFSET measurement of R_{LO}+ and R_{LO}– is still possible.
		R_{LO} 0.2 A	R_{OFFSET} > 9.99 Ω: ■ OFFSET measurement is not sensible. ■ Check contacting and system.
		R_{LO} 25 A	R_{OFFSET} > 1 Ω: ■ OFFSET measurement is not sensible. ■ Check contacting and system.
		ΔU	Z_{OFFSET} > 5 Ω: OFFSET measurement is not sensible. Check contacting and system.
		ΔU	ΔU_{OFFSET} > ΔU: ■ Offset value is greater than the measured value at the consuming system. ■ OFFSET measurement is not sensible. ■ Check contacting and system.

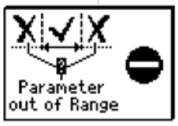
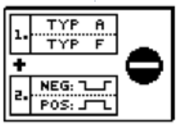
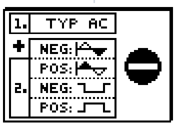
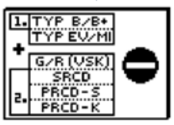
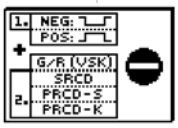
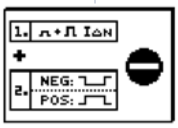
Symbol	Status	Rotary Switch Position	Function/Meaning
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, RCM, ΔU	Reverse contacting of test probes 1(L) and 2(N).
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP},	Reverse contacting of test probes 1(L) and 3(PE)
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM	Mains connection error – check mains connection.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Protective conductor interrupted.

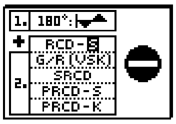
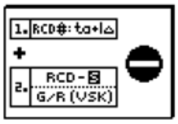
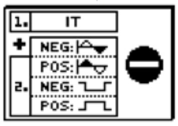
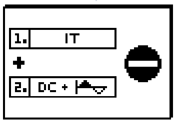
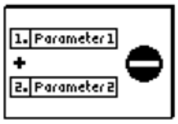
Symbol	Status	Rotary Switch Position	Function/Meaning
		$I_{L/AMP}$	After changing the current clamp transformation ratio at the measuring/test instrument, it must also be adjusted at the current clamp.
		$I_{L/AMP}$	After changing the current clamp transformation ratio at the measuring/test instrument, it must also be adjusted at the current clamp.
		$I_{L/AMP}$	After changing the current clamp transformation ratio at the measuring/test instrument, it must also be adjusted at the current clamp.
		$I_{L/AMP}$	After changing the current clamp transformation ratio at the measuring/test instrument, it must also be adjusted at the current clamp.
		$I_{L/AMP}$	After changing the current clamp transformation ratio at the measuring/test instrument, it must also be adjusted at the current clamp.
		$I_{L/AMP}$	After changing the current clamp transformation ratio at the measuring/test instrument, it must also be adjusted at the current clamp.
		RCD I_F⊿, RCD $I_{\Delta N}$, Z_{LOOP} DC+	Resistance in the N-PE path is too high. Check the test setup.
		R_{LO} 25 A	Line voltage for auxiliary power is not within the permissible range. Measurement not possible. Check mains connection. Rotate the mains plug and start again.
		R_{LO} 25 A, HV	No line voltage for auxiliary power, or line voltage is too low. Measurement not possible. Check mains connection.
		R_{LO} 25 A, HV	Line frequency for auxiliary power is not within the permissible range. Measurement not possible. Check mains connection.
		R_{LO} 25 A	Maximum test current has been exceeded. Use only approved test probes.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$, Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM	Internal hardware versions do not correspond. Turn off/on or fully charge the battery. If this error persists, send the measuring/test instrument to our service department ⇨ 149.

Testing for Dielectric Strength

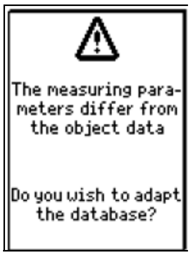
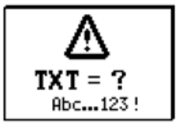
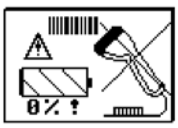
Symbol	Status	Rotary Switch Position	Function/Meaning
		HV	Measurement not enabled. Check the following: ■ Signal lamp combination and emergency off switch connections ■ Key switch position
		HV	HV measuring functions are not available. HV measuring functions are only available for the PROFITEST PRIME AC.
		HV	Passed voltage test. The device under test has withstood dielectric strength testing in compliance with the selected parameters.
		HV	Failed voltage test. The device under test has not withstood dielectric strength testing in compliance with the selected parameters. The limit value has been violated for at least one of the parameters.
		HV	Voltage test not enabled. Check the following: Whether or not the triggers of both high-voltage pistols are fully released Whether or not both of the high-voltage pistols' measurement cables are in flawless condition and all plug connections are correct

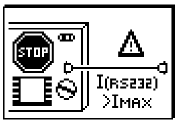
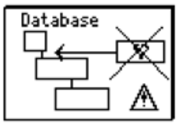
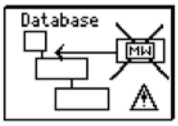
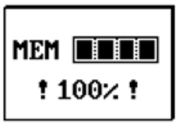
Entry Plausibility Check – Parameters Combination Checking

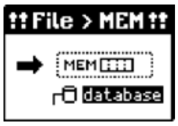
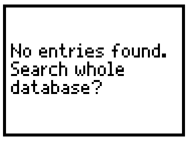
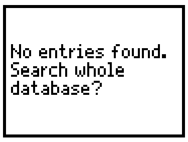
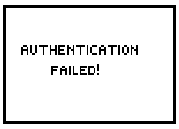
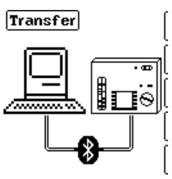
Symbol	Status	Rotary Switch Position	Function/Meaning
			Measurement is not possible with the selected setting.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. DC not possible with type A, F.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. Types B, B+ and EV not possible with G/R, SRCD or PRCD.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. DC not possible with G/R, SRCD or PRCD.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. ½ test current not possible with DC.

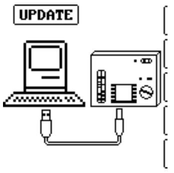
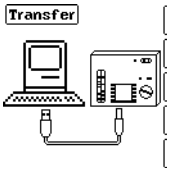
Symbol	Status	Rotary Switch Position	Function/Meaning
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. 180° not possible for RCD-S, G/R, SRCD, PRCD.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. The intelligent ramp is not possible with RCD types RCD-S and G/R.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. Measurement with half-wave or DC is not possible on IT systems.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	Measurement is not possible with the selected setting. Measurement with half-wave or DC is not possible on IT systems.
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$	The parameters you have selected do not make sense in combination with previously configured parameters. The selected parameter settings will not be saved. Remedy: enter other parameters.

Database and Entry Operations

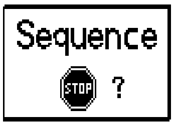
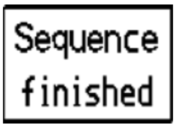
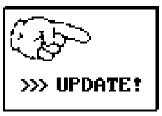
Symbol	Status	Rotary Switch Position	Function/Meaning
		RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, IMD, RCM	The parameters saved to the database for the object differ from the selected electrical circuit parameters. ✓ : The measured values are saved. The parameters in the database are adjusted. ✗ : The measured values are saved. Database parameters remain unchanged.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Enter an alphanumeric designation.
		U, R_{LO} 0.2A, R_{LO} 25A, RISO, RISO⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Barcode scanner inoperable due to excessively low battery voltage.

Symbol	Status	Rotary Switch Position	Function/Meaning
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO} ⌐, R_{ISO} ◿, RCD I_F ◿, RCD $I_{\Delta N}$, RCD I_F ◿+$I_{\Delta N}$ Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿, Z_{LOOP} ⎍, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Barcode not recognized, incorrect syntax.
			Current via the RS 232 port is too high. The barcode scanner is not suitable.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO} ⌐, R_{ISO} ◿, RCD I_F ◿, RCD $I_{\Delta N}$, RCD I_F ◿+$I_{\Delta N}$ Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿, Z_{LOOP} ⎍, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	No data can be entered here.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO} ⌐, R_{ISO} ◿, RCD I_F ◿, RCD $I_{\Delta N}$, RCD I_F ◿+$I_{\Delta N}$ Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿, Z_{LOOP} ⎍, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	No measured values can be saved here.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO} ⌐, R_{ISO} ◿, RCD I_F ◿, RCD $I_{\Delta N}$, RCD I_F ◿+$I_{\Delta N}$ Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿, Z_{LOOP} ⎍, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Memory is full. Save the data to a PC and then clear the database directly at the measuring/test instrument, or by importing an empty database.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO} ⌐, R_{ISO} ◿, RCD I_F ◿, RCD $I_{\Delta N}$, RCD I_F ◿+$I_{\Delta N}$ Z_{LOOP} ∿, Z_{LOOP} DC+∿, Z_{LOOP} ∿, Z_{LOOP} ⎍, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Delete the measurement / test step. ■ YES: deletion ensues. ■ NO: deletion is aborted.

Symbol	Status	Rotary Switch Position	Function/Meaning
		Setup	Delete the database? Appears after changing the language or selecting “GOME Settings”: Reset to default values. ■ YES: deletion ensues. ■ NO: deletion is aborted.
			The created structure is too large for measuring/test instrument memory. Data transmission is aborted.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}┌, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	The desired object could not be found.
		U, R_{LO} 0.2A, R_{LO} 25A, R_{ISO}┌, R_{ISO}⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	The desired object could not be found.
		Setup	Bluetooth® connection could not be established.
		Setup	Bluetooth® connection established.
		Setup	Enter the measuring/test instrument’s PIN at the other device in order to establish a Bluetooth® connection.
		Setup	Data transmission via Bluetooth® is active.

Symbol Status	Rotary Switch Position	Function/Meaning
	U, R_{LO} 0.2A, R_{LO} 25A, RISO┌, RISO⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Update will be executed via the USB port.
	U, R_{LO} 0.2A, R_{LO} 25A, RISO┌, RISO⊿, RCD I_F⊿, RCD $I_{\Delta N}$, RCD I_F⊿+$I_{\Delta N}$ Z_{LOOP}, Z_{LOOP} DC+, Z_{LOOP}, Z_{LOOP}, U_{res}, IMD, RCM, I_L, $I_{L/AMP}$, Extra, HV, Auto, Setup	Data transmission via USB is active.

Test Sequences

Symbol Status	Rotary Switch Position	Function/Meaning
	Auto	The test sequence includes a measurement which cannot be processed. The test step will be skipped.
	Auto	The test sequence has been run successfully.
	Auto	No test sequences have been saved.
	Auto	The current sequence step could not be executed. The step will be skipped. The sequence can be resumed.
	Auto	No test sequences have been saved.

28.2 RESET

If the system stops responding, the measuring/test instrument can be reset.

ATTENTION

Reset to Default Settings

Data loss.

(loss of all measurement data, database, instrument configuration, test sequences etc.)

- A reset should only be executed as a last resort. Contact our support department first ➪🗎150.
- Back up your data at regular intervals.

✓ The mains switch is in the **0** position (off).

1. Briefly press the recessed reset button on the front panel (➪ "Instrument Overview" 🗎15).
2. Acknowledge the security prompt.

↳ The measuring/test instrument is reset to its default settings.

29 REPAIRS

If your instrument requires repair, please contact our service department ➪ "Contact, Support and Service" 🗎150.

Note

Loss of Warranty and Guarantee Protection

Unauthorized modification of the instrument is prohibited. This also includes opening the instrument.

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

If the guarantee seal is damaged or removed, all guarantee claims are rendered null and void.

- The device may only be repaired or opened by authorized, qualified personnel who are familiar with the associated dangers.
- Original replacement parts may only be installed by authorized, qualified personnel.
- The instrument may not be placed back into operation until troubleshooting and repair have been performed, and calibration and dielectric strength have been tested and approved at our factory or by an authorized service center.

Note

Data Protection

Data can be stored in the instrument. This may include personal and/or sensitive data.

Back up your data before sending the instrument for repair.

Also, be aware of the owner's or end user's own responsibility with regard to protecting personal data and any other sensitive data stored in the instrument before sending it for repair.

30 CONTACT, SUPPORT AND SERVICE

Gossen Metrawatt GmbH can be contacted directly and conveniently – we have a single number for everything! Whether you require support or training, or have an individual inquiry, we can answer all of your questions here:

+49 911 8602-0

Monday to Thursday:	08:00 am - 4:00 pm
Friday:	08:00 am - 2:00 PM

Or contact us by e-mail at:
info@gossenmetrawatt.com

Do you prefer support by e-mail?

Measuring and Test Technology:
support@gossenmetrawatt.com

Industrial Measuring Technology:
support.industrie@gossenmetrawatt.com

Enquiries concerning training and seminars can also be submitted by e-mail and online:

training@gossenmetrawatt.com

https://www.gossenmetrawatt.de/en/knowledge/webinars/

Please contact GMC-I Service GmbH for repairs, replacement parts and calibration[1] :

+49 911 817718-0
service@gossenmetrawatt.com
www.gmci-service.com/en/

Beuthener Str. 41
90471 Nürnberg
Germany

[1] DAkkS calibration laboratory per DIN EN ISO/IEC 17025 accredited by the Deutsche Akkreditierungsstelle GmbH under reference number D-K-15080-01-01

31 CERTIFICATIONS

31.1 CE DECLARATION

The instrument fulfills all requirements of applicable EU directives and national regulations. We confirm this with the CE mark.

Gossen Metrawatt GmbH	Begleitende Formulare zum PEP EU-Konformitätserklärung / EU Declaration of Conformity	Form E0F34

Hersteller / Manufacturer:	Gossen Metrawatt GmbH
Anschrift / Address:	Südwestpark 15, 90449 Nürnberg
Produktbezeichnung/	Maschinen- und Installationstester
Product name:	Machine and Installation Tester
Typ / Type:	PROFITEST PRIME / AC
Bestell-Nr / Order No:	M516A/C
Zubehör / Accessories:	Z502F, Z503F/G , Z505C/D , Z506T/U/S/N/M/P/O/R/S/B/D/V/E/G/Z/Y/X/J/G/H

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsvorschriften der Union: / The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

2014/53/EU	RED - Richtlinie	RED Directive

Anforderungen an die Sicherheit gemäß 2014/35/EU (Niederspannungsrichtlinie) /
Safety requirements according to 2014/35/EU (Low Voltage Directive)

EN/Norm/Standard:

EN 61010-1 : 2010 + A1 : 2019 + A1 : 2019/AC : 2019 ,
EN 61010-2-030 : 2010 , EN 61010-2-032 : 2012 , EN 61010-031 : 2015

Anforderungen an die elektromagnetische Verträglichkeit gemäß 2014/30/EU (EMV Richtlinie) /
Requirements for electromagnetic compatibility according to 2014/30/EU (EMC Directive)

EN/Norm/Standard:

EN 61326-1 : 2013

2011/65/EU	RoHS - Richtlinie	RoHS Directive
(EU) 2015/863	Deligierte Richtlinie	Deligate Directive

EN/Norm/Standard:

EN IEC 63000 : 2018

Nürnberg, 01.03.2024
Ort, Datum / Place, Date:

Joachim Czabanski, Geschäftsführer / Managing Director

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller. Sie beinhaltet jedoch keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentationen sind zu beachten.

This Declaration of Conformity is issued under the sole responsibility of the manufacturer but does not include a property assurance. The safety notes given in the product documentation which are part of the supply, must be observed.

Datei:	Ausgabe:	Erstellt:	Freigabe:
24-2-M516A_F-CE-Entwurf	15.01.2021	Eckl	Weiß

Fig. 8: CE Declaration

31.2 CALIBRATION CERTIFICATE

A calibration certificate is included with the instrument.

32 DISPOSAL AND ENVIRONMENTAL PROTECTION

Proper disposal makes an important contribution to the protection of our environment and the conservation of natural resources.

ATTENTION

Environmental Damage

Improper disposal results in environmental damage.

- Follow the instructions concerning return and disposal included in this section.

The following comments refer specifically to the legal situation in the Federal Republic of Germany. Owners or end users who are subject to other regulations must comply with the respective local requirements and implement them correctly on site. Further information can be obtained, for example, from the responsible authorities or local distributors.

Waste Electrical Equipment, Electrical or Electronic Accessories and Waste Batteries (including rechargeable batteries)

Electrical equipment and batteries (including rechargeable batteries) contain valuable raw materials that can be recycled, as well as hazardous substances which can cause serious harm to human health and the environment, and they must be recycled and disposed of correctly.

The symbol at the left depicting a crossed-out garbage can on wheels refers to the legal obligation of the owner or end user (German electrical and electronic equipment act ElektroG and German battery act BattG) not to dispose of used electrical equipment and batteries with unsorted municipal waste ("household trash"). Waste batteries must be removed from the old device (where possible) without destroying them and the old device and the waste batteries must be disposed of separately. The battery type and its chemical composition are indicated on the battery's labelling. If the abbreviations "Pb" for lead, "Cd" for cadmium or "Hg" for mercury are included, the battery exceeds the limit value for the respective metal.

Please observe the owner's or end user's responsibility with regard to deleting personal data, as well as any other sensitive data, from old devices before disposal.

Old devices, electrical or electronic accessories and waste batteries (including rechargeable batteries) used in Germany can be returned free of charge to Gossen Metrawatt GmbH or the service provider responsible for their disposal in compliance with applicable regulations, in particular laws concerning packaging and hazardous goods. Waste batteries must be returned in the discharged state or with appropriate precautions against short circuiting. Further information regarding returns can be found on our website.

▶ Disposal of Lithium-Ion Batteries

In accordance with ElektroG (German electrical and electronic equipment act), we are required to describe safe removal of the installed battery in the event of disposal of the measuring/test instrument.

Required materials: Torx screwdriver

1. Switch the measuring/test instrument off and disconnect all power supply lines.
2. Disconnect all cables (measurement cables etc.) from the measuring/test instrument.
3. Remove the 17 Torx screws on the front panel using a screwdriver (the 4 Phillips head screws need not be removed).
4. Disconnect the battery plug connector (1) by removing the 5-pin ribbon cable from the circuit board (see figure below).
   When removing and disposing of the battery, make sure that it's not short-circuited.
5. Cut the two cable ties (2) (see figure below).
6. Dispose of the rechargeable battery in accordance with applicable regulations or send it to us for free disposal.

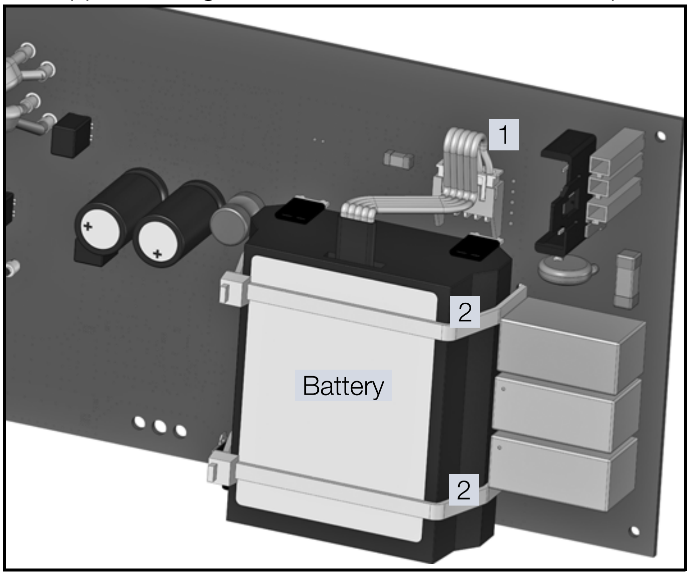


Fig. 9: Screenshot: Removing the Lithium-Ion Battery

Packaging Materials

We recommend retaining the original packaging materials for the case that you might require servicing or calibration in the future.

WARNING

Danger of Asphyxiation Resulting from Foils and Other Packaging Materials

Children and other vulnerable persons may suffocate if they wrap themselves in packaging materials, or their components or foils, or if they pull them over their heads or swallow them.

- Keep packaging materials, as well as their components and foils, out of the reach of babies, children and other vulnerable persons.

In accordance with German packaging law (VerpackG), the user is obligated to correctly dispose of packaging and its components separately, and not together with unsorted municipal waste (“household trash”).

Private end consumers can dispose of packaging free of charge at the designated collection point. Packaging which is not subject to so-called system participation is returned to the appointed service provider. Further information regarding returns can be found on our website.

33 APPENDIX

33.1 TABLES FOR THE DETERMINATION OF MAXIMUM OR MINIMUM DISPLAY VALUES UNDER CONSIDERATION OF MAXIMUM MEASURING UNCERTAINTY

33.1.1 R_{LO} DISPLAY VALUES

R_{LO} 0.2 A Measured Quantity: R_{LO}		R_{LO} 25 A Measured Quantity: R_{LO}			
Limit Values [Ω]	Max. Display Values [Ω]	Limit Values [mΩ]	Max. Display Values [mΩ]	Limit Values [Ω]	Max. Display Values [Ω]
0.10	0.07	10	7		
0.20	0.17	20	17	2.00	1.90
0.30	0.26	30	26	3.00	2.86
0.40	0.36	40	36	4.00	3.82
0.50	0.46	50	46	5.00	4.78
0.60	0.55	60	55	6.00	5.74
0.70	0.65	70	65	7.00	6.70
0.80	0.74	80	74	8.00	7.66
0.90	0.84	90	84	9.00	8.62
1.00	0.94	100	94	10.0	9.40
2.00	1.90	200	190	11.0	10.3
2.00	1.90	300	286	12.0	11.3
3.00	2.86	400	382	13.0	12.2
4.00	3.82	500	478	14.0	13.2
5.00	4.78	600	574	15.0	14.2
6.00	5.74	700	670	16.0	15.1
7.00	6.70	800	766	17.0	16.1
8.00	7.66	900	862	18.0	17.0
9.00	8.62	1000	940	19.0	18.0
10.0	9.40			20.0	19.2
20.0	19.0				
30.0	28.6				
25.0	23.8				
40.0	38.2				
50.0	47.8				
60.0	57.4				
70.0	67.0				
80.0	76.6				
90.0	86.2				

33.1.2 R_{ISO} DISPLAY VALUES

Measured Quantity: R_{ISO}					
Limit Values [kΩ]	Min. Display Values [kΩ]	Limit Values [MΩ]	Min. Display Values [MΩ]	Limit Values [GΩ]	Min. Display Values [GΩ]
50	63	1.00	1.07	1.00	1.07
100	115	2.00	2.12	1.05	1.13
200	220	3.00	3.17	1.10	1.18
300	325	4.00	4.22	1.15	1.23
400	430	5.00	5.27	1.20	1.28
500	535	6.00	6.32		
600	640	7.00	7.37		
700	745	8.00	8.42		
800	850	9.00	9.47		
900	955	10.0	10.7		
		20.0	21.2		
		30.0	31.7		
		40.0	42.2		
		50.0	52.7		
		60.0	63.2		
		70.0	73.7		
		80.0	84.2		
		90.0	94.7		
		100	107		
		200	212		
		300	317		
		400	422		
		500	527		
		600	632		
		700	737		
		800	842		
		900	947		

33.1.3 RCD DISPLAY VALUES

RCD I_F

Measured Quantity: $I_{\Delta N}$				Measured Quantity: $U_{I\Delta N}$	
Limit Values [mA]	Min. Display Values [mA]	Limit Values [A]	Min. Display Values [A]	Limit Values [V]	Max. Display Values [V]
3.0	2.8	1.00	0.92	5.0	4.8
4.0	3.8	1.10	1.01	10.0	9.6
5.0	4.7	1.20	1.11	20.0	19.1
6.0	5.7	1.30	1.20	25.0	23.8
7.0	6.6	1.40	1.30	30.0	28.6
8.0	7.6	1.50	1.39	40.0	38.1
9.0	8.5	1.60	1.49	50.0	47.6
10.0	9.2	1.70	1.58	60.0	57.1
20.0	18.7	1.80	1.68	65.0	> 70
30.0	28.2	1.90	1.77	70.0	> 70
40.0	37.7	2.00	1.87		
50.0	47.2	2.10	1.96		
60.0	56.7	2.20	2.06		
70.0	66.2	2.30	2.15		
80.0	75.7	2.40	2.25		
90.0	85.2	2.50	2.34		
100	94				
200	189				
300	284				
400	379				
500	474				
600	569				
700	664				
800	759				
900	854				

RCD $I_{\Delta N}$

Measured Quantity: $U_{I\Delta N}$		Measured Quantity: t_a	
Limit Values [V]	Max. Display Values [V]	Limit Values [ms]	Max. Display Values [ms]
5.0	4.8	5.0	1.0
10.0	9.6	6.0	2.0
20.0	19.1	7.0	3.0
25.0	23.8	8.0	4.0
30.0	28.6	9.0	5.0
40.0	38.1	9.9	5.9
50.0	47.6	10.0	6.0
60.0	57.1	20.0	16.0
65.0	> 70	30.0	26.0
70.0	> 70	40.0	36.0
		50	46
		60	56
		70	66
		80	76
		90	86
		100	96
		200	196
		300	296
		400	396
		500	496
		600	596
		700	696
		800	796
		900	896

Short-Circuit Current Minimum Display Values

for the determination of nominal current for various fuses and breakers for systems with a nominal voltage of U_N = 230 V

Nominal Current I_N [A]	Low Resistance Fuses in Accordance with the DIN VDE 0636 Series of Standards				With Circuit Breaker and Line Switch							
	Characteristic gL, gG, gM				Characteristic B/E (formerly L)		Characteristic C (formerly G, U)		Characteristic D		Characteristic K	
	Breaking Current I_A 5 s		Breaking Current I_A 0.4 s		Breaking Current I_A 5 × I_N (< 0.2 s/0.4 s)		Breaking Current I_A 10 × I_N (< 0.2 s/ 0.4 s)		Breaking Current I_A 20 × I_N(< 0.2 s/0.4 s)		Breaking Current I_A 12 × I_N (< 0.1 s)	
	Limit Value [A]	Min. Display [A]	Limit Value [A]	Min. Display [A]	Limit Value [A]	Min. Display [A]	Limit Value [A]	Min. Display [A]	Limit Value [A]	Min. Display [A]	Limit Value [A]	Min. Display [A]
2	9.2	10	16	17	10	11	20	21	40	42	24	25
3	14.1	15	24	25	15	16	30	32	60	64	36	38
4	19	20	32	34	20	21	40	42	80	85	48	51
6	27	28	47	50	30	32	60	64	120	128	72	76
8	37	39	65	69	40	42	80	85	160	172	96	102
10	47	50	82	87	50	53	100	106	200	216	120	128
13	56	59	98	104	65	69	130	139	260	297	156	167
16	65	69	107	114	80	85	160	172	320	369	192	207
20	85	90	145	155	100	106	200	216	400	467	240	273
25	110	117	180	194	125	134	250	285	500	578	300	345
32	150	161	265	303	160	172	320	369	640	750	384	447
35	173	186	295	339	175	188	350	405	700	825	420	492
40	190	205	310	357	200	216	400	467	800	953	480	553
50	260	297	460	529	250	285	500	578	1000	1.22 k	600	700
63	320	369	550	639	315	363	630	737	1260	1.58 k	756	896
80	440	517									960	1.16 k
100	580	675									1200	1.49 k
125	750	889									1440	1.84 k
160	930	1.12 k									1920	2.59 k

Example:

Display value of 90,4 A → next lower value for circuit breaker characteristic B from table: 85 A → nominal current (I_N) of the protective device: max. 16 A

33.1.4 Z_{LOOP} DISPLAY VALUES

Z_{LOOP}

Measured Quantity: Z			
Limit Values [mΩ]	Min. Display Values [mΩ]	Limit Values [Ω]	Min. Display Values [Ω]
50	35	1.50	1.37
100	80	2.00	1.84
200	170	2.50	2.31
300	260	3.00	2.78
400	350	3.50	3.25
500	440	4.00	3.72
600	530	4.50	4.19
700	620	5.00	4.66
800	710		
900	800		
1000	890		

Z_{LOOP} DC+

Measured Quantity: Z			
Limit Values [mΩ]	Min. Display Values [mΩ]	Limit Values [Ω]	Min. Display Values [Ω]
250	175	1.50	1.32
300	216	2.00	1.77
400	298	2.50	2.22
500	380	3.00	2.67
600	462	3.50	3.12
700	544	4.00	3.57
800	626	4.50	4.02
900	708	5.00	4.47
1000	870	5.50	4.92
		6.00	5.37
		6.50	5.82
		7.00	6.27
		7.50	6.72
		8.00	7.17
		8.50	7.62
		9.00	8.07
		9.50	8.52

Z_{LOOP}		Z_{LOOP}	
Measured Quantity: Z		Measured Quantity: Z	
Limit Values [Ω]	Min. Display Values [Ω]	Limit Values [Ω]	Min. Display Values [Ω]
0.50	0.35	0.6	0.4
1.00	0.80	1.0	0.8
2.00	1.70	2.0	1.7
3.00	2.60	3.0	2.6
4.00	3.50	4.0	3.5
5.00	4.40	5.0	4.4
6.00	5.30	6.0	5.3
7.00	6.20	7.0	6.2
8.00	7.10	8.0	7.1
9.00	8.00	9.0	8.0
10.0	9.0	10.0	8.9
11.0	9.9	20.0	17.9
20.0	18.2	30.0	26.9
30.0	27.4	40.0	35.9
40.0	36.6	50.0	44.9
50.0	45.8	60.0	53.9
60.0	55.0	70.0	62.9
70.0	64.2	80.0	71.9
80.0	73.4	90.0	80.9
90.0	82.6	100	90
		200	182
		300	274
		400	366
		500	458
		600	550
		700	642
		800	734
		900	826

33.1.5 DISPLAY VALUES U_{RES}

Measured Quantity: U		Measured Quantity: t_u	
Limit Values [V]	Max. Display Values [V]	Limit Values [s]	Max. Display Values [s]
5	5.6	1.0	0.7
10	11.1	2.0	1.7
20	22.1	3.0	2.7
30	33.1	4.0	3.7
40	44.1	5.0	4.7
50	55.1	6.0	5.6
60	66.1	7.0	6.6
70	77.1	8.0	7.6
80	88.1	9.0	8.6
90	99.1	10.0	9.6
100	111	20.0	19.4
200	221	30.0	29.2
300	331	40.0	39.0
400	441	50.0	48.8
500	551	60.0	58.6
600	661	70.0	68.4
700	771	80.0	78.2
800	881	90.0	88.0
900	991		

33.1.6 RCM DISPLAY VALUES

Measured Quantity: $I_{\Delta N}$				Measured Quantity: t_a	
Limit Values [mA]	Max. Display Values [mA]	Limit Values [A]	Max. Display Values [A]	Limit Values [s]	Max. Display Values [s]
3.0	2.5	1.10	1.01	1.0	0.7
6.0	5.4	1.20	1.11	2.0	1.7
10.0	9.2	1.30	1.20	3.0	2.7
20.0	18.7	1.40	1.30	4.0	3.7
30.0	28.2	1.50	1.39	5.0	4.7
40.0	37.7	1.60	1.49	6.0	5.6
50.0	47.2	1.70	1.58	7.0	6.6
60.0	56.7	1.80	1.68	8.0	7.6
70.0	66.2	1.90	1.77	9.0	8.6
80.0	75.7	2.00	1.87	10.0	9.6
90.0	85.2	2.10	1.96		
100	94	2.20	2.06		
200	189	2.30	2.15		
300	284	2.40	2.25		
400	379	2.50	2.34		
500	474				
600	569				
700	664				

Measured Quantity: $I_{\Delta N}$				Measured Quantity: t_a	
Limit Values	Max. Display Values	Limit Values	Max. Display Values	Limit Values	Max. Display Values
[mA]	[mA]	[A]	[A]	[s]	[s]
800	759				
900	854				
1000	920				

33.1.7 DISPLAY VALUES HV_{AC} (PROFITEST PRIME AC ONLY)

Measured Quantity: U				Measured Quantity: I	
Limit Values	Max. Display Values	Limit Values	Max. Display Values	Limit Values	Max. Display Values
[V]	[V]	[kV]	[kV]	[mA]	[mA]
10	16	1.00	1.10	10.0	8.8
20	26	1.10	1.21	20.0	18.1
30	37	1.20	1.31	30.0	27.4
40	47	1.30	1.42	40.0	36.7
50	58	1.40	1.52	50.0	46.0
60	68	1.50	1.63	60.0	55.3
70	79	1.60	1.73	70.0	64.6
80	89	1.70	1.84	80.0	73.9
90	100	1.80	1.94	90.0	83.2
100	110	1.90	2.05	100	88.0
200	215	2.00	2.15	110	97.0
300	320	2.10	2.26	120	106
400	425	2.20	2.36	130	115
500	530	2.30	2.47	140	125
600	635	2.40	> 2.50	150	134
700	740	2.50	> 2.50	160	143
800	845			170	153
900	950			180	162
				190	171
				200	181

33.2 AT WHICH VALUES SHOULD/MUST AN RCD ACTUALLY BE TRIPPED? REQUIREMENTS FOR RESIDUAL CURRENT DEVICES (RCDS)

General Requirements

- Tripping must occur no later than upon occurrence of rated residual current (nominal differential current $I_{\Delta N}$).

and

- Maximum time to trip may not be exceeded.

Additional Requirements due to Influences on the Tripping Current Range and the Point in Time of Tripping which Have oo be Taken Into Consideration

- Residual current type or waveform:
  This results in a permissible tripping current range.
- Mains type and line voltage:
  This results in maximum tripping time.
- RCD variant (standard or selective):
  This results in maximum tripping time.

Definitions of Requirements in the Standards

VDE 0100-600, which is included in all collections of German standards for electricians, applies to measurements in electrical systems. It plainly states: “The effectiveness of the protective measure is substantiated when disconnection occurs no later than upon occurrence of rated differential current $I_{\Delta N}$.”

As a requirement for the measuring instrument manufacturer, DIN EN 61557-6 (VDE 0413-6) unmistakably specifies:

“The measuring instrument must be capable of substantiating the fact that the residual current which trips the residual current device (RCD) is less than or equal to rated residual current.”

Comment

For all electricians, this means that during required testing of protective measures after system modifications or additions to the system, as well as after repairs or during the E-check conducted after measurement of touch voltage, the tripping test must be conducted no later than upon reaching a value of, depending upon the RCD, 10, 30, 100, 300 or 500 mA.

How does the electrician react in the event that these values are exceeded? The RCD is replaced!

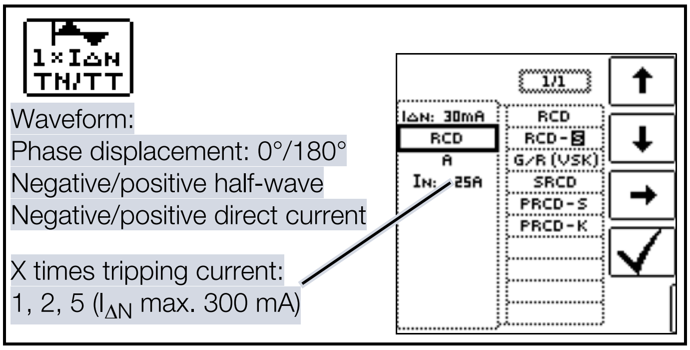
If it was relatively new, a complaint is submitted to the manufacturer. And if the manufacturer’s test lab determines: The RCD complies with the manufacturer’s standard and is OK.

A look at the VDE 0664-10/-20/-100/-200 manufacturer’s standard shows us why:

Type of Residual Current	Residual Current Waveform	Permissible Tripping Current Range
Sinusoidal alternating current		0.5 … 1 $I_{\Delta N}$
Pulsating direct current (positive or negative half-waves)		0.35 … 1.4 $I_{\Delta N}$
Phase angle controlled half-wave currents Phase angle of 90° el Phase angle of 135° el		 0.25 … 1.4 $I_{\Delta N}$ 0.11 … 1.4 $I_{\Delta N}$
Pulsating direct current superimposed with 6 mA smooth, direct residual current		Max. 1.4 $I_{\Delta N}$ + 6 mA
Smooth direct current		0.5 … 2 $I_{\Delta N}$

Because the current waveform plays a significant role, the current waveform used by the measuring/test instrument is also important.

Set residual current type or waveform at the measuring/test instrument:



It’s important to be able to select and take advantage of the corresponding settings at one’s own measuring/test instrument.

The situation is similar for breaking times. The new VDE 0100-410 should also be included in the standards collection.
Depending upon mains type and line voltage, it specifies breaking times ranging from 0.1 to 5 seconds.

System	$50\ V < U_0 \leq 120\ V$		$120\ V < U_0 \leq 230\ V$		$230\ V < U_0 \leq 400\ V$		$U_0 > 400\ V$	
	AC	DC	AC	DC	AC	DC	AC	DC
TN	0.8 s		0.4 s	5 s	0.2 s	0.4 s	0.1 s	0.1 s
TT	0.3 s		0.2 s	0.4 s	0.07 s	0.2 s	0.04 s	0.1 s

RCDs usually interrupt more quickly, but in some cases they can take a bit longer. Once again, the ball is in the manufacturer’s court.

The following table is also included in VDE 0664:

Design	Fault Current Type	Breaking Time at			
	Alternating residual current	1 × $I_{\Delta N}$	2 × $I_{\Delta N}$	5 × $I_{\Delta N}$	500 A
	Pulsating direct residual current	1.4 × $I_{\Delta N}$	2 × 1.4 × $I_{\Delta N}$	5 × 1.4 × $I_{\Delta N}$	500 A
	Smooth, direct residual current	2 × $I_{\Delta N}$	2 × 2 × $I_{\Delta N}$	5 ×2 × $I_{\Delta N}$	500 A
Standard (undelayed) or briefly delayed		300 ms	Max. 0.15 s	Max. 0.04 s	Max. 0.04 s
Selective		0.13 … 0.5 s	0.06 … 0.2 s	0.05 … 0.15 s	0.04 … 0.15 s

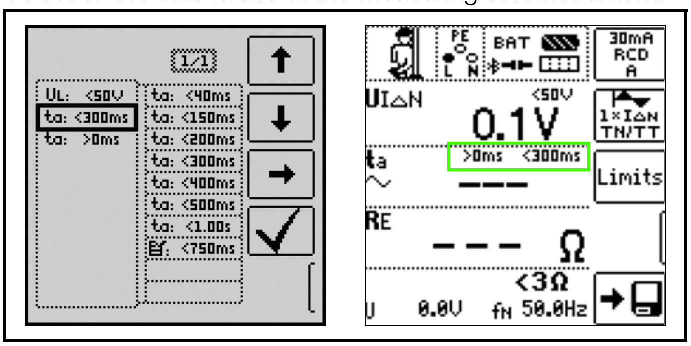
Two limit values are highly conspicuous:

StandardMax. 0.3 s

SelectiveMax. 0.5 s

All of the limit values are already included in good measuring/ test instruments, or it's possible to enter them directly and they're displayed as well!

Select or set limit values at the measuring/test instrument:



Tests for electrical systems include "visual inspection", "testing" and "measurement", and thus may only be conducted by experts with appropriate work experience.

In the final analysis, the values from VDE 0664 are technically binding.

33.3 TESTING ELECTRICAL MACHINES PER DIN EN 60204 – APPLICATIONS, LIMIT VALUES

Comparison of Tests Specified by the Standards

Testing per DIN EN 60204-1	Testing per DIN EN 61557	Measuring Function
Continuity of the protective conductor system	Part 4: Resistance of earth conductors, protective conductors and equipotential bonding conductors	R_{LO}
Testing of fault loop impedance, and for suitability of the overcurrent protective device	Part 3: Loop resistance measurement	Z_{LOOP}
Insulation resistance tests	Part 2: Insulation resistance	R_{ISO}
Testing for dielectric strength	Part 14: Equipment for testing the safety of electrical equipment of machinery	HV (PROFITEST PRIME AC only)
Protection against residual voltage	Part 14: Equipment for testing the safety of electrical equipment of machinery	U_{res}
Function tests	—	—

Uninterrupted Connection of a Protective Conductor

Uninterrupted connection of a protective conductor system is tested here be using an alternating current of 0.2 to 10 A with a line frequency of 50 Hz
(= low-resistance measurement). Testing must be conducted between the mains circuit and the PE terminal (various points within the protective conductor system).

Loop Impedance Measurement

Loop impedance $Z_{L\text{-}PE}$ is measured and short-circuit current ISC is ascertained in order to determine if the breaking requirements for protective devices have been fulfilled (see chap. 15). If loop measurement is not possible, e.g. where frequency converters are installed, mathematical calculation is required.

Insulation Resistance Measurement

All of the active conductors in the primary circuit are short-circuited at the machine (L and N, or L1, L2, L3 and N) and measured against PE (protective conductor). Controllers or machine components which are not laid out for these voltages (500 V $_{DC}$) can be disconnected from the measuring circuit for the duration of the measurement. The measured value may not be any less than 1 MΩ. The test can be subdivided into separate segments. A maximum resistance of 50 kΩ is required for the measurement of slip-rings etc.

Testing for Dielectric Strength

The electrical equipment of the machine under test must withstand a test voltage of twice its own rated voltage value or 1000 V~ (whichever is greater) applied between the conductors of all circuits and the protective conductor system for a period of at least 1 second. The test voltage must have a frequency of 50 Hz.

(Residual) Voltage Measurements

EN 60204 specifies that after switching supply power off, residual voltage must drop to a value of 60 V or less within 5 seconds at all accessible, active components of a machine to which a voltage of greater than 60 V is applied during operation.
When conductors are exposed, residual voltage must drop to a value of less than or equal to 60 V within 1 second.

Function Test

The machine is operated with nominal voltage and tested for correct functioning, in particular with regard to safety functions.

Special Tests

- Pulse control mode for troubleshooting
- Protective conductor test with 25 A test current

Limit Values per DIN EN 60204-1

Measurement	Parameter	Cross-Section	Standard Value
Protective conductor measurement	Test duration		10 s
	Limit value Protective conductor resistance based on phase conductor cross-section and characteristics of the overvoltage protection device (calculated value)	1.5 mm²	500 mΩ
		2.5 mm²	500 mΩ
		4.0 mm²	500 mΩ
		6.0 mm²	400 mΩ
		10 mm²	300 mΩ
		16 mm²	200 mΩ
		25 mm² L (16 mm² PE)	200 mΩ
		35 mm² L (16 mm² PE)	100 mΩ
		50 mm² L (25 mm² PE)	100 mΩ
		70 mm² L (35 mm² PE)	100 mΩ
		95 mm² L (50 mm² PE)	050 mΩ
		120 mm² L (70 mm² PE)	050 mΩ
Insulation resistance measurement	Nominal voltage		500 V_{DC}
	Resistance limit value		≥ 1 MΩ
Leakage current measurement	Leakage current		2.0 mA
Protection against residual voltage	Discharge time after switching off supply power		5 s
	Discharge time after exposing conductors		1 s
Testing for dielectric strength	Test voltage		2 × U_N or 1 kV
	Test voltage frequency		50 Hz or 60 Hz
	Test duration		1 s

Overvoltage Protection Device Characteristics for Limit Value Selection for Protective Conductor Testing

Breaking Time, Characteristics	Available for Cross-Section
Fuse breaking time: 5 s	All cross-sections
Fuse breaking time: 0.4 s	1.5 mm² up to and including 16 mm²
Circuit breaker Characteristic B I_a = 5 × I_N – breaking time: 0.1 s	1.5 mm² up to and including 16 mm²
Circuit breaker Characteristic C I_a = 10 × I_N – breaking time: 0.1 s	1.5 mm² up to and including 16 mm²
Adjustable circuit breaker I_a = 8 × I_N – breaking time: 0.1s	All cross-sections

33.4 PERIODIC TESTING PER DGUV REGULATION 3/4 (PREVIOUSLY BGV A3, VBG4, UVV) – LIMIT VALUES FOR ELECTRICAL SYSTEMS AND OPERATING EQUIPMENT

Limit Values per DIN VDE 0701-0702

Maximum Allowable Limit Values for **Protective Conductor Resistance** for Connector Cables with Lengths of up to 5 m

Test Standard	Test Current	Open-Circuit Voltage	R_{SL} Housing – Mains Plug
VDE 0701-0702	> 200 mA⎓	4 V < U_L < 24 V	0.3 Ω [1)] + 0.1 Ω [2] for each additional 7.5 m

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

2 Total protective conductor resistance: max. 1 Ω

Minimum Allowable Limit Values for **Insulation Resistance**

Test Standard	Test Voltage	R_{ISO}			
		PC I	PC II	PC III	Heating
VDE 0701-0702	500 V	1 MΩ	2 MΩ	0.25 MΩ	0.3 MΩ [1)]

1) With activated heating elements (where heating power > 3.5 kW and RISO < 0.3 MW: leakage current measurement is required)

Maximum Permissible Limit Values for **Leakage Current** in mA

Test Standard	I_{PE}	I_C	I_{DI}
VDE 0701-0702	PC I: 3.5 1 mA/kW *	0.5	PC I: 3.5 1 mA/kW * PC II 0.5

* For devices with heating power of greater than 3.5 kW
Note 1: Devices which are not equipped with accessible parts that are connected to the protective conductor, and which comply with requirements for housing leakage current and, if applicable, patient leakage current, e.g. computer equipment with shielded power pack
Note 2: Permanently connected devices with protective conductor
Note 3: Portable x-ray devices with mineral insulation

Key for table:

I_B Housing leakage current (probe or touch current)

I_{DI} Residual current

I_{SL} Protective conductor current

Maximum Permissible Limit Values for **Equivalent Leakage Current** in mA

Test Standard	I_{EL}
VDE 0701-0702	PC I: 3.5 1 mA/kW [1] PC II 0.5

1 For devices with heating power ≥ 3.5 kW

33.5 BIBLIOGRAPHY

Statutory Source Documents

German Occupational Safety Legislation (BetrSichV)

Regulations Issued by Accident Insurance Carriers

Title	Information Rule/Regulation	Publisher	Issue / Order No.
German occupational safety legislation (BetrSichV)	German occupational safety legislation		2015
Electrical systems and equipment	DGUV regulation 3 (formerly BGV A3)	DGUV (formerly HVBG)	2005

VDE Standards

German Standard	Title	Date of Issue	Publisher
DIN VDE 0100-410	Low-voltage electrical installations – Part 410: Protection for safety – Protection against electric shock	2007-06	Beuth-Verlag GmbH
DIN VDE 0100-530	Low-voltage electrical installations – Part 530: Selection and erection of electrical equipment, switchgear and control gear	2011-06	Beuth-Verlag GmbH
DIN VDE 0100-600	Low-voltage electrical installations – Part 6: Tests	2008-06	Beuth-Verlag GmbH
DIN EN 61557 VDE 0413	Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Equipment for testing, measuring or monitoring of protective measures	2007-12	Beuth-Verlag GmbH
DIN VDE 0105-100	Operation of electrical installations – Part 100: General requirements	2015-10	Beuth-Verlag GmbH
DIN EN 61851-1 VDE 0122-1	Electric vehicle conductive charging system – Part 1: General Requirements	2013-04	Beuth-Verlag GmbH

Further Literature in German

Title	Authors	Publisher	Issue / Order No.
Prüfung ortsfester und ortsveränderlicher Geräte	Bödeker, K. Lochthofen, M.	HUSS-MEDIEN GmbH Berlin www.elektropraktiker.de	9th edition, 2016
DIN VDE 0100 richtig angewandt	Schmolke, H.	VDE Verlag GmbH www.vde-verlag.de	VDE-Schriftenreihe Volume 106 7th edition, 2016
Schutz gegen elektr. Schlag DIN VDE 0100-410	Hörmann, W. Schröder, B.	VDE Verlag GmbH www.vde-verlag.de	VDE series Volume 140 4th edition, 2010
VDE-Prüfung nach BetrSichV, TRBS und DGUV-Vorschrift 3 (BGV A3)	Henning, W.	Beuth-Verlag GmbH www.beuth.de	VDE series 43 2015 edition
Notebook for Electricians	Gossen Metrawatt GmbH	www.gossen-metrawatt.com	Order No. 3-337-038-01
de Jahrbuch 2014 Elektrotechnik für Handwerk und Industrie	Behrends, P.; Bonhagen, S.	Hüthig & Pflaum Verlag München/Heidelberg www.elektro.net	ISBN 978-3-8101-0350-5
Elektroinstallation für die gesamte Ausbildung	Hübscher, Jagla, Klaue, Wickert	Westermann Schulbuchverlag GmbH www.westermann.de	ISBN 978-3-14-221630-0 4th edition, 2014
Praxis Elektrotechnik	Klaus Tkotz, Thomas Käppel, Klaus Ziegler, Peter Braukhoff, Bernd Feustel	Europa-Lehrmittel www.europa-lehrmittel.de	ISBN 978-3-8085-3266-9 13th edition, 2015
Fachkunde Elektrotechnik		Europa-Lehrmittel www.europa-lehrmittel.de	ISBN 978-3-8085-3435-9, 30th edition, 2016

33.6 INTERNET ADDRESSES FOR ADDITIONAL INFORMATION

www.dguv.de	DGUV information, rules and regulations from German statutory accident insurance
www.beuth.de	VDE regulations, DIN standards, VDI directives from Beuth-Verlag GmbH
www.bgetem.de	BG information, rules and regulations from the trade associations e.g. BG ETEM (trade association for energy, textiles and electrical medical devices)
www.zveh.de	General Association of German Electricians

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